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The Editor's Talk With MACHINERY'S Readers

HOW often one hears the busy shop executive exclaim: "I ought to get around more to see what they are doing in other shops, but I never seem to have the time!" That is exactly it—the progressive shop executive should get around to see what is being done in other shops; but he is mistaken in thinking he cannot find the time. He may not be able to spend a week or two touring the shops in which he would like to see certain work performed, but he can always find the time to come along on the specially conducted tour that MACHINERY arranges each month. He can take this tour seated in his easy chair at home with his pipe near at hand and without any of the annoyances incident to railroad travel. Others, specially trained to observe, have done the rough and tiring work for him. He travels by proxy.

THIS month MACHINERY'S readers will visit the Rome Brass & Copper Co., in Rome, N. Y., where they will see and have explained to them the methods used in extruding brass and copper rods. By this method a billet can be converted by a single operation into a rod of practically the required size. After the extrusion by means of a powerful hydraulic press, it is only necessary to pickle the bar to remove the scale and pass it once through the die of a draw-bench to reduce the diameter to the exact size required. Those who are familiar with past methods of making brass and copper rods will appreciate the value of the extrusion process. It is one of those new mechanical methods that simultaneously improve the product and increase the production, which is the ideal strived for by every mechanical executive, no matter what line of manufacturing he is engaged in.

THE next place to be visited will be the R. K. LeBlond Machine Tool Co.'s plant in Cincinnati, Ohio, where MACHINERY will take its readers upon an inspection tour of the apprentice system and apprentice school conducted by this company. This system is described in detail in the article "Training Future Mechanics," and differs in many important details from those used by other manufacturers. It contains the best features of the old-time apprenticeship together with the characteristics of the modern trade school. The boys not only receive theoretical instruction in an actual school, but are also given preliminary shop instruction in a special training shop conducted for this purpose alone. They are not placed in the actual shop departments until they have received sufficient training on the machines of each department to insure their ability to handle the work in a satisfactory manner, without too much personal instruction from the foreman.

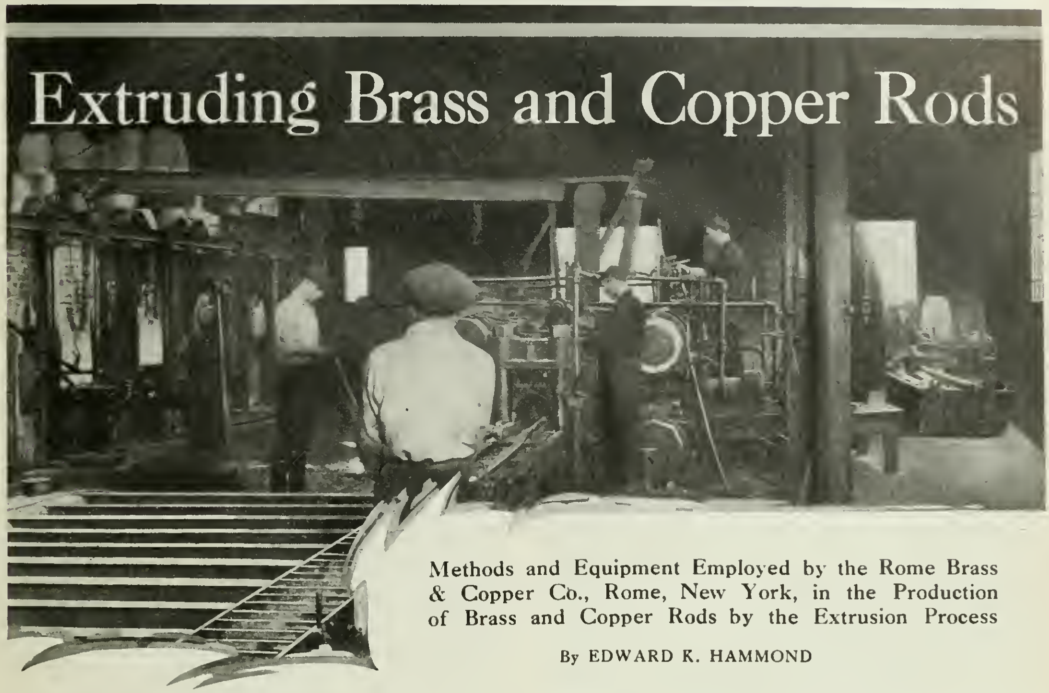
OUR next stop will be at Watervliet, N. Y., where the Ludlum steel mill will be visited. Here high-grade tool steel is manufactured by modern methods, using the electric furnace. The traveler, still comfortably seated in his easy chair at home, may follow the operations throughout as explained in the article "The Production of Tool Steel." He will be taken into the melting shop and shown its arrangement and equipment. He will see the furnaces charged and may follow the subsequent operations as if he had actually visited the plant. Tool steel is one of the principal products employed in metal working plants, and every mechanic is interested in the methods of its manufacture.

AS we continue our inspection trip, Carl G. Olson, chief engineer of the Illinois Tool Works, Chicago, Ill., shows us exactly how to sharpen hobs and cutters for gear cutting. This is illustrated with clear and definite line engravings showing exactly, step by step, how to proceed in performing this important operation. H. L. Van Keuren, formerly of the Bureau of Standards, and well-known in the mechanical field as an expert on precision measuring methods, shows us how to measure balls and gages by the light-wave method. J. Bingham, president of the B. J. Stamping Co., Toledo, Ohio, discusses the making of dies for shaping the automobile body panels and for the manufacture of door knobs. Many other interesting machines, tools and devices will be shown to those who come along on this specially conducted inspection trip that MACHINERY has arranged for September.

MONTH after month MACHINERY takes its readers in this way into the progressive and up-to-date machine shops and metal-working plants of the country, so that at the end of a year every one who has carefully read the articles published will have visited hundreds of the leading plants of the country, and conversed with hundreds of the ablest mechanical men in America—the presidents, general managers, superintendents, mechanical engineers, designers, and the brightest mechanics in the shops—wherever they are found. This is peculiarly the mission of MACHINERY—to find what is latest and best in mechanical practice, verify, edit, illustrate and publish it in a manner worthy of the great mechanical field the journal serves.

SEPTEMBER MACHINERY 1920

Extruding Brass and Copper Rods



Methods and Equipment Employed by the Rome Brass & Copper Co., Rome, New York, in the Production of Brass and Copper Rods by the Extrusion Process

By EDWARD K. HAMMOND

A MARKED economy is effected by using the extrusion process in the production of brass and copper rods. By this method, a billet can be converted by a single operation into a rod of practically the required size. After the extrusion has been accomplished, it is only necessary to pickle the work to remove oxide scale, give it one pass through the die on a draw-bench to reduce the diameter to the required size, and finally straighten the rod and cut it into pieces of the desired length. Those who are familiar with older methods of manufacturing brass and copper rods will readily appreciate the importance of substituting an extrusion process, which can be performed in a few seconds, for a sequence of drawing operations that would otherwise be necessary, and that would involve repeatedly annealing the metal to reduce hardness and physical strains.

Preparing the Metal for Extrusion

At the plant of the Rome Brass & Copper Co., in Rome, N. Y., where data were obtained to form the basis of this article, it is the practice to extrude cast billets measuring 26 inches in length by 6¾ to 7 inches in diameter. The metal is melted in crucible furnaces which are fired with coal and equipped with natural draft, the molten metal being cast in cylindrical shaped molds. In producing brass billets for subsequent extrusion into rods, various mixtures are employed to meet the requirements of different consignees; and it is necessary for the casting shop to compound copper and zinc, or copper, zinc, and tin in the required proportions to fulfill these different specifications. The billets are cast in vertical molds and the next step is to cut off the excess metal from the upper end, for the double purpose of reducing the billet to the specified length of 26 inches and to remove metal which may be of inferior quality. After cutting off the crop end, the cross-section of the metal is inspected to be sure that it is solid and free from such defects as pipes, blow-holes, etc. The billet dimensions which have been given provide the volume of metal which is ordinarily used for extrusion; but where especially long rods are ordered or where other special conditions arise, it may be necessary to make special sized billets to meet the requirements of the job.

Heating the Billets Ready for Extrusion

The extrusion process is performed with the metal at a temperature of from 1600 to 1700 degrees F., that is to say within about 200 degrees F. of the melting point, so that the metal is in a condition to flow freely when the pressure is applied. For heating the billets a special furnace is employed, which has an inclined hearth down which the billets roll by gravity. A continuous procession of billets is passing through the furnace, about one hour being required for a billet to roll from the door at one end of the furnace through which it enters, to the door at the opposite end from which the heated billet is removed. This allows sufficient time for the heat to thoroughly soak into the metal, so that its temperature is uniform throughout, and as a result there is no danger of lack of uniformity in the ductility or other physical properties. At the right-hand side of Figs. 1 and 2 the billets will be seen entering the furnace at *A*, it being merely necessary to raise the end door to allow the billets to roll down the hearth until they come against a continuous row of billets inside the furnace. For transferring the heated billets to the extrusion press, use is made of a lever shown at *B* in Fig. 2, which is furnished with two bent arms that are shaped to hold a billet as it is rolled off the hearth of the furnace. This lever is suspended from a trolley *C* so that relatively little physical effort is required of the furnace attendant to carry a billet across and deposit it in a pivoted transfer arm *D*, Fig. 3, on the extrusion press.

Design and Functions of the Press

The extrusion presses used by the Rome Brass & Copper Co. for making rods were built by the Watson-Stillman Co. of New York. Each press completes the extrusion process at a single operation. Fundamentally each machine consists of

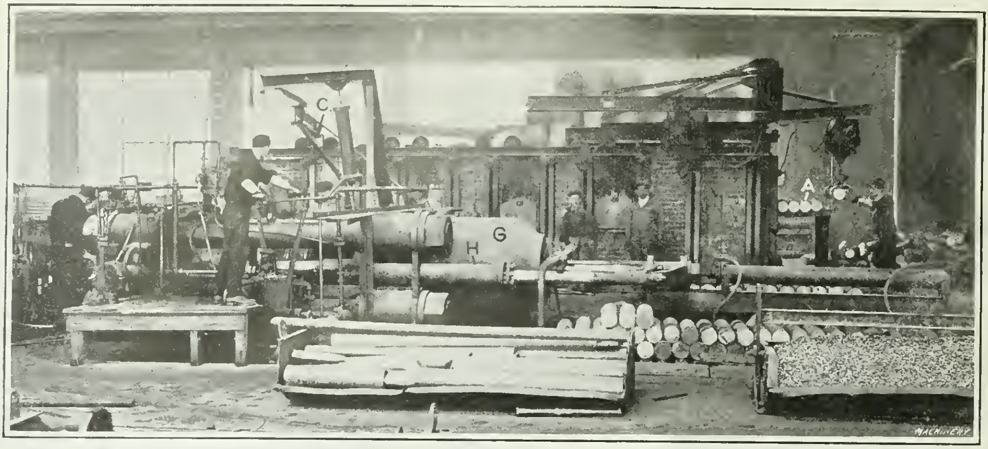


Fig. 1. General View of the Hydraulic Extrusion Press and Furnace in which the Billets are heated

a cylinder known as a "container," at the forward end of which there is a die of similar design to the die on a drawbench, and at the back end there is a plunger or piston which applies pressure at the back of the heated billet after it has been placed in the container. Through the application of hydraulic pressure, the plunger moves forward and causes the heated metal to flow out through the die at the forward end of the container, a billet measuring 26 by 6¾ inches being converted into a long thin rod by this method. There is considerable variation in the size of rods that can be produced by the extrusion process, the range at this company's plant extending from ⅜ inch to 4 inches in diameter. A billet of standard size would produce a ⅜-inch rod 703 feet long, as well as a 4-inch rod 6 feet long.

Sequence of Movements in Operating the Extrusion Press

Having made a general statement of the way in which the extrusion press accomplishes its work, we are in a position to enter into a detailed description of its construction and the sequence of movements that are involved in operating an equipment of this type. When the heated brass or copper billet is carried from the furnace and deposited in the transfer arm *D*, Fig. 3, the oscillation of this arm rocks the billet over into line with the container of the extrusion press. Then an auxiliary pusher-rod which runs through the center of the main ram, moves forward into contact with the end of the billet and pushes it into the container. This rod is operated by a compressed air cylinder shown at *F* in Fig. 2. The billet is pushed in far enough so that there is sufficient space to insert a steel disk known as a "dummy block" behind it, after which the main ram of the press advances and pushes both the dummy block and the metal forward, the action being similar to that of a piston compressing air or gas in a cylinder; but as the heated brass or copper is noncompressible, the only way in which it can adapt itself to the constantly contracting volume of space between the dummy block and the front end of the container, is for the metal to flow out through the extrusion die. Presses of this type are built for operation at pressures up to 5000 pounds per square inch, giving the main ram pressure capacity up to 2000 tons.

Materials Used for Making the Extrusion Dies and Container Lining

The extrusion die is made of high-speed steel, and there may be two or more openings in the die so that more than one extruded rod emerges from the press simultaneously. This practice is followed in the case of rods of small diameter in order to reduce the length of the rods. For instance, it has been stated that a billet of standard size contains sufficient metal to produce a ⅜-inch rod 703 feet long, but the die used for such a size would have at least four openings, thus reducing the length of each rod to about 175 feet. Each rod is gripped in a pair of tongs carried by a laborer whose duty it is to draw the work along a roller hot bed to avoid danger of its buckling. It will be apparent that the action of hot metal under the high pressure that is used in

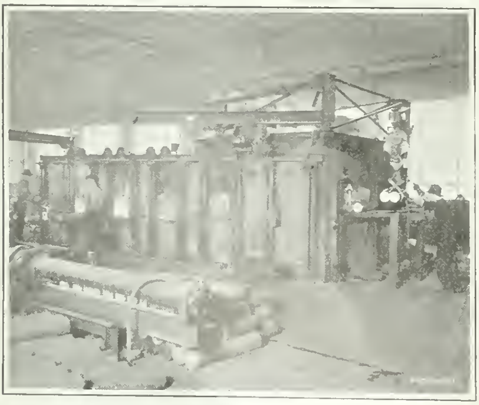


Fig. 2. Close-up View of Heating Furnace, Billet-carrying Trolley and Air Cylinder for operating the Auxiliary Pusher-rod

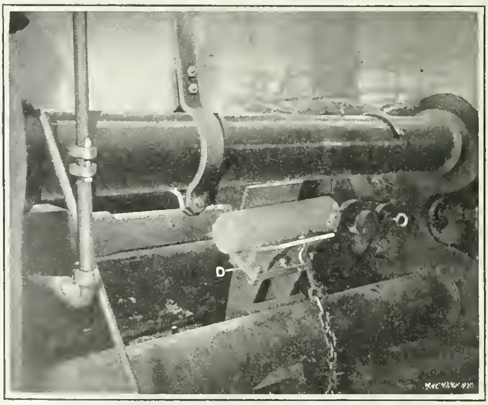


Fig. 3. Close-up View of Rocker Arm which transfers a Heated Billet into the Required Position for entering the Container

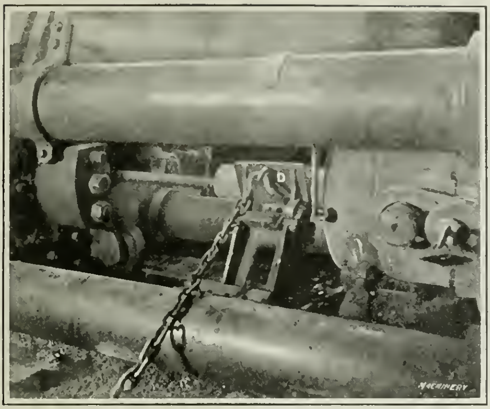


Fig. 4. Rocker Arm D has swung over, and the Pusher-rod is sliding the Billet into the Container

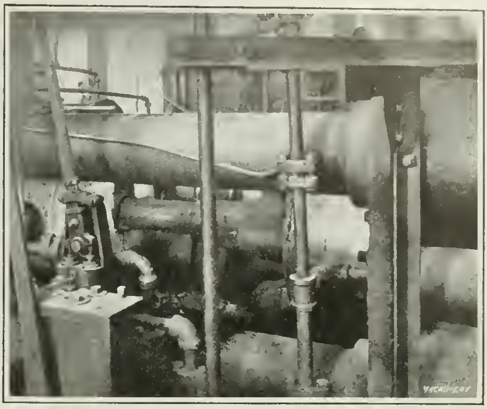


Fig. 5. Close-up View of Main Ram advancing into the Container to perform the Extruding Operation

extrusion must exert considerable wear and tear on the container and dies of the extrusion press. The dies are of simple construction and relatively inexpensive, so that their replacement is not a serious item. But it would not do to have the container so constructed that it had to be entirely replaced when the inner surface became worn. To avoid such a serious item of expense, the expedient adopted is to insert a steel lining in the container. This practice is quite similar to that followed in the construction of large field and naval guns, with which most engineers have become more or less familiar, due to the publicity that this subject has received during recent years.

In starting to operate an extrusion press, it is necessary to preheat the inside of the container sufficiently so that it will not tend to chill the billet before the extrusion operation can be completed. This preheating is accomplished by successively pushing several red-hot billets into the container and allowing them to remain until most of their heat has been absorbed, after which the billets are withdrawn. There is no way of telling definitely what temperature is reached by the inside of the container, but it is estimated that this approaches a red heat after the press has been in continuous operation for several hours. Mention was made of the use of a dummy block between the end of the billet to be extruded and the main ram of the extrusion press. The function of this dummy block is to prevent the red-hot metal from coming into contact with the ram, which would result in the destruction of the ram and cause a serious expense when replacement became necessary. The dummy block is of negligible cost so that its destruction is a matter of very slight importance.

Removing the Butt End of the Billet from the Container

A little thought will make it apparent that it would be impossible to extrude all of the metal out through the dies, and as a residue is left in the container and attached to the rods extending through the die, some means must be provided for cutting off this butt end of the billet and removing it from the container. This result is accomplished by having the forward end of the container which carries the extrusion die mounted on a slide, so that the die may be securely held in place at the end of the container while extruding the metal, after which the slide and forward end of the container may move forward to bring the butt end of the billet under a shear blade which cuts it off. Then the extruded rods can be pulled out of the die, after which the slide returns to its initial position ready for performing the next operation. The arrangement of this slide for carrying the front end of the container and the provision made for shearing off the butt end of the billet will be readily understood by referring to Figs. 6 and 7. The shear blade is shown at *I*, the extrusion die at *J*, and the dummy block that enters the container behind the billet is illustrated at *K*.

After the extrusion die has been cleared by shearing off the butt end of the billet, the plunger is returned to the starting point by means of pull-back cylinders located at either side of the main cylinder *G*, Fig. 1. One of these pull-back cylinders is shown at *H* in the same illustration.

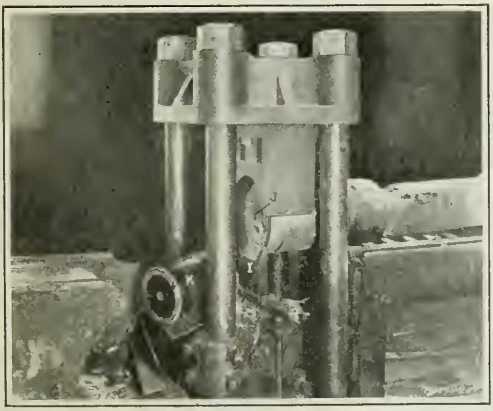


Fig. 6. Shear Blade I has cut off the Butt End of the Billet so that the Extruded Rod can be withdrawn from Die J

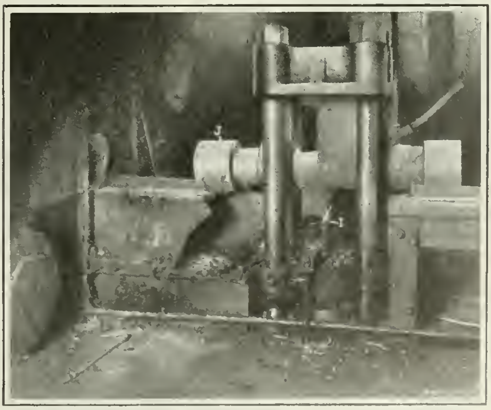


Fig. 7. Here the Slide is shown returning Die J to its Position in the Forward End of the Metal Container

All movements of the rams are governed by a set of specially designed operating levers controlled by pilot valves located at the side of the machine.

Pickling, Drawing, and Straightening

After the extrusion process has been completed, it is still necessary to remove the oxide scale which has formed on the red-hot metal as it emerges from the die, subject the work to a cold-drawing operation which improves the smoothness of the surface and reduces the rod to exactly the required diameter, and finally straighten the bar ready for shipment to the consignee. Pickling is accomplished by immersing the rods in a tank containing a solution of "Edis" compound, the strength of which is such that the solution has a specific gravity of 30 degrees Baumé. A 5 per cent solution of sulphuric acid could be used with satisfactory results. It is necessary to pickle the rods both with the view of removing the scale to improve the appearance of the product and to avoid damage to the cold-drawing dies which would result from having this hard surface coating on the metal. The drawing is accomplished in a hydraulic draw-bench built by the Waterbury Farrel Foundry & Machine Co., of Waterbury, Conn., and after drawing, the rods go to a straightening machine of the type built by the Medart Patent Pulley Co., of St. Louis, Mo. Both of these equipments have been described in MACHINERY in connection with the manufacture of cold-drawn shafting and screw stock, seamless brass and copper tubes, etc. After straightening, the rods are cut up into lengths specified by the consignee and packed for shipment.

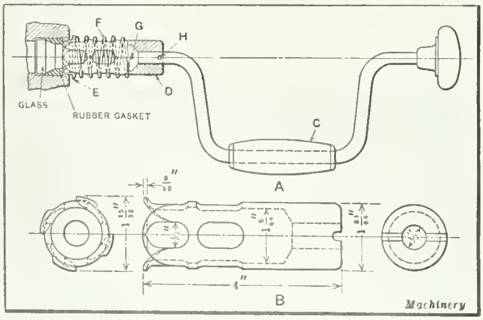
* * *

TOOL FOR REMOVING LUBRICATOR GASKETS

By NORMAN McCLEOD

The replacing of the rubber gasket in certain types of sight-feed lubricators is sometimes necessary, but its removal frequently results in badly marring the threads provided for the retaining cap. The consequence is that the hole must often be retapped to a larger diameter and another cap provided. The device shown at *A* in the illustration was designed for the purpose of removing gaskets without impairing the threads. It consists of a carpenter's brace *C* and a hollow circular tool-steel cutter *D*, shown in detail at *B*.

When it is desired to remove a gasket, a special steel bushing *E* and an expansion coil spring *F* made of 1/8-inch wire, are first slipped over the small end of the cutter. The spring is held in place by a pin *G*. The purpose of the bushing is to protect the threads and to guide the cutter when removing the gasket, while the spring exerts a pressure on the bushing and prevents it from withdrawing from the hole. After the cutting end of tool *D* and bushing *E* have been placed in the hole, the end of brace *C* is inserted in the opposite end of the cutter. Then by means of pin *H*, which projects from each side of the brace and engages with a groove in the cutter, the tool can be readily turned.



Tool designed for removing Rubber Gaskets from Sight-feed Lubricators

FORMULA FOR MAKING TAPER MEASUREMENTS

By C. N. PICKWORTH

The formula published in the April number of MACHINERY, page 763, for finding the diameter of a disk to be placed in contact with a disk of different diameter when measuring tapers, involves four distinct operations including the squaring of a five-figure quantity. The writer is in favor of simplifying the method explained in MACHINERY'S HANDBOOK, page 899, which may be written as a formula in the following form, in which the letters *D* and *d* represent disk diameters, and *a* the angle, as shown in the diagram.

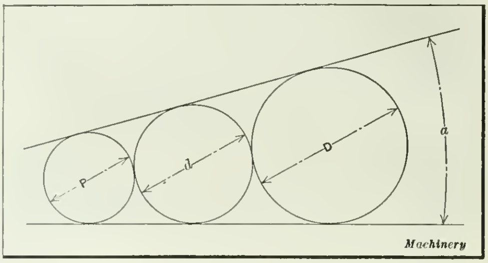


Diagram used in Connection with Taper Measurement Formula

$$D = \frac{2d\left(\sin\frac{a}{2}\right)}{1-\sin\frac{a}{2}} + d \quad .$$

From this we get

$$D = \frac{2d\left(\sin\frac{a}{2}\right) + d - d\left(\sin\frac{a}{2}\right)}{1-\sin\frac{a}{2}}$$

$$= \frac{d\left(\sin\frac{a}{2}+1\right)}{1-\sin\frac{a}{2}}$$

or, expressed in conventional form

$$D = d \times \frac{1+\sin\frac{a}{2}}{1-\sin\frac{a}{2}}$$

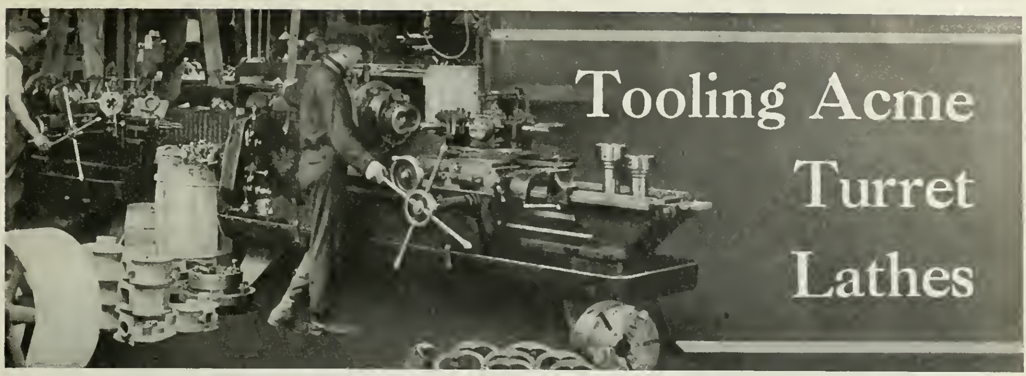
Applying the above equation to the example contained in the previously published article, where *d* equals 1 inch and *a* equals 15 degrees,

$$D = 1 \times \frac{1.13053}{0.86947} = 1.3002 \text{ inches}$$

It may be of interest to point out that the diameter of the tangent circle *P* (see diagram) on the opposite side of circle *d*, is the reciprocal of the diameter *D*, that is

$$P = d \times \frac{1-\sin\frac{a}{2}}{1+\sin\frac{a}{2}} = 1 \times \frac{0.86947}{1.13053} = 0.76908 \text{ inch}$$

From the foregoing it follows that the product of the diameters of the two tangent circles *P* and *D* is constant and is equal to the square of the diameter of circle *d*.



Tooling Acme Turret Lathes

Tooling Equipment for Performing Turret Lathe Operations on Friction Pulleys, Aluminum Pistons, Gear Blanks and Other Machine Parts

In turret lathe operations increased output is often obtained by a carefully thought out arrangement of the tools that are used and the order in which successive operations are performed. This is a specialized branch of tool designing, and most of the builders of turret lathes maintain engineering service departments which are prepared to design special tool equipments to meet the requirements that must be fulfilled in machining parts handled on their lathes. Acknowledgment is made to the tool designers of the Acme Machine Tool Co., Cincinnati, Ohio, for data and illustrations which form the basis of this article. All the tools have been actually developed for use on Acme machines. So far as possible, examples have been selected which deal with the finishing of pieces of the general types that are handled on turret lathes. The methods of tooling up for these jobs will suggest ways and means for the efficient performance of many similar operations; and statements concerning the rates of production which are secured with this equipment will enable manufacturers in similar lines to compare their rates of output with those which are being attained in other industrial plants.

Turret Lathe Operations on Friction Pulleys

Fig. 1 illustrates the tools provided on an Acme universal turret lathe for performing machining operations on friction pulleys at the plant of the Davis & Furber Machinery Co., of North Andover, Mass. At the first setting of the work, there are two sequences of three operations each to be performed on these pieces. It will be evident that a three-jaw chuck is used to hold the casting by its outside diameter, and tools carried by the main turret are employed for facing hub *A* and rim *B*, for boring hole *C*, and for reaming the same hole with a tool carried on the next face of the turret.

After the boring tool has started its cut in hole *C*, the second sequence of operations is commenced with tools carried by a turret toolpost mounted on the carriage. These tools are shown at the left-hand side of Fig. 1, where it will be apparent that the first tool is employed to turn taper *D*, connection being made with a taper-turning attachment at the rear to obtain the required form for the work. This taper-turning operation proceeds while the boring operation takes place in hole *C*. After indexing the turret toolpost, the tool at the second station turns hub *E*, and when this

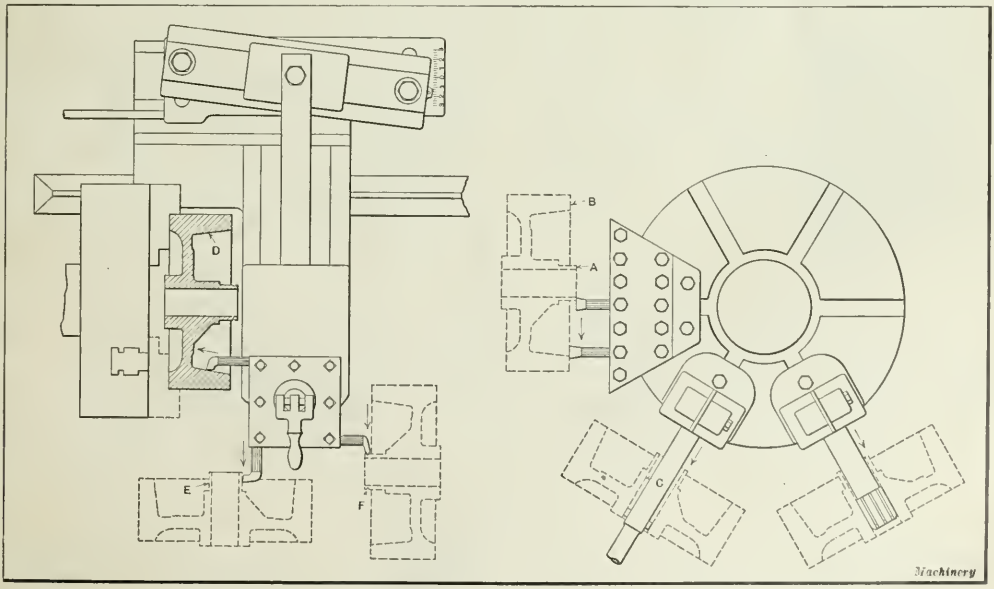


Fig. 1. Diagram of Tool Lay-out for First Sequence of Turret Lathe Operations on Friction Pulleys

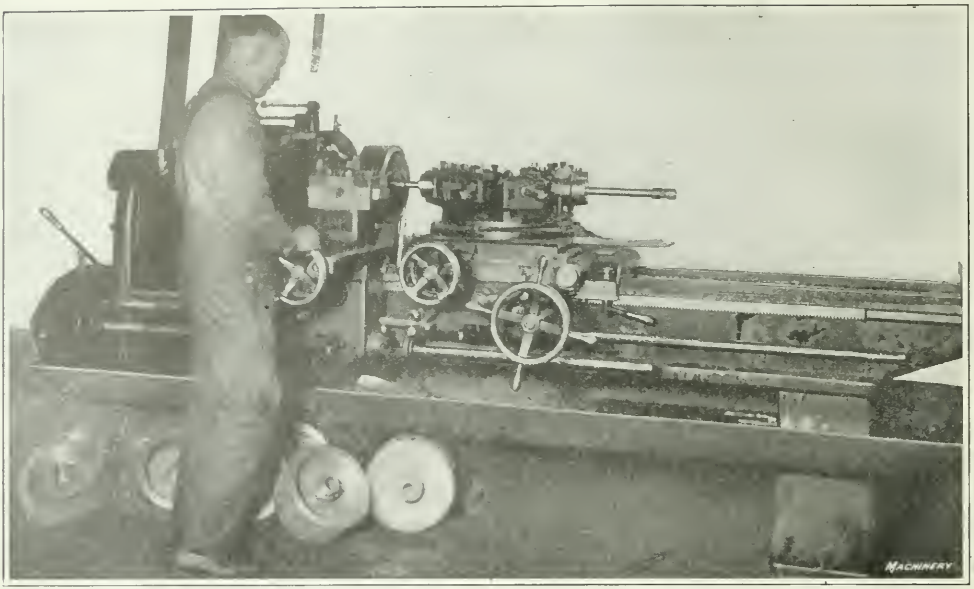


Fig. 2. Turret Lathe equipped for Second Sequence of Operations on Friction Pulleys

result has been accomplished, the turret toolpost is again indexed to bring the third tool into position for turning a notch *F*. Conforming with the usual practice, none of the tools mounted on the carriage are in operation while the reamer in the turret is finishing hole *C*. These friction pulleys are made of cast iron, and with the tool equipment here illustrated and described, it is possible to perform the complete series of operations in 45 minutes.

Second Sequence of Operations on Friction Pulleys

After bringing the friction pulley castings to the condition in which they leave the tools illustrated in Fig. 1, it is still necessary to perform a second sequence of operations on the outside diameter and the opposite end of the castings. The machine set up for this purpose is shown in Fig. 2, and a special work-holding fixture shown at *G* in Fig. 3 is secured to the spindle nose, which provides for utilizing the taper bore *D*, that was finished during the preceding sequence of operations, as a locating point. By following this method, assurance is obtained that the surfaces which still have to be finished will be brought into the proper relationship with those that have already been machined. To assist in maintaining accurate alignment and freedom from spring, there is a pilot *H* mounted on the work-holding fixture, which

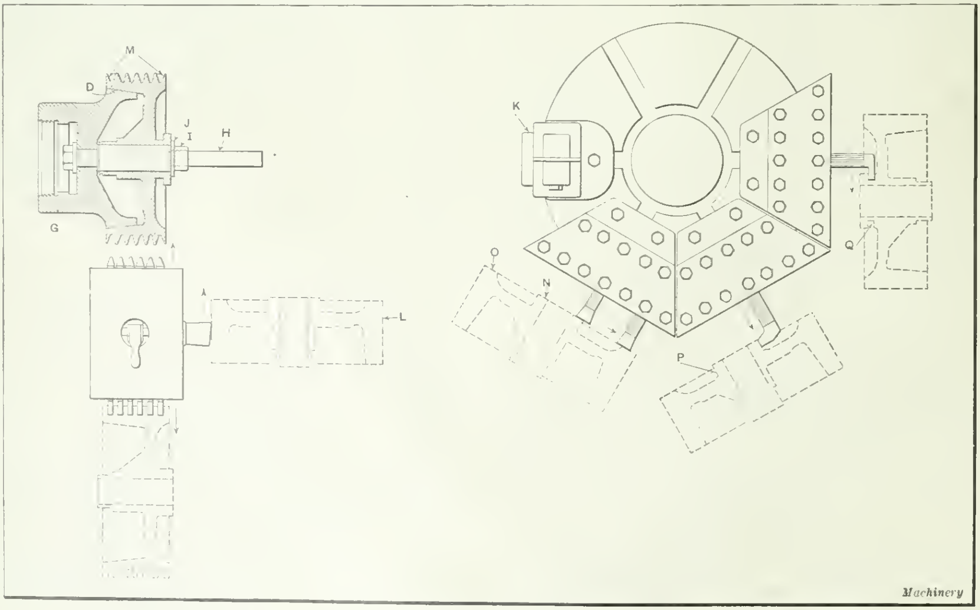


Fig. 3. Diagram of Tool Lay-out for Second Sequence of Turret Lathe Operations on Friction Pulleys

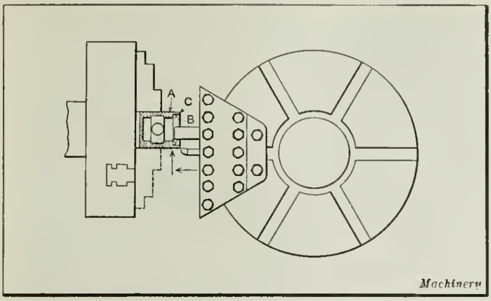


Fig. 4. Lay-out of Tools for First Sequence of Turret Lathe Operations on Pistons

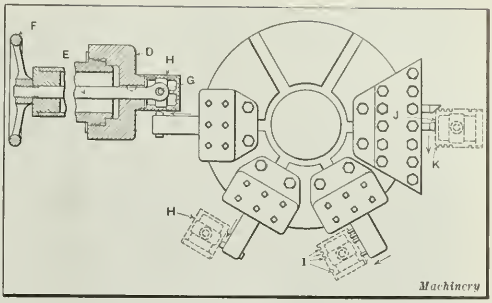


Fig. 5. Lay-out of Tools for Second Sequence of Turret Lathe Operations on Pistons

projects through the finished bore of the work, so that it may enter a bushing on the turret to provide additional support for the work while the multiple grooving tools mounted on the carriage are taking their heavy cut. Attention is called to the nut *I* and washer *J*, by means of which the casting is held back on the taper nose of work-holding fixture *G*. It will be evident that the diameter of nut *I* is small enough to enable it to pass through the bore of the work, and washer *J* is of the familiar slotted type so that it is only necessary to slightly loosen the nut and withdraw the washer, after which the work can be slipped over the nut. This practice is the means of saving a considerable amount of time in setting up castings and removing finished pieces from the fixture.

With the casting held on a work-holding fixture as shown, the turret is advanced to allow pilot *H* to enter bushing *K* carried on the first station of the turret. Mounted on the cross-slide there is a turret toolpost with a turning tool carried by the first face to provide for turning the outside diameter *L* of the pulley. On the second station there are six square-nosed grooving tools which provide for roughing out grooves in the outside of the work, and on the third station a similar set of pointed tools provides for finishing the grooves to the form shown at *M*. The bushing *K* and pilot *H* prevent the work from springing while these heavy cuts are being taken. On the second station of the turret, two facing tools provide for facing surfaces *N* and *O*; on the third station a tool turns the outside diameter *P* of the hub; and at the fourth station a hook tool turns groove *Q* in the hub. In the performance of this sequence of operations, 60 minutes is required to complete the job on one pulley.

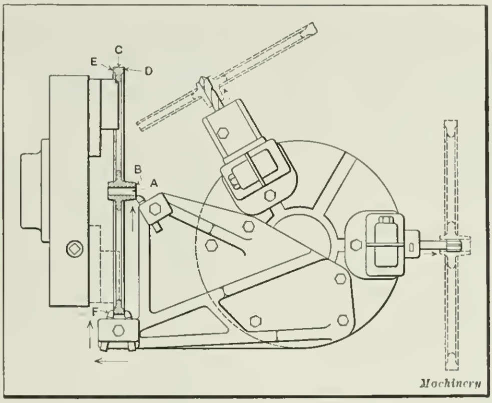


Fig. 6. Lay-out of Tools for drilling, reaming, facing and turning Gear Blanks on a Turret Lathe

Turret Lathe Operations on Aluminum Pistons

Fig. 4 illustrates tooling developed for use in performing the first of two successive series of operations on aluminum pistons at the plant of the Orteig Motor Co., New York City. Reference to this illustration will make it apparent that piston *A* is held by its outside diameter in a three-jaw chuck, and that two tools mounted on the first face of the turret provide for boring out the skirt at *B* and facing end *C* of the piston. For this combination boring and facing operation on piston skirts, the rate of production is fifty-five pistons per hour. These two finished surfaces are then used as locating points for holding the work while a second sequence of operations is being performed.

Second Sequence of Operations on Pistons

In Fig. 5 there is shown a diagram of the tools employed for the second sequence of operations on aluminum pistons. A work-holding fixture *D* is mounted on the spindle nose, the forward end of which is formed to accurately fit into the bored and faced skirt of the piston. Extending through the turret lathe spindle there is a draw-in rod *E*, the left-hand end of which is threaded to receive handwheel *F* that has its hub bored and tapped to fit the screw on the draw-in rod; and at its right-hand end, rod *E* has an eye formed on it to enable pin *G* to be slipped through the wrist-pin hole in the piston and through this

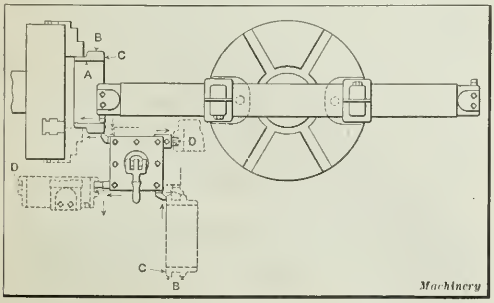


Fig. 7. Diagram of Tool Lay-out for First Sequence of Turret Lathe Operations on Friction Sleeves

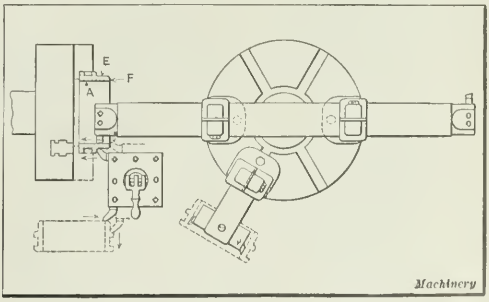


Fig. 8. Diagram of Tool Lay-out for Second Sequence of Turret Lathe Operations on Friction Sleeves

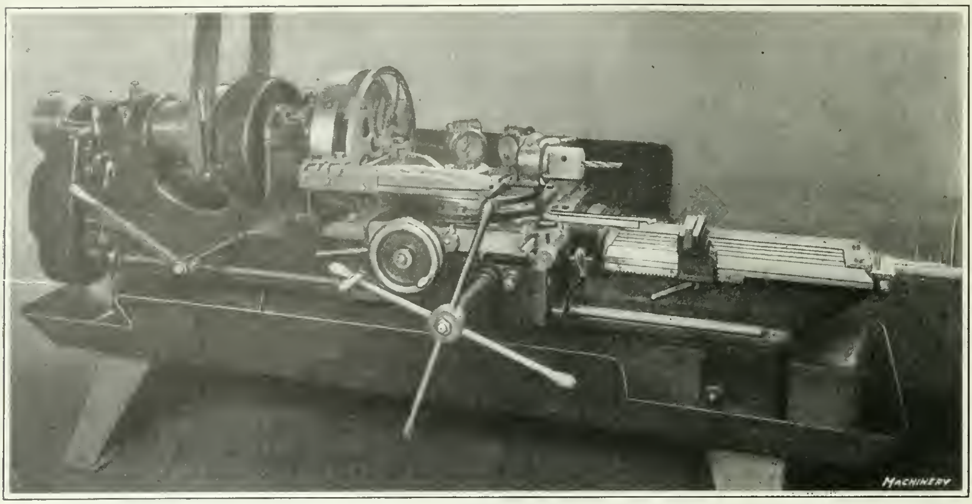


Fig. 9. Work indicated in Lay-out in Fig. 6 in Place on Machine

eye, so that when handwheel *F* is turned, rod *E* will pull the piston back securely into place on the formed nose of work-holding fixture *D*. On the first station of the turret there is a tool for rough-turning outside diameter *H* of the piston, and at the second station a similar tool finish-turns this surface; on the third station there is a tool with four cutter bits for cutting grooves *I*, and at the fourth station of the fixture two tools provide for facing end *J* of the piston and beveling it at *K*. On this job the machining time from floor to floor is 5½ minutes.

Drilling, Reaming, Turning, and Facing Gear Blanks

At the Michigan Washing Machine Co.'s plant in Muskegon, Mich., turret lathes are tooled up as indicated in Fig. 6, to provide for the performance of a sequence of operations on gear blanks of the form illustrated. Reference to this tool diagram will make it apparent that the work is carried by a three-jaw chuck provided with special jaws to grip the work from the inside of the rim. On the first station of the turret there is a twist drill for drilling hole *A*, and this hole is finished by a chucking reamer mounted on the third station of the turret. At the second station an interesting form of tool construction has been developed for simultaneously facing end *B* of the hub, turning outside diameter *C*, and facing sides *D* and *E* of the rim. Evidently such a tool is the means of effecting a substantial saving in the time required for machining gear blanks of this form. Reference to the arrows which indicate the direction of feed movement will make it apparent that the turret at first is moved toward the left to provide for feeding tool bit *F* across the face of the gear blank to turn outside diameter *C*; then the cross-feed movement of the turret is engaged, so that the two straddle tools will be fed in a downward direction opposite the faces *D* and *E*, while the third tool will be fed across the face *B* of the hub. Fig. 9 shows the blank in place in the machine. These gear blanks are made of cast iron, and the machining time for the operations which have been described is 7 minutes from floor to floor.

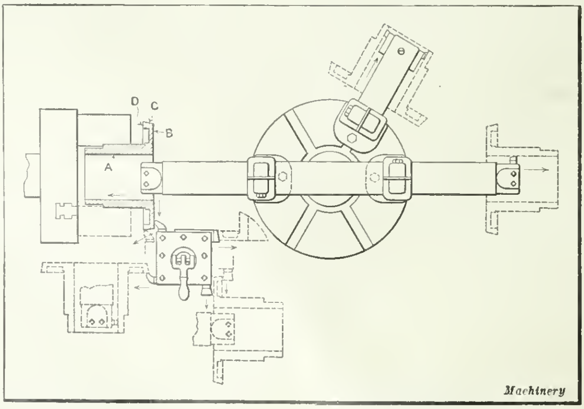


Fig. 10. Tooling of a Turret Lathe for performing First Sequence of Operations on Frictions

Machining Friction Sleeves on the Turret Lathe

Figs. 7 and 8, respectively, show diagrams of the turret lathe tools used in the plant of the Acme Machine Tool Co., Cincinnati, Ohio, for performing the first and second sequence of operations on cast-iron friction sleeves. For the first series of operations it will be evident that the casting is held by its outside diameter in a three-jaw chuck, and a boring-bar on the turret provides for performing a rough-boring operation in hole *A*, Fig. 7. Mounted on the cross-slide there is a turret toolpost, on the first station of which a tool is provided for rough-turning outside diameter *B* and rough-facing end *C*, feed movements as indicated by the arrows being utilized for taking these two cuts. A tool at the second station rough-forms groove *D*. At the third station there is a tool, similar to the one carried at the first station of the turret toolpost, which provides for finish-turning diameter *B* and finish-facing end *C*. At the fourth and final station, a tool is provided for finishing groove *D*. The tools mounted on the carriage are brought into use immediately after the boring-bar on the turret has started taking its cut. These sleeves are made of cast iron, and for the first sequence of operations the machining time is 25 minutes.

Second Sequence of Operations on Friction Sleeves

In Fig. 8, there is shown a tool diagram indicating the way in which the turret lathe is equipped for performing the second sequence of operations on these sleeves. The method of procedure is to perform the first sequence of operations on 100 pieces and then change the tools, with the exception of the boring-bar on the turret. By indexing the turret through 180 degrees, the opposite end of this bar, which carries the finish-boring tool, is brought into the operating position. As in the previous case, the work is held in a three-jaw chuck, but owing to the fact that it is gripped by faces which have already been finished, special soft jaws are provided to avoid damaging the work. While the boring-bar carried on the first station of the turret is engaged in finish-boring hole *A*, tools mounted on the turret toolpost on the carriage are rough- and finish-turning diameter *E*, and rough- and finish-facing end *F* of the work. On the second station of the turret a Kelly reamer is mounted for use in reaming the bore to exactly the required size. No other tools are operating while the reamer is taking its cut. For the performance of this second sequence of operations the machining time is 18 minutes, the complete time for the two series of operations employed in machining the friction sleeves being 43 minutes.

Machining Frictions on the Turret Lathe

At the plant of the Acme Machine Tool Co., Cincinnati, Ohio, turret lathes built by this company are equipped as shown by the tool diagram Fig. 10, to provide for machining frictions for use in lathes of their manufacture. It will be noticed that the work is held by its outside diameter in a three-jaw chuck which is furnished with special soft jaws of suitable form to accommodate the work. On the first station of the turret a boring-bar provides for rough-boring hole *A*, after which the turret is indexed through 180 degrees to bring the opposite end of this bar into position for finish-boring the same hole. Then a second index movement of the turret brings a reamer into line with the work to provide for reaming the hole. On the cross-slide there is a turret toolpost, the first station of which carries a tool for use in rough-facing surface *B* and rough-turning taper *C*, the tool being guided over these faces of the work by feed movements in the direction indicated by the arrows. At the second station there is a tool for rough-facing surface *D*. Then at the third station a tool is provided for finish-facing surfaces *B* and *D*, and at the fourth station a forming tool finishes tapered surface *C*. The tool at the first station merely removes the scale from the tapered surface, while the forming tool at the fourth station is depended upon to attain the desired degree of accuracy. It will be apparent that the tools on the carriage can be in operation while the rough- and finish-boring cuts are being taken in hole *A*; but the reaming of the hole must be performed separately, to assure accurate work. Fig. 12 shows a view of the tools as set up for the first operation. On this job the machining time is 40 minutes from floor to floor.

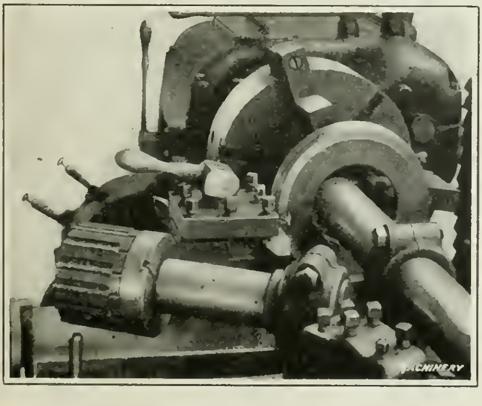


Fig. 12. Tools for First Operation on Frictions, as shown diagrammatically in Fig. 10

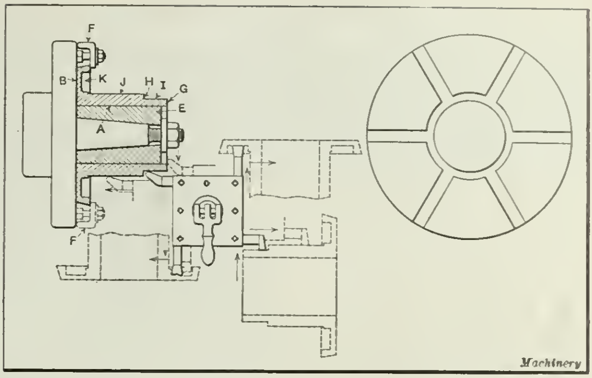


Fig. 11. Tooling of a Turret Lathe for performing Second Sequence of Operations on Frictions

Second Sequence of Operations on Frictions

After completing the sequence of operations shown in Fig. 10, it is necessary to reset the work on a machine which is tooled as shown in Fig. 11 to provide for the performance of a second sequence of operations. For this purpose it will be evident that a special work-holding fixture is provided on the nose of the lathe spindle. It consists of a piloted faceplate that provides for utilizing the bore *A* and surface *B*, that were machined during the previous sequence of operations, as locating points for setting up the work on the machine now under consideration. It will be evident that pilot *E* is made to accurately fit reamed bore *A* and that straps *F* hold the work back so that surface *B* is tight against the faceplate. For performing the sequence of operations handled on lathes equipped according to this method, no tools are mounted on the main turret; but there are four tool bits carried by a turret toolpost on the carriage. At the first station, the tool rough-faces end *G* and shoulder *H*, and rough-turns diameters *I* and *J*. To provide for feeding the tool over these surfaces, feed movements are imparted in the direction indicated by the arrows. A tool carried on the second station roughs out the three faces of pocket *K* through imparting feed movements in the direction indicated by the arrows. Then at the third station of the turret, a tool is provided for finish-facing surfaces *G* and *H* and finish-turning diameters *I* and *J*. And finally, the turret toolpost is indexed to its fourth station to bring a tool into operation for finishing the three faces of pocket *K*, through imparting to this tool feed movements similar to those which were employed for the tool at the second station of the turret. These frictions are made of cast iron, and for this second sequence of operations the machining time is 40 minutes from floor to floor.

* * *

SAFETY ENGINEERING IN TECHNICAL SCHOOLS

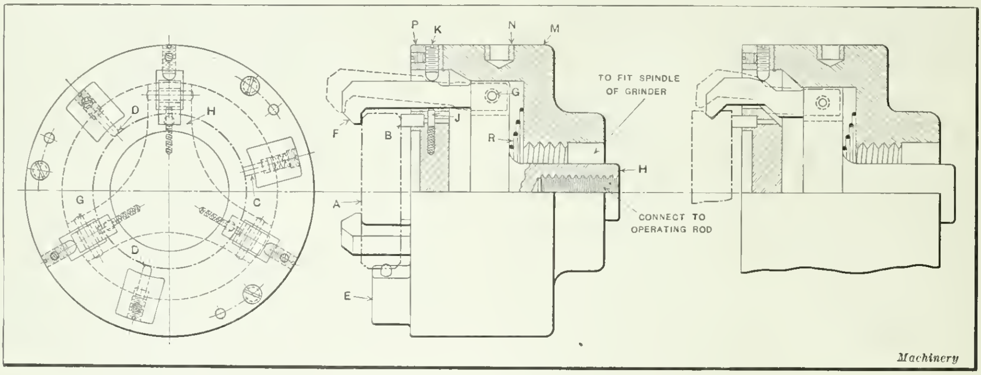
The National Safety Council has made several suggestions for improving the education in engineering colleges with regard to safety of workers in the industries. Safety education in engineering colleges, says the council, should not be confined to a course intended specifically for safety engineers. An effort should be made to impress upon all engineering students the fact that safety in the industries is necessary to engineering efficiency, so that the students, when entering practical work, will know that the full measure of efficiency cannot be obtained without safe working conditions. Safety engineering, therefore, should be worked into all engineering courses. Such courses as machine design, shop practice, and industrial management are particularly suitable for including safety engineering education. The matter of safety in the industries should be presented to the students as a subject definitely related to engineering efficiency rather than as a humanitarian subject.

INTERNAL GRINDING CHUCKS

By F. WILLIAM STEIN

Trouble is often experienced in chucking parts that must have the bore ground at right angles to a side and concentric with the periphery, particularly when a collet chuck is used, or one employing the usual design common to three- and four-jaw chucks. This trouble, on work of thin-wall section, is caused by the work springing while being clamped in the chuck, so that when this frail work is removed the parts spring back into shape, leaving the ground hole out of round. For service on work of this kind, the chuck described in this article has been in successful use for a number of years.

By referring to the illustration it will be seen that two separate forces are employed in holding the work *A* in place, a radial force and an axial force. This is the distinguishing characteristic of the chuck, and it eliminates the possibility of distortion. The seat for the work is provided by three hardened pins *B*, the top surfaces of which are face-ground, after they have been assembled and the chuck mounted on the grinding machine spindle, a provision which enables the bore to be ground normal to the face. The work is located on these pins, concentric with the spindle center, by means of three pins which are carried in bosses *E* positioned radially, and equally spaced with reference to the circumference of the work. One of these pins is a spring plunger *C*, the coil spring which actuates it being sufficiently stiff to force the work against pins *D* and hold it by radial force. These pins are hardened and ground, the adjustable ones *D* being a close fit in the reamed holes of the bosses. The opposite ends of the pins are threaded and slotted so as to be readily adjusted to suit different diameters of work that is to be ground. Set-screws are provided in the bosses for locking the pins in place after they have been properly adjusted.



Types of Chucks used for holding Rings and Similar Parts when grinding the Bore

The axial force employed to hold the work is exerted through three jaws *F*, which are hinged to the legs of spider *H* and extend through holes in cover plate *P*, and hook over the outside of the work. The extremities of the legs of spider *H* are a close sliding fit within the chuck body *M*, which is screwed on the spindle of the machine. The shank of the spider extends through the body and is connected to the operating handwheel by means of a rod extending through the spindle. The function of plungers *J* is to force the jaws into contact with the adjusting screws *K*, so that as the handwheel is turned and the spider traversed from right to left, the jaws, on account of the contour of their upper surface, will be forced radially outward to the position indicated by dotted lines in the illustration, thus releasing the work. The conical coil spring *R*, interposed between the spider and inner wall of the body, exerts an axial force on the spider and holds the jaws in the forward position. On account of the large number of holes necessary in cover plate *P*, this part is made from cast steel and is attached by means of set-screws and dowel-pins to the cast-iron body, on which it is accurately centered. The bosses that carry the radial locating pins are attached to this plate. The minor details of the chuck consist of headless set-screws for locking the adjusting screws *K* in place; hardened steel bushings *G* in the jaws to reduce the wear at this joint as much as possible; and steel bushings *N* in the spanner wrench holes in the chuck body.

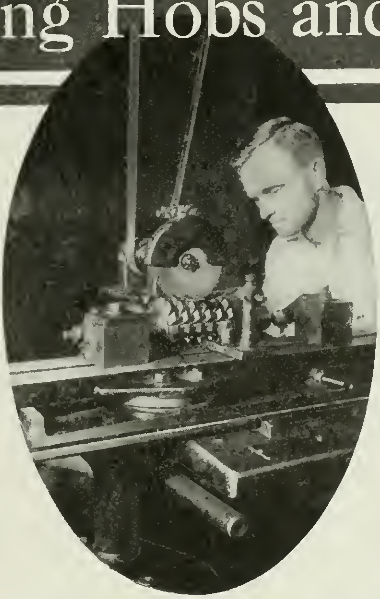
The view shown at the right-hand side of this illustration is an adaptation of the principle incorporated in the chuck just described. This chuck is operated in the same way as the other chuck, but, being designed for work which must have its bore ground concentric with the vee on its circumferential surface, the jaws are made to fit this vee. Certain other modifications are also made, so that the force exerted by the jaws is normal to the side of the vee against which they act, rather than axial. For this reason, the shape of the jaws is changed to agree with conditions. The inner edge of the three holes through which the jaws extend, is beveled to produce a "camming" surface to force the jaws radially outward, in place of the spring-plunger arrangement. In other respects the construction of the chuck is the same as that previously described. It is suggested that a small air cylinder might be substituted for the handwheel on the operating rod where quick manipulation is desired to save chucking time. It will be noticed in the illustration that for the sake of clearness, the chucks are shown in the conventional method with some of the projections omitted.

* * *

DEMAND FOR HIGH-PRODUCTIVE MACHINE TOOLS IN SWEDEN

At the beginning of this year, the eight-hour day was established by law for all the industries in Sweden, thus reducing the former ten-hour day by 20 per cent. Wages are also much higher than formerly, the hourly rates being from three to four times what they were before the war. Therefore, those manufacturers who wish to keep the production at the same level as it was with the longer working day, find it necessary to increase their machine equipment and to obtain equipment of high productive capacity, and in doing so will require a considerable number of American machines. The Swedish machine tool builders who make machines and tools of good quality are quite active at the present time, there being in round numbers from thirty to forty builders of machine tools in Sweden, not counting the firms in other lines that built machine tools temporarily during the war.

Sharpening Hobs and Cutters



Important Points to be Considered in Obtaining Good Results in the Cutting of Gears

By CARL G. OLSON, Chief Engineer, Illinois Tool Works, Chicago, Ill.

HOBS and cutters should be kept sharp by grinding the faces of the cutting teeth. This sharpening is of the utmost importance, and great care should be taken to retain the correct angles and surfaces necessary to maintain the accuracy of the work for which the hobs or cutters were made.

The grinding machines used for sharpening hobs should preferably be machines made for this work, but, in general, the ordinary universal cutter grinder is well suited for the purpose. It is essential that the grinding machine be properly adjusted and free from vibration. Particular attention should be given to the machine centers; they should be true and of the correct taper. The grinding wheels should be of medium grade, and the peripheral speed should be about 5000 feet per minute.

In grinding, take light cuts and move rapidly through the gashes of the hob or cutter. It is better to go around several times, taking light cuts, than to risk drawing the temper of the cutting edges. This applies particularly to carbon steel tools, but it is well to avoid heating high-speed steel also.

Another important point is to use arbors that are perfectly straight and true, for holding the hobs or cutters. These arbors should have large clean centers of 60-degree taper, and the depth of clearance at the bottom should be sufficient to clear the points of the centers of the grinding machines or their fixtures. The arbors should be tested by an indicator while being revolved on centers, as shown in Fig. 1. A special gage with a 60-degree angle should be used for frequent checking of the arbor centers. (See Fig. 2.)

New hobs are mounted on an arbor, placed in the grinding machine, and ground on the face of the teeth until proper sharpening has been obtained and also until all of the teeth have been ground concentric with the axis of the hob. The indicator in Fig. 3 registers the eccentricity of the teeth after the hob has thus been sharpened. A variation of 0.001 to 0.002 inch, depending on the size and pitch of the hob, may be allowed.

Grinding Radial and Under-cut Teeth

The teeth are usually ground with radial cutting faces (see Fig. 4), but new developments have recently brought out hobs with hooked or under-cut teeth. In sharpening, the cutting faces should be maintained radial in hobs designed for radial teeth, and it is equally important that the angle of under-cut in hooked hobs and cutters be maintained throughout the life of the tool.

Fig. 5 shows a cutter so ground that the cutting faces of the teeth have "negative rake." This is incorrect under all circumstances, as the cutting action is reduced to what is generally called a "drag." Fig. 6 shows the position of the grinding wheel in grinding an under-cut. This is also wrong for cutters designed to be ground radial, but in the new type of cutters previously referred to, this under-cut becomes a part of the design and should be maintained to the angle specified. This is the angle a between the plane of the cutting face and a radial line.

Grinding the Heels or Rear Ends of the Teeth

To facilitate sharpening by the use of an ordinary universal cutter grinder, the teeth of straight-gashed hobs are ground on the heel to an even length for the purpose of indexing as in Fig. 7. A measuring gage, shown in Fig. 8, is used for checking after this operation. With the backs of the teeth thus ground resting against the index finger, as in Fig. 9, the hob may be sharpened repeatedly and the length of the teeth maintained equal to each other, keeping the points of the teeth concentric with the axis of the hob.

Sharpening Helically Fluted Hobs

When sharpening helically fluted hobs, the table of the grinding machine should be swiveled to correspond with the

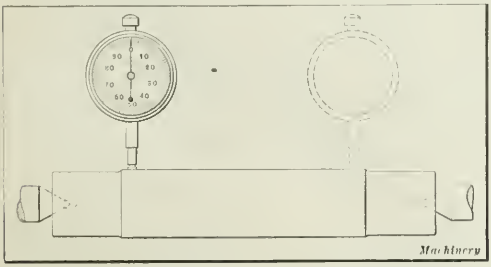


Fig. 1. Method of testing Accuracy of Arbor used for holding Hobs and Cutters while sharpening

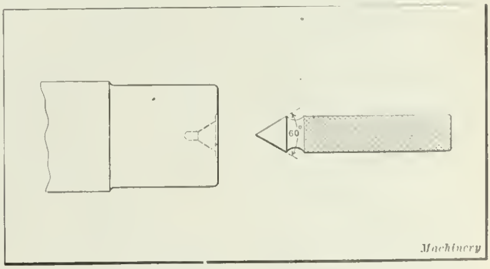


Fig. 2. Gage with 60-degree Included Angle, which is used for testing Center Hole in Arbor

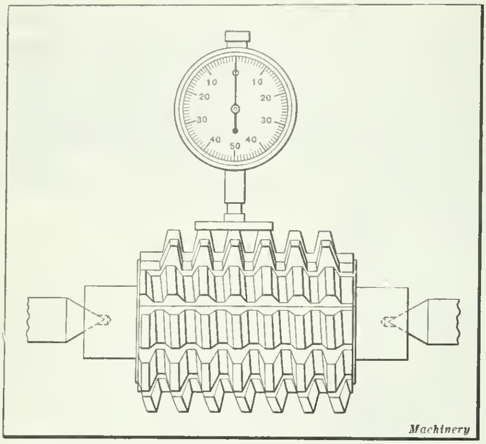


Fig. 3. Testing Eccentricity of Hob Teeth with Indicator, after sharpening

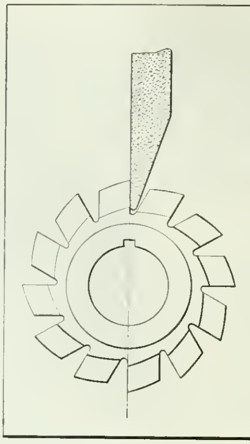


Fig. 4. Wheel set for grinding Radial Cutting Faces

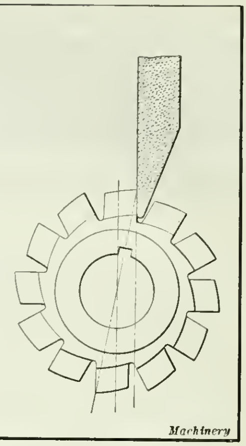


Fig. 5. Wheel incorrectly set, producing Negative Rake

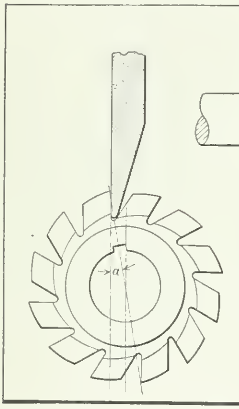


Fig. 6. Proper Position of Wheel when Under-cut Teeth having Positive Rake are desired

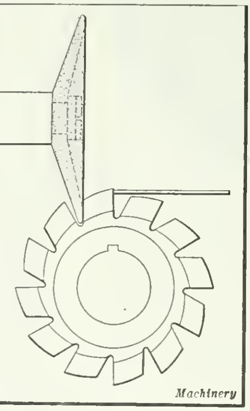


Fig. 7. Wheel set for grinding "Heels" or Rear Ends of Teeth to facilitate Indexing

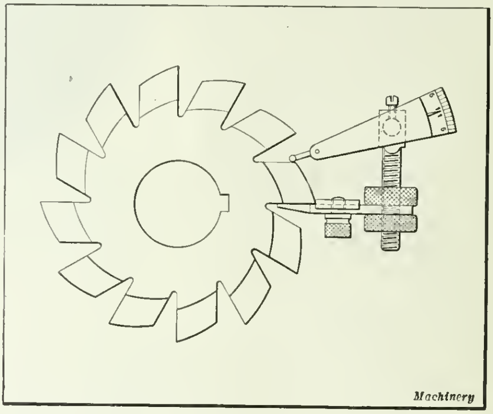


Fig. 8. Gage used for testing Hob Teeth to see that they are of Uniform Length after the "Heels" or Rear Ends of the Teeth have been ground as illustrated in Fig. 7

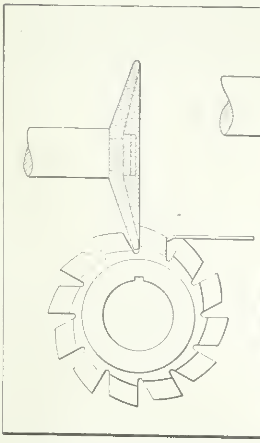


Fig. 9. Sharpening Straight-gashed Hob by indexing from the Backs of the Teeth

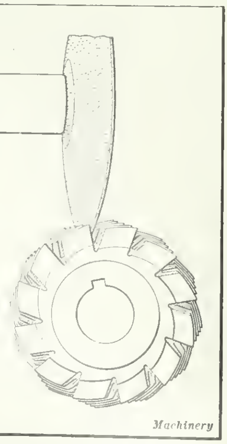


Fig. 10. Angular Side of Wheel set for sharpening a Helically Fluted Hob

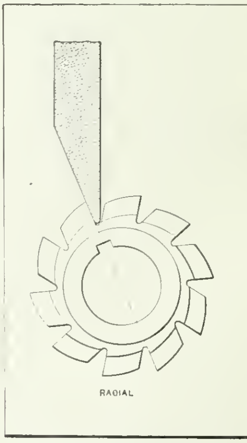


Fig. 11. Using Angular Side of Wheel for sharpening Radial Teeth on Helically Fluted Hob

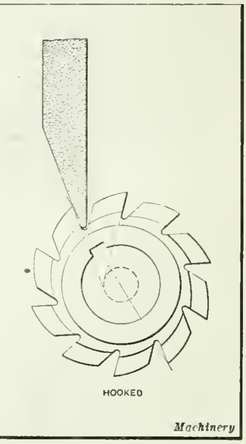


Fig. 12. Positions of Wheel and Helically Fluted Hob having Under-cut Teeth

angle of the flutes. This angle will be found stamped on one end of the hob. A helically fluted hob is sharpened by using the angular side of a dished grinding wheel, as shown in Fig. 10. To produce radial cutting teeth this grinding wheel must be set off center until the angular side of the wheel is radial to the center of the hob, thereby producing radial tooth faces, as shown in Fig. 11. When a hooked helically fluted hob is ground, this setting is altered until the grinding wheel produces the required angle of hook, or under-cut, as shown in Fig. 12.

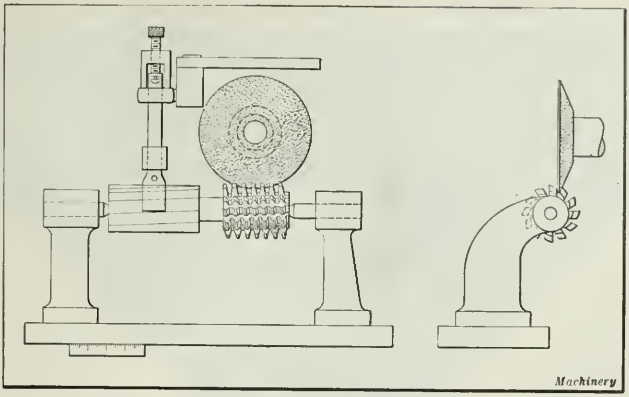


Fig. 13. Former mounted on Arbor with Helically Fluted Hob to give the Required Rotation when sharpening the Teeth

The faces of the teeth of a helically fluted hob cannot be ground with the straight side of a wheel, because the hob teeth present a helical surface, and the straight side of the wheel would interfere with some of the teeth. Therefore the convex side of the wheel is used, as there is no trouble from interference owing to the curvature of the wheel; this curvature does not prevent grinding either radial or hooked teeth correctly.

Unlike the straight-gashed hob the helically fluted hob is indexed from a former having helically milled flutes equal in lead and in number to the flutes in the hob. This former is mounted on the same arbor with the hob, and the arbor is placed between the centers of the grinding machine. A contact finger, mounted in a holder secured to the frame of the machine, turns the former as the table is moved, thus giving the proper rotation to the hob. The contact finger, or guide, is provided with an adjusting arrangement for feeding the teeth of the hob against the grinding wheel, as shown in Fig. 13.

After resharpening hobs or cutters, it is well to mount them on an arbor between the centers in a testing machine or lathe, to check the points of the teeth with an indicator, as in Fig. 3, and thereby make sure that the cutting teeth are concentric.

Fixture for Testing Faces of the Teeth

A fixture for testing the faces of the teeth is shown in Fig. 14. This fixture should be used in the grinding department with proper instructions to the men in regard to angles for sharpening. In using this fixture, the hob or cutter is placed on a stud. The gage attached to the indicator lever is inserted into the gash of the hob until the point of one hob tooth touches the flat end of the indicator lever. Then the hob is rotated counter-clockwise until the gage is brought parallel to the tooth face, the angle being shown on the scale by a pointer attached to the indicator lever.

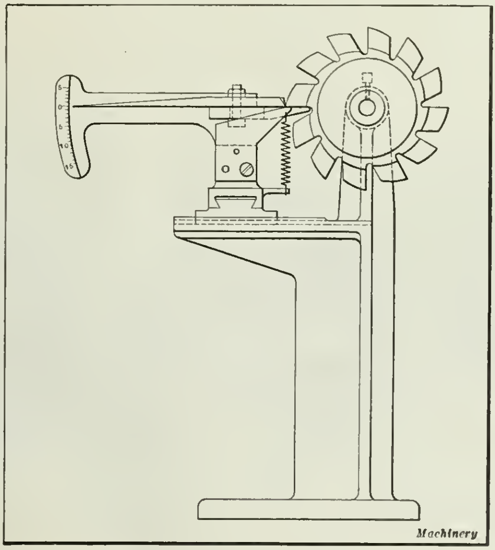


Fig. 14. Fixture for testing Faces of the Teeth after sharpening

It will be noticed that the indicator lever is fulcrumed in line with its flat end. This flat end also serves as a stop for the cutter teeth as they are brought into position. This feature enables the fixture to measure correctly the angles of the teeth of any size of cutter that is within its range.

The contact gage being perfectly straight also checks the straightness of the tooth face. This is done by noticing the admission of light between the tooth and the gage. For convenience in making this light test, the fixture has been made high enough to hold the work level with the eyes of the operator when it is used on a work-bench.

Special Hob-sharpening Machines

Special machines made for the purpose of sharpening hobs have been designed, and several types of these machines are on the market. In these machines, some of which are automatic, the lead of the helix may be adjusted to conform to the lead of the flutes in the hob. This is a great convenience, as no helical formers are required in this case. In plants where several hobs are sharpened daily, it is advisable to purchase one of these special machines, but where only a few hobs are used the universal cutter grinder will give satisfactory results.

* * *

CANADIAN INDUSTRIAL FATIGUE COMMITTEE

The Canadian Government has recently established a committee on industrial fatigue for the purpose of making the knowledge and experience of medical science, in its relation to industrial health and efficiency, available for all industries. Thus employers will be enabled to increase production by reducing lost time and labor turnover, and employes will be helped to maintain steady wages and employment by the reduction of preventable illness and hardship of working conditions. The principal objects are to offer manufacturers the assistance of scientific laboratories in solving the health problems presented by particular processes in their plants; to establish an intelligence bureau where up-to-date information on general and specific problems of industrial hygiene is kept; and to cooperate in investigating conditions in different industries, the occurrence and causes of sickness, and the actual relation existing between the hours of work, working environment, and production. An office has been opened at the University of Toronto, and other offices will be opened later.

Measuring Balls and Plugs by Light-wave Method

By H. L. VAN KEUREN
Consulting Mechanical Engineer
Boston, Mass.

It would be difficult to find a mechanical product that is of greater utility or refinement in regard to accuracy than steel balls for bearings, especially when one considers the great quantities produced. Accuracy, or more particularly uniformity, is a necessity demanded by the conditions under which steel balls are used; and while present efficient and rapid gaging methods secure uniformity for ordinary requirements, a new and practical application of light-wave measurement makes possible most accurate shop measurements of balls or rollers required for work of special refinement. The light-wave method may also be applied readily to the measurement of plain cylindrical plug gages. Nearly everyone demands in these plug gages an accuracy of 0.0001 inch or better. By extending the principles of interference of light measurement to diameter measurements, it is no longer necessary to guess or take things for granted in determining the ten-thousandth part of an inch in the production and use of plug gages. The unit of measurement, which is the half wave length of light (approximately 0.00001 inch), eliminates all guesswork, and no difficulty is encountered in securing fractions of this unit, making possible measurements within a few millionths inch.

There is nothing complicated about the procedure; in fact, it is most rapid, and the principles are in part familiar to every mechanic. Concerning the scientific details of light-wave measurement, it may be stated that while science is the foundation, as is the case in any real development of the present age, a knowledge of these details is not necessary in order to become proficient in measuring by light waves. However, it is of importance to know about the occurrence of interference bands, and how to interpret their meaning. Therefore in the following explanation there is given only the fundamental facts that are of utility in making the application of light waves for diameter measurements.

A Few Facts about Interference Bands

Recent articles on the measurement of flat precision gage-blocks by light waves should make unnecessary a detailed explanation or proof of the following facts:

1. Light is a form of wave motion. Different colors of light have different wave lengths ranging from 0.0000169 inch (the average length of violet waves) to 0.0000268 inch for red waves. Daylight contains all the colors and has an average wave length of approximately 0.00002 inch.

2. Monochromatic light is light in which one wave length or color predominates. The following explanations assume a monochromatic light having a wave length of 0.00002 inch.

3. An optical flat is a practically flat transparent test surface. Unlike a lens, it has no magnifying power.

4. Interference bands, which occur between the contacting surface of an optical flat and a flat or nearly flat reflecting surface, appear as merging colored bands or fringes in daylight; and as alternate light and dark bands in monochromatic light.

5. When a series of straight interference bands occurs between two flat contacting surfaces, there is always a wedge of air between them, contact being at one side only.

6. The bands take a direction at right angles to the slope or direction of the wedge.

7. The number of bands per inch indicates the steepness of the wedge, which increases in thickness from the point or side of contact at the rate of one-half wave length (0.00001 inch) per dark band.

8. The pronounced light spot indicates the point of contact.

9. The dark interference bands are not light waves, but simply show the points or spaces where the light waves reflected from one surface interfere with the waves reflected from the other surface. The light spaces show the points of

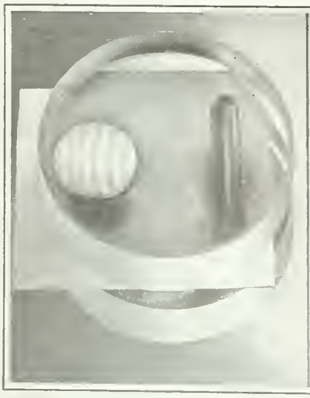


Fig. 1. Measuring the Diameter of a ¼-inch Plug Gage by comparing it with a ¼-inch Gage-block

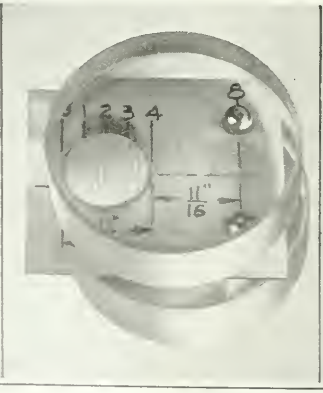


Fig. 2. Comparing Two Balls for Uniformity. Bands are almost Parallel with Line connecting Ball Centers

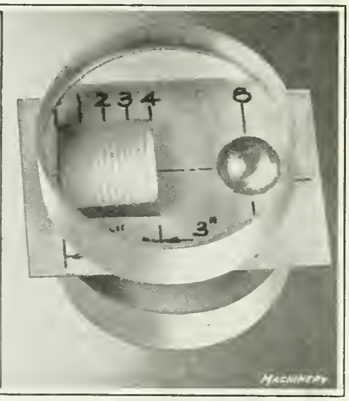


Fig. 3. Measuring the Diameter of a ½-inch Ball by comparing it with a ½-inch Gage-block

reinforcement. It is the dark interference bands that indicate the useful measuring unit of 0.00001 inch.

10. Straight parallel and evenly spaced bands indicate a flat surface, and curved and irregular bands indicate a curved or irregular surface.

One of the earliest devices to be used in mechanics was the wedge. It is this elementary mechanical principle that is employed in comparing the length of two flat gage-blocks, and also for measuring diameters of cylindrical plugs and balls. Two optical flats are used to form the wedge. The thickness of the wedge is fixed at one point by the thickness or length of a known standard gage-block, and at another point by the diameter of the ball or cylinder being measured. From the position, direction, and spacing of the interference bands, the slope of the wedge is found and, consequently, the exact amount that the ball or plug is larger or smaller than the standard is easily determined. A few examples will serve to illustrate the method of procedure.

Measuring an Over-size Plug

The measurement of a ¼-inch plug which is straight (that is, not tapering), but which is found to be over size by 12 units, or 0.00012 inch, is indicated in the drawing Fig. 4. The 0.250-inch circular gage-block standard is wrung on the lower optical flat, and the plug being tested is placed a definite distance away from one side of the gage-block. Usually, in order to make the calculation easy, it is placed a distance away from the gage equal to the width or diameter of the gage. A cardboard templet, as shown, serves to locate the plug at the proper distance.

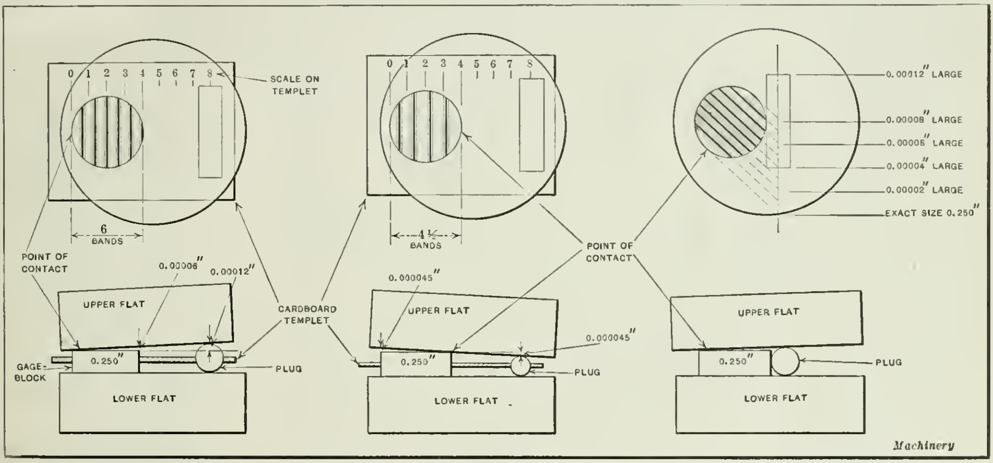


Fig. 4. Method of comparing a Cylindrical Plug with a ¼-inch Standard Gage-block

Fig. 5. An Under-size Plug. The Point of Contact is on the Side Adjacent to the Plug

Fig. 6. A Tapering Plug. The Bands incline relative to the Plug

Now the thickness of the wedge between the two flats where contact is made by the upper flat on the standard gage-block is just 0.250 inch. The wedge is increasing in thickness from this point of contact by 0.00001 inch for every dark band. Thus, counting six bands across the gage, which is a distance half way to the center of the plug, it is evident that the plug is 0.00012 inch large or over size.

Measuring an Under-size Plug

The location of the point of contact between the upper optical flat and the standard gage-block determines whether the plug is large or small. As shown in Fig. 4, when the plug is large the point of contact is located on the side of the gage away from the plug. Conversely, when the plug is small the point of contact is located on the side of the gage near the plug. Thus, in Fig. 5, it will be seen that as four and one-half bands can be counted from the point of contact across the gage, the upper flat slopes upward or away from the surface of the gage-block 0.000045 inch in a distance of ¾ inch, which is the diameter of the gage-block. The flat slopes downward to the plug (which is located ¾ inch away), by the same amount, and the plug is therefore found to be 0.000045 inch under size.

Tapering Plugs

In the two previous examples, both the over-size plug and the under-size plug were assumed to be straight, or without any taper. In actually measuring work, it is very easy to detect the slightest taper, simply by noting whether or not the bands are parallel to the axis of the plug. If the bands are parallel to the axis of the plug, it is straight; but if the bands are at an angle to the axis of the plug, it is tapering. Thus in Fig. 6 there is shown a ¼-inch plug which tapers from 0.00004 inch over size on one end to 0.00012 inch over size on the other end.

Further examples are shown in the photographs reproduced in Figs. 1, 2, and 3. Fig. 1 shows the measuring of the diameter of a ¼-inch plug gage by comparing it with a ¼-inch gage-block. The plug is under size by six bands or 0.00006 inch. The bands are practically parallel to the axis of the plug, indicating that the plug is not tapering. Fig. 2 shows a method of comparing two balls for uniformity. The bands are almost parallel to the line connecting the centers of the balls. The balls are, therefore, very nearly the same size. Variations would be shown by the angularity of the bands. Fig. 3 shows the method used for measuring the diameter of a ½-inch ball by comparing it with a ½-inch gage-block. This method of measuring the ball diameter shows that the ball is under size by an amount equivalent to fourteen bands or 0.00014 inch.

Measuring Plugs of Small Diameter

It is often necessary to measure the diameter of plugs or cylinders of very small diameter, such, for instance, as thread-measuring wires. This can easily be accomplished by the method previously described. A standard is selected of convenient length or thickness, say ½ inch, and a combination of gage-blocks is placed under the wire or small plug to be measured. Preferably the combination of blocks should be chosen so that the length of the combination plus the diameter of the wire is slightly higher (about 0.0001 inch) than the standard gage. The various blocks of the combination should be carefully wrung together, and the combination should be wrung on the flat as well as the standard.

Points to Observe when Taking Measurements

When measuring diameters by this method, one encounters little difficulty in making most accurate measurements. In fact, the apparatus and procedure are so simple that there is little chance for errors to occur in the measurement. However, a few suggestions will be included which will assist in obtaining proficiency in making the measurements.

When wringing the standard gage-block on the lower optical flat, care should be taken to get the gage in good contact. When a flat gage is properly wrung on the flat, no bands can be seen in monochromatic light, and no tinge of color is discernible in daylight.

Small nicks or burrs on the gage-block may prevent its being properly wrung on the flat. These nicks should therefore be removed.

The plug or ball being tested and the upper surface of the gage-block should be clean and dry.

A slight pressure is exerted on the upper flat to make sure that it is in contact all the way along the plug, as well as in proper contact with the gage-block standard. After contact is once secured, the pressure can be reduced.

It has been shown that with two optical flats and a source of monochromatic light, it is possible to make very accurate diameter measurements. While these explanations give an idea of the extreme accuracy obtainable, they do not convey the idea of the rapidity with which the measurements can be made. Owing to the very simplicity of the outfit required, there is no time lost in making adjustments and detailed preparations, as would be the case if an elaborate measuring machine were required. Indeed, it is almost necessary to see or actually perform the measuring operations with the optical flats to realize the advantages and efficiency of the optical method.

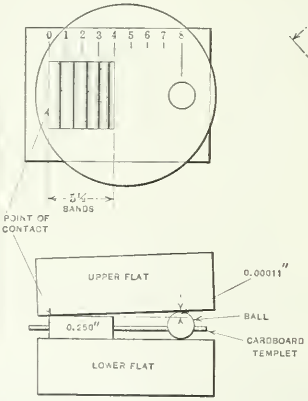


Fig. 7. An Over-size Ball

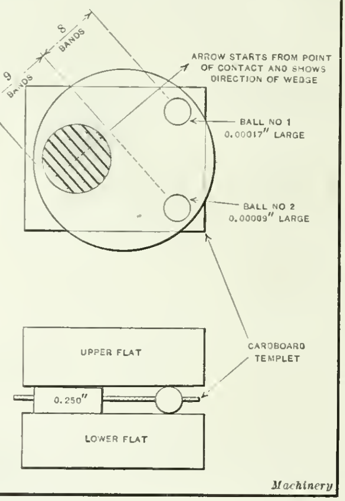


Fig. 8. Selecting Balls of Uniform Size

Measuring Diameters of Steel Balls

The measurement of the diameter of a steel ball is even more simple than the measurement of a cylindrical plug. The procedure is illustrated clearly in Fig. 7, which shows the measurement of a ball in comparison with a 0.250-inch square gage-block standard. The ball is 0.00011 inch over the standard size of ¼ inch.

It will be noted that the measurement of the ball is shown in comparison with a square gage-block, rather than a round gage-block as was the case with the plug measurement. The fact is that either the round or the square gage-block may be used for measuring the plug or the ball. However, the round gage is preferable in measuring the plug, inasmuch as the upper flat, which makes a line contact with the plug, adjusts itself automatically to the proper point contact on the round gage-block.

The square gage-block provides a line contact with the upper flat, and this serves to steady the flat when it is making point contact on the steel ball. In using the round gage for ball measurement, the upper flat is either manipulated with the hand or balanced, so that the interference bands run at right angles to a line drawn through the center of the ball, the center of the round gage-block and the point of contact of the upper flat on the gage-block.

Selecting Balls of Uniform Size

If it is simply desired to select a number of steel balls of the same size, a templet would be used which provides for two balls, located as shown in Fig. 8. If the interference bands appearing on the gage-block are parallel to a line between the two balls, then the two balls are of the same size. In the example shown in Fig. 8, the bands make an angle with the center line of the two balls, and it will be noted that the arrow, which is drawn from the point of contact of the upper flat on the gage-block, perpendicular to the bands, points in the general direction of the larger ball. The arrow shows the direction of the wedge, and the larger ball is, of course, farther out on the wedge. The difference in diameter is readily estimated as indicated in the illustration.

General Application of Light-wave Method

The application of the foregoing principles makes possible measurements in which there is absolutely no question about avoiding an error of 0.0001 inch, as the unit of measurement is 0.00001. If necessary, this unit may be divided even as far in certain cases as a tenth of a unit or one millionth of an inch. However, the question often arises, how does this apply to production? Production, today, is either on the basis of, or is tending toward the basis of, enormous schedules for the manufacture of interchangeable parts. This requires definite limits on important dimensions and gages to determine these limits. Limits of 0.002 inch are common on production work. Now an error of 0.0001 inch on a gage, say a plug gage for a hole, either robs the working tolerance of 5 per cent, making production more difficult, or it means a loss of life in the gage itself of 30 per cent (the allowable gage wear being 0.0003 inch). Thus by applying the few essential rules of light-wave measurement, one can be sure of the ten-thousandth inch and easily measure in hundred-thousandths. The result is better work and more economical tools.

* * *

A three-ton motor truck has completed the trip from Los Angeles to New York—3450 miles—in 13½ days, making an average of 260 miles a day. Motor-truck enthusiasts see in this record an indication of the value of the motor truck for long-distance hauls, but it is entirely out of the question for the motor truck under normal conditions to compete with the railways for long-haul business. For short-haul traffic the motor truck is the most economical freight vehicle, but the limit of its successful competition with the railroad may be placed at about 100 miles. When motor trucks can successfully compete with railroads over longer distances than this, it is an indication that the railroad service has broken down.

CHART FOR DETERMINING FIT ALLOWANCES

By J. B. CONWAY

The accompanying chart was evolved to facilitate the establishment of limits and tolerances for various classes of fits. It is based upon the formulas given on page 880 of MACHINERY'S HANDBOOK. The chart presents an interesting comparison with the tables given on the same page, as the values established by the formulas vary somewhat from those tabulated. From this comparison it would seem that the tabulated values are, as a whole, more convenient to work to than some of the closer limits obtained by means of the chart. However, any reference table of this nature is always subject to modification, depending upon the nature of the work and mating parts, and the degree of accuracy and refinement desired. In some instances, where closer limits are required than those given in the tables, the chart will supplement them directly, interpolation being unnecessary.

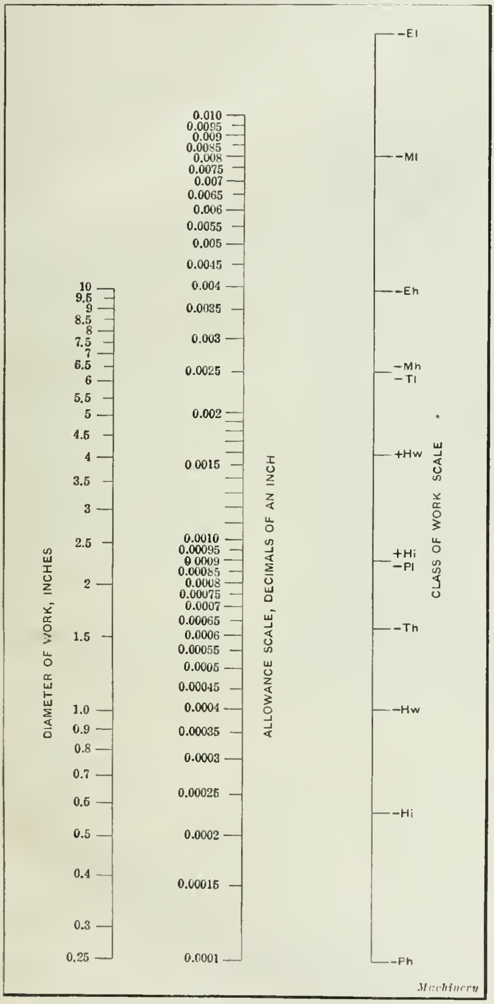


Chart for determining the Tolerances and Limits to be allowed for Various Classes of Fits

Reference to the chart will show that it consists of three graduated scales. The left-hand scale is graduated to represent diameters of parts or holes on which fit allowances are to be established; the middle scale gives the fit allowances to be provided; and the scale at the right of the chart is graduated to indicate the class of work. The method of using the chart is to place a straightedge so that it will extend from the graduation on the diameter scale corresponding to the diameter of the work or hole, to the graduations on the limit scale representing the high and low limits for the class of fit desired. The allowances for each limit can then be read directly on the middle scale. The capital letter in each symbol and letters "i" and "w" represent the class of fit; thus Hi represents fit for inspection plug gages, standard holes; Hw, fit for working plug gages, standard holes; P, shafting push fit; E, engine and ordinary shafting fit; M, shafting fits for high speeds and good machine work; T, fit for fine tool work. The letter "h" after any capital letter indicates the high limit and the letter "l" the low limit. Wherever the plus sign is placed before the symbol it indicates that the allowance is to be added to the nominal size of the part or hole, while the minus sign indicates that it is to be deducted.

The following example will illustrate the method of using the chart: Assume that a standard 2-inch hole is to be fitted with a shaft, the class of work requiring an "E" fit as established from the chart. The high-limit allowance is found by first laying the straightedge so that it extends from the graduation on the diameter scale marked 2 inches to the graduation on the limit scale marked — Eh, and then reading the dimension nearest the intersection on the allowance scale, which in this case will be found to be 0.0017 inch. The low-limit allowance is next found by shifting the right-hand end of the straightedge to — El, and then reading the dimension at the intersection on the allowance scale as before. The low-limit allowance will be found to be 0.0035 inch. The tolerance allowed on the shaft will be the difference between the two limits or 0.0018 inch. As minus signs are placed before the symbols of both the high and low limits, it is obvious that the allowances must be deducted from the nominal diameter of the hole to find the limits on the diameter of the shaft. Thus 2 — 0.0017 = 1.9983 inches, the largest permissible diameter of the shaft and 2 — 0.0035 = 1.9965 inches, the smallest permissible diameter. The initial clearance between the shaft and the hole is, of course, 0.0017 inch, provided the hole is exactly 2 inches in diameter. The high- and low-limit dimensions must always be changed when the tolerance allowed on the hole permits it to be smaller in diameter than the nominal size if the tolerance on the part obtained by means of the chart is to be maintained.

The symbols employed to represent the classes of fits are readily remembered, and if the classes of fits are specified on the drawings, these symbols may be utilized for that purpose. As previously stated, the graduations on the limit scale marked Hi and Hw respectively, indicate limits for inspection and working plug gages used for measuring standard holes. However, these fits can also be provided on other classes of work. The construction of the chart is somewhat unusual, as corresponding graduation spaces on the diameter and allowance scales are equal in length. For example, the space between the 1.5- and 2-inch graduations on the diameter scale is the same length as the space between the 0.0015- and 0.002-inch graduations on the allowance scale. A little study of the chart will show it to be a handy reference for draftsmen, as well as for shop men who often must rely on the cut-and-try method before a satisfactory tolerance is obtained.

* * *

The Federal Trade Commission has sent out questionnaires in order to determine the attitude of manufacturers in the iron and steel trade with regard to guarantees against price decline. About 250 replies have been received favoring the practice and about 150 opposing it. The Federal Trade Commission will hold a hearing on this subject in Washington, October 5.

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TRAINING VERSUS INSPECTION

Careful training of operators in the mechanical industries, instead of elaborate means of inspection, is one of the great needs of modern industry, in the opinion of Henry M. Leland, whose high standing and long experience in the automobile field give weight to his utterances. The waste due to lack of such training is appalling and counts heavily in the cost of production. It is the exception for men to be carefully instructed in regard to their work. They are left very much to their own resources, which may be meager enough. Great reliance is placed upon the inspection department, where the inaccuracies due to incapable, untrained workmanship are discovered, when they might have been largely prevented. With careful training of machine operators, the work of the inspection department could be materially reduced, in the opinion of Mr. Leland. There would be less spoiled work and fewer parts requiring remachining—all resulting in large savings in costs of production.

Inspection service will always be necessary in our highly organized industries, but the statement that inspection departments in modern factories are much larger than necessary, while preliminary training of the workers is neglected, comes with great force from a man of Mr. Leland's life-long practical experience in mechanical work. A little more attention paid to training would save a great many dollars now wasted, and, besides reducing the cost of the finished product, would improve its quality. Incidentally, it would reduce labor turnover, for the trained, responsible operator is worth more than the other kind, can earn more, and has greater respect for his job.

* * *

POTENTIAL AND COMMERCIAL VALUES OF NEW DEVELOPMENTS

Occasionally MACHINERY is asked for an opinion regarding the value of an invention or a new design of machine or tool. Perhaps an inventor has succeeded in originating some mechanical device that performs certain work satisfactorily; the question then arises: How much is it worth?

This question brings up the point often disregarded—that there is a vast difference between the *potential* and *commercial* values of mechanical developments, which is also true of commercial products in general. The organization back of a new type of tool or machine is such an essential factor that predictions regarding possible values are worthless unless the organization is considered. Well-planned selling campaigns often make a relatively inferior product of greater commercial value than a superior product lacking the support of a good selling organization.

Many inventors are so intent upon "making the thing work" that they give little or no thought to the commercial side of the inventing business, which is often as important as the actual development of the device itself. A machine may be very effective and have great potential value, but converting this value into cash is, after all, the most important and usually the most difficult part of the task.

After developing any mechanical device, it is necessary to consider, first, the cost of manufacture, which must not be out of proportion to the value of the machine as a producer. Many machines perform the work as the designer intended, but the real test comes when the prospective user compares the purchase price with the cash value of the output of the machine.

Besides this essential point, there is another matter of vital importance that inventors frequently overlook. A product, even though of great potential value to some large industry, has practically no commercial value until the possible users know of its existence. While this fact is obvious, it is evidently one of those simple axioms that are easily ignored. Then, too, when attempting to introduce a new machine or other device, it is necessary to overcome what has been called "human inertia," or that natural inclination to cling to the old in preference to the new, especially in the case of some mechanical development embodying a new principle. Here is where advertising and merchandising plans frequently increase the commercial value of a product out of all proportion to their cost. The man whose training has been entirely along technical lines, and especially inventors, often fail to realize that an invention—even though of exceptional merit—may not travel far on the road leading to commercial success unless it is impelled by good business methods, good advertising, and a resourceful sales force.

* * *

INTENSIVE USE OF FREIGHT CARS

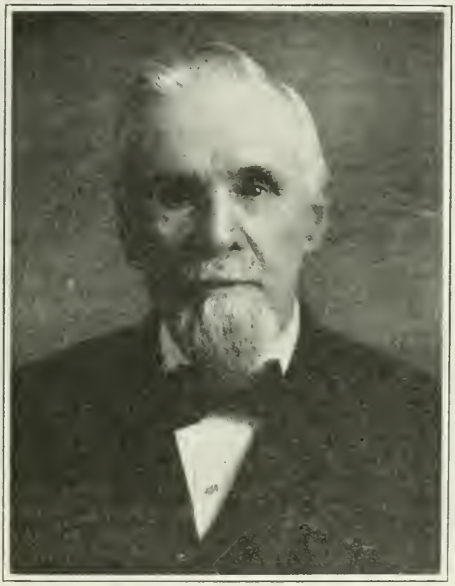
Statistics show that the railroads in the United States require an annual replenishment of 100,000 freight cars and 2500 locomotives, but during the past two years hardly 100,000 freight cars and less than 2000 locomotives were built, leaving a deficit of over 100,000 cars and 3000 locomotives for that period alone. This handicap of the railroads was seriously increased by the switchmen's strike in April, which made it impossible to load and unload cars with anything like normal dispatch.

An appeal is now made to shippers to cooperate with the railroads in assisting them to handle the large volume of freight that must be moved with inadequate facilities. It is pointed out that one of the most important ways in which this can be accomplished is by the speedier loading and unloading of freight cars, so that they may be kept constantly in service. For many years shippers, apparently, have not found demurrage charges sufficiently heavy to warrant making any special effort to avoid incurring them; but until such time as the railroads are able to replenish their rolling stock, promptness in loading and unloading cars is a vital consideration and demanded in the public interest. Failure to cooperate may result in regulations which the shipper will find more difficult than the voluntary effort to empty the cars quickly and keep them working. It is to be expected that the railroads will continue to make use of the economies in handling freight introduced during the war period and develop further economies along similar lines.

Amos Whitney—An Industrial Pioneer

AMOS WHITNEY, one of the founders of the Pratt & Whitney Co., Hartford, Conn., and long prominent as a manufacturer both in the machine tool field and in other lines, died at the Poland Spring House, Poland Springs. Maine, August 5, after an illness which lasted about four weeks. He was in his eighty-eighth year.

Amos Whitney was born in Biddeford, Maine, October 8, 1832. His early education was acquired in the common schools of Saccarappa, Maine, and Exeter, N. H. When he was fourteen years old, his parents moved to Lawrence, Mass., where he was apprenticed to the Essex Machine Co. During his apprenticeship period of three years, he worked on machinists' tools and locomotives, and after completing his apprenticeship, he stayed with the Essex Machine Co. another year as a journeyman. working on cotton machinery. In 1850 he went from Lawrence to Hartford, Conn., and worked in Colt's pistol factory, where his father was also employed, this factory at that time being generally known as Colt's Armory.



In 1852, Francis A. Pratt, later of the Pratt & Whitney Co., came to Hartford and entered the employ of Colonel Colt in his pistol factory. It was at this time that Amos Whitney and Francis Pratt first became acquainted, and when in 1854 Mr. Pratt became superintendent of the shop of George L. Lincoln & Co., afterward known as the Phoenix Iron Works, Mr. Whitney went with him. The two young men were closely associated, one as superintendent and the other as contractor, and remained with the Phoenix Iron Works until 1864; but in the meantime—in 1860—they rented a room on Potter St. and began doing some work on their own account, manufacturing a little machine known as a "spooler" for the Willimantic Linen Co., who owned a patent on this device for winding thread—the Conant patent. This was the beginning of the well-known Pratt & Whitney Co. of today. Both partners retained their positions with the Phoenix Iron Works and worked nights in their own shop. Shortly after their start, their shop was burned out, but a month later they were settled again for business in another location in Hartford. In 1863, they took into partnership Monroe Stannard of New Britain, Conn., each of the three partners contributing $1200. The association then formed remained unbroken until 1900. Mr. Stannard at first assumed charge of the shop, but the business so increased that in 1864 both Mr. Whitney and Mr. Pratt were obliged to give up their positions with the Phoenix Iron Works and devote their whole time to their own business. Incidentally it may be mentioned that it was about this time that Mr. Pratt designed the well-known type of milling machine known as the Lincoln miller.

In 1865 the partners erected their first building on the present site of the Pratt & Whitney Co., and from that time on the life of Mr. Whitney was identified with that of the Pratt & Whitney Co. until the business was sold to the Niles-Bement-Pond Co. in 1901. One of the chief products of the early firm was the Lincoln milling machine designed by Mr. Pratt. About 10,000 of these machines have been made and distributed by the company to all parts of the world Beginning with the manufacture of a few machine tools, gun tools, and tools for the making of sewing machines, the Pratt & Whitney Co. gradually extended its lines until it built a great many types of standard and special machine tools. The invention of the typewriter and bicycle materially increased the demand for special machinery and tools, and Mr. Whitney was active in the direction of the company's affairs during the great period of expansion that followed the development of these new industries. Up to the spring of 1898 Mr. Whitney was superintendent of the works, and after 1893 vice-president. In March, 1898, he became president. From the organization of the firm in 1860 until 1893 Mr. Whitney never had more than three or four days vacation in the course of any one year, and he always, up to 1901, when he ceased to take an active part in the management of the business, except as a director, kept in close touch with his men.

In addition to his position as superintendent. Mr. Whitney was also the principal salesman of the plant, and his ability to sell machinery and tools was no less remarkable than his ability to keep in contact with the work in the shop while absent. On his return from business trips varying from two to eight weeks, he seemed to know just how the work in the shop had progressed, and could take up the broken thread as if he had been continuously in the shop. For a period of thirty years he traveled about one-third of the time, visiting large and small factories throughout the principal manufacturing districts in the United States. His acquaintance was very large among owners of shops, superintendents, and foremen, and he enjoyed an enviable reputation for good judgment and reliability. He was often called upon to give advice with regard to machinery for increasing production and reducing costs, and many of the orders that he filled proved of the greatest benefit to his customers. In some instances he was given a free hand to go ahead and build the needed machinery for a plant on his own responsibility. Work of this kind naturally led to the building of a great variety of machinery, much of which was of a special nature.

Mr. Whitney's policy in regard to visiting mechanics was a liberal one. Those who desired the privilege of going through the shop were rarely refused. In fact, he often gave his own time to showing them around and explaining the machinery and methods of manufacture Needless to say, this was advertising of a most valuable kind, for in later years some of these men came to occupy positions of responsibility, and the methods that they had seen used in the manufacture of the Pratt & Whitney Co.'s machines often induced them to purchase from that concern.

In 1896 the Whitney Mfg. Co. of Hartford, Conn., was organized by Clarence E. Whitney, a son of Amos Whitney, Charles S. Whiting, and Arthur L. Shipman. In 1901 the controlling interest in this firm was acquired by Amos Whitney and Clarence E. Whitney. The former has been a director of this company since 1900 and secretary and treasurer since 1902. He was also a director of the Pratt & Whitney Co., and of the Hartford Faience Co., and president of the Gray Telephone Pay Station Co.

Mr. Whitney married, in 1856, Miss Laura Johnson of Hartford, Conn. They had two daughters, Nellie Hortense, who died in childhood, and Nettie Louise, who survives him, and one son, Clarence Edgar, who is now president of the Whitney Mfg. Co. Amos Whitney and his wife celebrated the fiftieth anniversary of their wedding in 1906, at which time more than one thousand people attended the reception given by them at their residence.

In spite of his advanced age, Mr. Whitney continued to fill an active and important place in the industrial life of Hartford until his death. He was always an indefatigable worker, and he ascribed his unusual vigor for his age to this fact. Throughout all the years of his business life he kept in close touch with his men, and they all felt a strong allegiance to him. He was always straightforward in his dealings with them, and as one of his old men said, "whatever he promised he would do." He was easily foremost among the representative self-made men of Hartford, and the city owes much of its material prosperity directly to his efforts.

* * *

COOPERATIVE MECHANICAL HIGH-SCHOOL COURSE

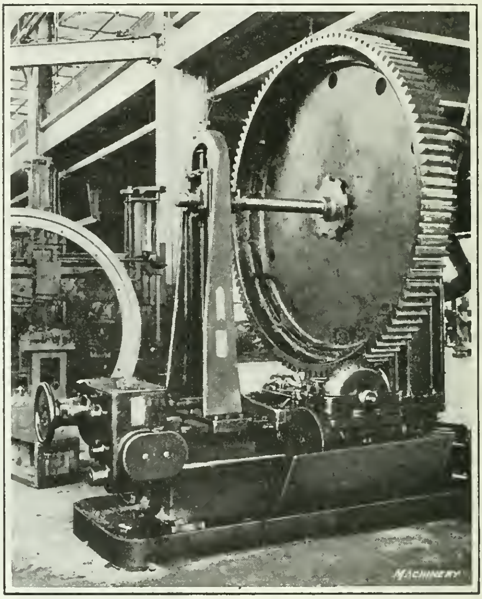
Cooperative high-school courses have been in operation in Springfield, Vt., for several years, the high schools cooperating with the local manufacturing companies. A total of forty-four boys are now taking this course, working part of the time in the shops and part of the time in the high school. The course alternates with two weeks of practical work and two weeks of school work, and in addition the boy works full time in the shop during the school vacations, except that he is allowed a vacation of two weeks. The present rates of pay in the shops are 20 cents per hour for the first year, 25 cents for the second year, and 32 cents for the third year, in addition to a special bonus which is paid to the students upon graduation. For those beginning the course this summer, this bonus will amount to $180. Altogether, in the three years' duration of the course, the boy will earn about $1400.

The shop work includes complete instruction and training in all the ordinary shop departments, and the school work instruction in drawing, mathematics, the theoretical side of shop practice, physics, chemistry, theoretical mechanics, etc. Instruction is also given in English and history. Students are accepted from localities other than Springfield, and a number of boys come to the school from the most distant parts of the state, and even from other states. The graduates are accepted without examination and with full standing in the engineering courses given by the University of Vermont, the University of Cincinnati, the Worcester Polytechnic Institute, the Norwich University, and the Northeastern College of Boston. John M. Pierce, director of the cooperative work in the Springfield high school, in reviewing this work in *The Vocational Summary* states that there has been a remarkable spirit of cooperation between the managements ot the different plants and the school authorities, and that foremen and superintendents have been lending active assistance toward the success of the plan.

To enter the course, the same requirements are made as for entrance in the regular high-school course, and the course provides an opportunity for boys with limited means to obtain the equivalent of a high-school education.

CUTTING THE TEETH IN A LARGE GEAR

The accompanying illustration shows an old-style Gould & Eberhardt gear-cutting machine engaged in cutting the teeth in a large lathe faceplate gear at the Putnam Machine Works, Fitchburg, Mass. This operation is of interest from the fact that the job requires the machine to be set at very nearly its maximum capacity and that the work is performed with excellent results, both regarding quality and rapidity. The gears are cast from steel having the following analysis: Carbon, 0.25 to 0.35 per cent; manganese, 0.60 to 0.80 per cent; silicon, 0.15 to 0.30 per cent; phosphorus and sulphur, not over 0.05 per cent. These steel blanks are annealed and the teeth are then cut with a roughing and a finishing cutter. The teeth are of the 20-degree involute form, and the gear is of 88-inch pitch diameter, and has 110 teeth of 1¼ inches diametral pitch. The face of the gear is 7½ inches, and the time required to rough- and finish-cut the teeth is twenty-six hours, which is considered a satisfactory production rate.



Gould & Eberhardt Old-style Gear-cutting Machine engaged in cutting Teeth in Large Gear

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STEEL TREATERS' SOCIETY CONVENTION

The American Steel Treaters' Society and the Steel Treating Research Society who will hold their annual joint convention in Philadelphia, September 14 to 18, at the Commercial Museum, 34th and Spruce Sts., have arranged for an extensive program and for the reading of a great many papers of importance in the steel-treating field. In addition to the convention program, a very extensive exhibition will be held. The exhibition will open Tuesday, September 14 at 9 A. M. and will be kept open during Tuesday and Wednesday, September 14 and 15, until 10:30 P. M., while on Thursday and Friday, September 16 and 17, it will close at 5 P. M. Saturday, September 18, the exhibition will be open from 9 A. M. to 6 P. M. Over 80,000 square feet of floor space will be used to display heat-treating appliances and heat-treating products, and over 125 firms will exhibit. The exhibitors will represent the leaders in their line and include firms of national reputation. On Friday, September 17, there will be no sessions, but instead a number of plants in Philadelphia and vicinity will be visited.

The German Machine Tool Industry

From MACHINERY'S Special Correspondent

Berlin, August 6, 1920

THE past year has been a difficult one in the German metal-working industries. Repeatedly there has been evidence of improvement in the industrial and economic situation and then unexpected events have scattered the hopes. It has been a time of uncertainty and of internal political disturbances, and much time has been lost in the rehabilitation of the industries by endless and aimless discussion. The result of it all has been that at the end of 1919 the situation seemed to grow more and more difficult. In spite of all these difficulties, the Association of German Machine Tool Builders prepared for two exhibitions of machine tools, one of which has already been held at Leipzig, demonstrating that the machine tool industry in Germany is still active.

Increase in Manufacturing Costs

The three items, wages, cost of raw materials, and overhead expenses have increased to a considerable degree during the past year, and the prices of machine tools have been increased in proportion. Labor unrest, with numberless strikes, has harassed the machine tool industry. In the beginning of 1919 the manufacturing costs had advanced to three times those in peace time, but at the end of 1919 the manufacturing costs were from eight to nine times what they were previous to the war. Hence, during 1919, both costs and selling prices increased about three times, or 300 per cent. Many firms suffered heavy losses on account of the rapid changes in business conditions. The home market was not active, as buyers were of the opinion that the high prices could not be kept up perpetually, and recognized that an investment in machine tools at eight or nine times the peace-time price would be a dangerous experiment. Hence, business has steadily decreased in spite of the fact that a demand for machine tools would exist provided the price were more nearly normal.

The Foreign Trade in Machine Tools

Early in 1919 the Board of the Association of German Machine Tool Builders suspended the price control rule which had governed the foreign trade of the members, it being the opinion that this was necessary in order to meet the competition of America and England. By giving the German trade a free hand in this way, it was believed that the interest of the members of the association would be served in the best manner. The sale of machine tools abroad assumed huge proportions, but the price obtained in foreign currency was only a fraction of the price obtained for machine tools manufactured in other countries, due to the depreciation of the German mark. This led to a new control ot export prices, which took effect on October 7, 1919. From that time on, reasonable selling prices in the foreign trade have been maintained. The large exports in 1919 are considered in Germany as a life-saver for the German machine tool industry, as this export trade compensated for the decreasing home demand.

These conditions no longer exist in the present year. The output of the German machine tool industries since 1914 has increased considerably, and while there is a great demand for machine tools in all parts of the world, American competition is beginning to be felt and German machine tool builders must be able to decrease their costs, which can only be done by reductions in the costs of raw materials and wages. It has been pointed out that in order for Germany to hold its own in competition with England and America, the claims of labor in Germany must be modified, that the German selling organizations of the past must again be built up to at least equal those of America and England, and that manufacturers in Germany must learn once more to be content with the profit which they formerly considered sufficient.

The export of twist drills and other metal-working tools, as well as of precision measuring instruments, assumed large proportions during the past year. At present the export prices on metal saws, chucks, and grinding wheels are controlled, and the prices of other accessories and tools will be controlled at an early date.

Association of German Machine Tool Builders

The Association of German Machine Tool Builders has been active in organizing the whole German machine tool and accessories industry. The industry has been divided into a number of groups, each group being the complete master of its own interests and having complete control of the studies of the home and foreign markets, by which it is proposed to prepare for the severe times which the industry must pass through. In numerous cases conferences between manufacturers making competitive lines have led to a friendly understanding as regards both methods of manufacture and selling policies for certain classes of machines. This cooperation is one of the most valuable results of the work of the association during 1919. The number of members of the machine tool builders' association and the associated industries are as follows: Association of German Machine Tool Builders, 363; Association of German Precision Tool Builders, 108; Association of German Woodworking Machinery Builders, 75; Association of German Manufacturers of Grinding Wheels, 34; Association of German Manufacturers of Twist Drills, 20; and of the Society for Research, 73.

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CHARLES PARSONS AWARDED FRANKLIN MEDAL

The Franklin Institute this year awarded the Franklin medal to Sir Charles Parsons, "in recognition of his epoch-making success in the development and construction of the steam turbine, which has revolutionized the art of steam engineering, particularly in regard to the propulsion of mercantile and naval vessels, and the driving of electrical generators." Like that of all pioneers, his path was at first one of difficulties and discouragements. For years it was impossible to make engineers in general accept the steam turbine seriously, and Mr. Parsons separated from his original partners because they became too discouraged to proceed further with the development work. Mr. Parsons, however, did not become discouraged, but overcame each mechanical and commercial difficulty as it arose, and established certain principles of design which are now followed and accepted wherever steam turbines are built. *Engineering*, of London, says that there is no exaggeration in the statement that the work of Sir Charles Parsons has cut in half the cost of producing electric power and reduced in still greater proportion the original cost of power generating machinery. The problem solved was one of unusual difficulty, since the steam turbine is essentially a machine which must be built in big units in order to show its full efficiency, and is at a disadvantage when built in small sizes. Yet, until Mr. Parsons made good with the smaller sizes, there was, of course, no demand for larger units; hence he was forced to make a success of the design of the machine even in its most disadvantageous form.

Why the Westinghouse Company Does Not Use the Metric System

In view of the discussion on the metric system that has been caused by the activities of the advocates of laws making the system compulsory in the United States, the present article, prepared by the Westinghouse Electric & Mfg. Co., stating the company's position in regard to the metric system will prove of interest and value. This opinion from one of the largest manufacturing concerns in the United States enumerates briefly the company's chief objections to the metric system.

IT is sometimes difficult to explain the obvious, all the more so when reasons for the explanation appear unnecessary as well as approaching monotonous repetition. This is doubly true of the case against the adoption of the metric system, whose use, pro and con, has been expounded in all sections of the United States since the early part of the nineteenth century. At first, suggestions were quietly put forth regarding its supposedly simple characteristics. During the last few years, propaganda urging its general adoption has grown more aggressive, until now the mails are filled with metric literature. Bills have even been introduced in Congress whose passage would have meant that the use of any system of weights and measures other than the metric system would have been illegal.

In spite of all this urging there appears to be no general demand for the adoption of the metric system in this country. The manufacturing plants that are using it are few in number, while the great mass of people who are responsible alone for a system of weights and measures are scarcely aware of its existence. This cannot be attributed to ignorance, for it is taught in all public schools, and the statutes of the country legalized its use many years ago. If it has so many desired characteristics it would seem to the layman that the process of simplifying weights and measures was very slow.

One of the reasons most commonly urged for the adoption of metric units is that it would greatly aid foreign trade. That would appear to be inviting the mountain to go to Mahomet, for the greater number of manufacturing plants are located in English-speaking countries, where naturally the people use only the British system of weights and measures. Factories located in the United States, for instance, sell all but a small percentage of their goods in this country. It would appear, then, that to sell a few articles to metric countries, a certain class would make one hundred million people climb out of their accustomed channels to learn a puzzling unfamiliar language. Nor is this necessary, for the Westinghouse Electric & Mfg. Co. does a great deal of business with countries using the metric system without difficulty or embarrassment.

From stories sent out it would seem that all foreign countries with the exception of Great Britain were metric. This is not true. In Latin America, some countries use a system of English extraction but with Spanish terms; some use metric and Spanish; others use metric alone, but they are all familiar with the English system.

No one doubts for a moment the tremendous difficulties that would be involved in making this country over into a metric speaking and thinking people. These difficulties would multiply daily until nothing less than chaos would result. First, the greatest number of people in the country would have to learn the metric tables. Then they would have to translate metric terms into English before a ratio of values could be obtained. This, in daily life, where thousands of small transactions are carried on would be difficult.

This is a period when production is needed, there being shortage of manufactured materials throughout the country. Is there any reason for urging the adoption of the metric system at this time when it is certain that, were it suddenly introduced in the factory, production undoubtedly would be held up until the workmen familiarized themselves with the new units? The very fact that English measurements can be halved and quartered without introducing complicating fractions makes it more advantageous in shop work than the metric measurements.

A case in which metric measurements complicate shop work has been recently acknowledged by an official of one of the largest tire companies in the world. His company recently adopted the metric system, and it is now partially used in all except the most recent factory, which is all metric. His words regarding the advantages of the system are interesting, particularly in regard to its use in the storekeeping and shipping departments. In the former, raw materials received in English units must be transferred into metric units by production clerks before going to the workmen. Upon completion, the metric article must again be converted into the English units, in order to mark shipping weights. There are some departments of that company which are still using the English system—more translation. This condition, the writer says will last until the United States adopts the metric system. Judging from past experience there will be a long wait.

The Westinghouse Electric & Mfg. Co. has no desire to install a metric translation department pending the adoption of the French system in America. It is a complex organization, highly detailed, and a delay in any point of production, is felt in every department. Thousands of delicate, high-priced instruments are in daily use which the company has no desire to scrap for metric tools. There are also many tables computed in the English system which would have to be made over and in addition it would be necessary to have a table of equivalents, practically tripling the labor used in making up tables, as well as doubling their size. This paves the way for errors. This company, too, has little desire to install a school to teach its thousands of workmen the metric system. The work entailed in this one item alone would be enormous, even if it were certain that employes could pick up the system rapidly.

These are, briefly, some of the reasons why the Westinghouse Electric & Mfg. Co. is opposing the introduction of the metric system in America. Its advantages have yet to be proved in every way, except theoretically, and its practicability in the United States is uncertain.

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BRITISH ENGINEERING STANDARDS ASSOCIATION

The British Engineering Standards Association held its second annual meeting in London July 15. This association is rendering a valuable service in coordinating standards, promoting efficiency, and eliminating waste. The association has been at work for nearly twenty years, and has now thirty committees with over 1400 members who give their time and experience, often at great personal expense and inconvenience, to this standardization work. At the present time the association is working on standards for copper alloys, steel wire ropes, milling cutters and reamers, and many other classes of products outside of the metal-working field.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, August 12

THE machine tool industry in Great Britain is rapidly reaching more normal conditions, although this does not mean normal as judged by the old standards. After the remarkable demand of the last few years, the importance of any falling off in inquiries and orders is apt to be exaggerated. Many users and dealers still complain of the shortage of really high-class machine tools, and the complaints go further, the statement being made that some of the imported machine tools that rightly gained a reputation for accuracy in the years before the war now often show unreliability in this respect.

Market in Used Machine Tools

Sales by auction of machine tools used in munition factories are still proceeding. In some respects, this source of supply has been a very useful feature in connection with the reconstruction work that has been going ahead in most engineering works, in so much that tools from this source represent immediate delivery—an all-important point. When these tools began to come before public notice, some of the most reputable machine tool makers and merchants realized that the large quantities to be offered opened up enormous possibilities. Consequently they bought up stocks of the tools at reasonable prices, transferred them to their own works, and subjected them to a thorough and complete overhauling, effected repairs where necessary, and finally offered them as rebuilt machine tools in first-class working order at competitive prices.

General Situation in Machine Tool Industry

Several large districts report a distinct lull in the inquiries for new machines, and there is no doubt that high prices have recently been a contributory factor. The partial decontrol of coal should before long have a good effect on the machine tool trade, since the immediate result of decontrol has been the placing of important contracts for the extension of mine properties adjacent to the large machine tool centers. Another factor is that the disorganization in the casting supply due to the great strike is gradually being rectified: in fact, some firms in the Birmingham and Coventry districts have reached the stage of being able to quote immediate delivery of castings.

The most striking feature in the industry is to be noted in the large number of machine tool firms who are reducing the number of models made, concentration on a minimum of varieties being substituted for the pre-war tendency on the part of many firms to undertake any type of tool for which an inquiry was received. This change will be exemplified at the forthcoming Machine Tool and Engineering Exhibition to be held at Olympia, London in September, for which the majority of firms are developing new machines that will then be seen for the first time.

In the engineering establishments on the Clyde, business, especially in shipbuilding, remains good, although here too the falling off in demand for machine tools is seen, the heavy tool trade being most affected in this district. International and colonial trade shows no such wavering; exports of machine tools are continuing to rise, and for the month of May a value of over £280,000 was sent out of the country. Colonial requirements of small tools, particularly in Australia and India, are growing to large proportions. Imports into Great Britain show a falling tendency; this condition has been expected. At the same time Switzerland has been recently sending over some very highly developed machine tools among which are some automatic thread-chasing lathes of the precision class. Sweden also is endeavoring to get a good footing here, but with tools of the heavier type. Small Austrian 12-inch lathes have also made their appearance.

In the letter relating to the British machine tool industry in the May number of MACHINERY, page 890, a statement was made relating to the increased trade in machine tools for which Sweden is laying the foundation in the English market through its selling organization—the Swedish Machine Tool Makers Export Co., Ltd. Unfortunately this statement was made in the same paragraph that referred to a definition of the term "dumping" as related to the importation of goods. The fact that these two statements appeared in the same paragraph might give the impression that the Swedish export company referred to is dumping machines on the British market. This impression should be corrected; it was not intended to convey this meaning, as it is not in accordance with the facts. The Swedish Machine Tool Makers Export Co. is not competing in the cheaper machine tool market, but handles machines of a class and at a price competing on an even basis in the best British machine tool market.

Labor Conditions

Labor leaders here have for some time realized the peril of forcing up wages far beyond an economic figure, and there is now some evidence that they have succeeded in making this fact appreciated by the rank and file. In some engineering industries, works have been shut down, although not in the machine tool trade. New claims for large increases in wages in the shipbuilding and engineering trades have recently been before the Industrial Court. At the same time manufacturers are insisting that unless means can be found of arresting the increasing cost of production, widespread unemployment is inevitable. Payment by results is already in force in many iron foundries, and the Midlands show some excellent examples of its effects.

The wrought-iron industry in England has been considerably hampered during the last few years through lack of men, particularly puddlers. Staffordshire is the principal seat of the wrought-iron industry, there being from 600 to 700 puddling furnaces in the district, all operated by hand. These furnaces have a total capacity of over half a million tons of puddled bars per year, and in the past used to employ 10,000 men; but even before the war there was the difficulty of obtaining the required number of men. When the war began, this shortage was accentuated by the rush of men to the colors. Experiments in mechanical puddling have never been viewed with much favor in England, and the results achieved have been unable to overcome the prejudice against it. It has become necessary, however, during the past year, to experiment with a new system of mechanical puddling in order to overcome the condition existing through lack of experienced puddlers. As England has furnished the world with its principal supply of high-grade wrought iron, any curtailment of this industry would be serious, both from the British point of view and from that of other nations who have obtained the wrought iron now used mainly from British or Swedish sources.

On the outbreak of the war, the British Government hurriedly bought up the whole available supply of Swedish iron in Sweden and shipped it to England to prevent its falling into the hands of the enemy. The large stocks then formed are now being broken up, and in the present scarcity this iron has proved a valuable source of auxiliary supply to the Sheffield steel makers. Castings are still in very strong demand in most districts, and manufacturers who do not operate their own foundries are still buying without counting the cost; consequently prices are very irregular.

A recent report by the Ministry of Labor on profit-sharing schemes does not show the various experiments that have been made in a favorable light. The average life of these experiments seems to be about fourteen years, abandonment frequently being caused by the inability of the firm to earn regularly the necessary profits required to make profit-sharing a success.

New Developments in the Industries

From all quarters news comes of extensive developments in all branches of the machine and small tool industries. Nearly all firms of importance are increasing their capacity, and many new companies have been formed. In Birmingham a new tool steel is being developed which it is intended shall fill the wide gap between carbon and high-speed steels. It can be used up to a temperature of from 1100 to 1300 degrees F., and the steel can be produced to sell at about 50 per cent above carbon steel and 30 per cent below tungsten steel. It is also suitable for ball races. In the Glasgow district new foundries are being erected. J. Rhodes & Sons, the large makers of power presses in the Wakefield district, have increased their ground space by twelve acres, on which a new works for the manufacture of power presses and similar tools will be erected. They also have in hand worldwide orders for press plants for the manufacture of paint drums and petroleum cans. In Coventry, Alfred Herbert, Ltd., is adding ten 30 by 200 feet bays to their Edgwick works; these will be devoted to the increasing manufacture of large combination turret lathes.

At the present time it is computed that only three and one-half million is being used out of a possible sixty million horsepower available from water power in the British Empire. W. G. Armstrong Whitworth & Co., Ltd., are now undertaking the manufacture of water turbines at Glasgow, in anticipation of a larger use of this natural power.

New Machine Tools

It is not possible to indicate many details of the numerous new designs of machine tools that are undergoing development, as in most cases the forthcoming Olympic exhibition is the goal for which these are being prepared. Many new machines have appeared within the last few weeks, however, and a few of the more important can be mentioned. One of these uses an entirely novel method of screw production, in that the screw thread is generated by a rotating cutter whose axis is substantially at right angles to that of the rotating work. Striking claims are made for the output capacity of the machine, but it is not yet possible to give further details. A number of heavy-duty railway wheel lathes have just been completed by Loudon Bros., Ltd., Johnstone, Glasgow. On test, one of these machines turned a pair of 5-foot brake hardened driving wheels in thirty-six minutes. A new automatic power sheet press has been completed by J. Rhodes & Sons, Wakefield. The press is capable of making up to 100 stampings per minute, and a good saving of material is effected, since it can be set to stamp in staggered positions, thus cutting down waste to an absolute minimum. By stamping direct from the sheet, it also saves preparatory shearing of the metal into strip form, and one operator can easily run two machines. Clifton & Waddell of Johnstone, Glasgow, has developed a horizontal disk sawing machine with a saw, 5 feet 6 inches in diameter, mounted directly on the armature shaft of the motor. The saddle carrying the motor and the saw is traversed along the bed by a small auxiliary motor. The main motor is of 40 horsepower, and the capacity of the machine is up to 24- by 7½-inch sectors. T. Atkinson, Ltd., Accrington, have a new toolroom lathe of 4¼-inch centers. An interesting feature in the manufacture is the fact that no planing is used, milling operations being substituted.

Milton, Ltd., of Streathan, London, is making a relieving attachment that is a radical departure from all existing methods. The cutting tools are carried in rocking arms, the relieving effect being obtained from a toothed wheel having the same number of teeth as the cutter to be relieved. The amount of relief is variable while the machine is running, and the work is carried out at approximately ordinary turning speed; in fact, for light finishing cuts such as are required to produce a relieved land the tool can be reciprocated 1000 times a minute. The Lumsden Machine Co., Ltd., Gateshead-on-Tyne is developing a new line of vertical surface grinders for a 60- and a 24-inch diameter wheel, while a horizontal machine is to have a 30-inch wheel.

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DELAMATER-ERICSSON MEMORIAL TABLETS

At the annual convention of the American Society of Mechanical Engineers last December, a memorial meeting was held on the evening of December 3 in commemoration of the eightieth anniversary of the arrival in the United States of Captain John Ericsson and his fifty years association with Cornelius H. DeLamater in engineering work. In advance of the meeting it had been decided to erect memorial tablets to mark the sites of certain buildings which were closely identified with the work of DeLamater and Ericsson. It was proposed to erect four tablets as follows: One at the Phoenix Foundry at Laight and West Sts., where the first screw-propelled vessel in this country was constructed and where many other original developments were made; one at Captain Ericsson's residence, 26 Beach St., where he designed the *Monitor* and made all his inventions during his later years; one at the DeLamater Iron Works at the foot of W. 13th St., where the engines of the monitors *Puritan* and *Dictator* were built, as well as the first submarine boat, the first torpedo boat, the first torpedo boat destroyer, the first self-propelled torpedo, the first air compressors, the first ice machines, and many other industrial appliances now in general use; and one at the Continental Iron Works, Greenpoint, L. I., where the hulls of the *Monitor* and other warships were built.

It is believed that there are many marine and industrial firms, organizations and individual manufacturers and engineers who, if given an opportunity, would contribute to the tablet fund, especially to commemorate the invention of the screw propeller and the building of the *Monitor*. Those interested are requested to communicate with the DeLamater-Ericsson Tablet Committee, H. F. J. Porter, chairman, Room 1100, Engineering Societies Bldg., 29 W. 39th St., New York City.

* * *

AMERICAN FOREIGN TRADE FLOATING EXPOSITION

It has been announced that the first national foreign trade floating exposition will sail from the United States for South America and the Far East in October. The vessel will contain exhibits of American manufactures, the purpose being to improve trade relations with the countries visited and reduce the expenses incident to trade promotion by each individual manufacturer. Various lines of manufactures will be represented, but only one manufacturer in each competing field will have an exhibit. The ship will stop at the various ports for a period of from five days to two weeks. Interpreters will be placed on board, and a publicity man will precede the exhibition, making proper announcements. The trip, as planned, will last eight months, and all the important Central and South American ports will be visited, in addition to New Zealand, British Straits Settlement, Australia, the Philippine Islands, China, and Japan. The exposition offices are at 50 Church St., New York City.

DIES FOR SHAPING AN AUTOMOBILE BODY PANEL

By J. BINGHAM

The construction and operation of three forming dies used in the production of metal panels which are assembled on the framework that supports the seat of an automobile are described in the following article. The first operation consists of trimming to size the rectangular piece of sheet steel from which the panel is formed, and this is done on a shearing machine. The die used in the first shaping operation on the blank is illustrated in Fig. 1, which shows the appearance of the work and the positions of the various parts at the end of the downward movement of the press ram. Prior to the downward stroke, blank-holder *A* is in a raised position, the highest surface of the steel inserted piece *B* being in the same plane as surface *X* of die-block *C*. Piece *B* is brought to this position by means of pins *D* which are actuated by a rubber buffer attachment.

In the operation of this die, the blank is placed across the die opening, one end resting on surface *X* of die-block *C*, against the locating strip *E*, and the other end resting on point *Y* of the die-block. Then as punch *F* descends on the downward stroke of the press ram, the blank is gripped between the surfaces of the punch and of blank-holder *A*, and as they descend together, the blank is formed to the shape of the punch and die parts. The panel is ejected from the die after the completion of the operation by the blank-holder as it returns to its original position by the arrangement previously described. There is no tendency for the blank to adhere to the punch on its return stroke, and so no means are provided for its removal. Blank-holder *A*, die-block *C*, and punch *F* are made of cast iron, which is a suitable material for dies of this type where the bends produced on the work have a comparatively large radius. Punch *F* is provided with two steel faces *G* and *H*, and blank-holder *A* is provided with a steel inserted piece *B* for producing the small bends at the ends of the panel. Die-holder *C* and punch *F* have large cored openings at suitable places in order to lighten their weight.

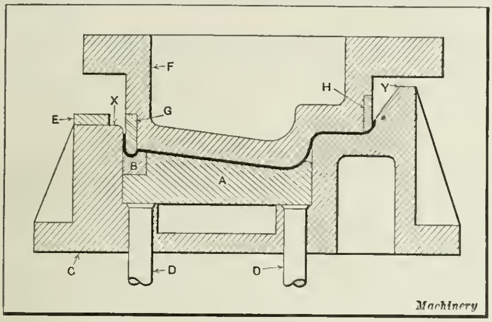

Fig. 1. Die employed for the First Forming Operation on a Rectangular Shaped Blank

The next operation on the panel is performed by the die shown in Fig. 2, and consists of bending surface *X* of the work at right angles with surface *Y*. The upper surface of blank-holder *A* is of the same contour as that of a portion of the work as it comes from the preceding operation, thus serving to locate the work properly for the operation to be performed by this die. The blank-holder is in a raised position when punch *B* is lifted from the die, and so it is possible for surface *X* to rest upon the slanting surface of die-block *C* prior to the shaping operation. The blank-holder is raised to the proper height by means of springs, which are not shown in the illustration. The work is bent to shape as punch *B* descends on the downward stroke of the press and forces the work into the die, the work being held firmly between the punch and the blank-holder while the bending action is occurring. It will be noted that punch *B* is offset, so that there is no interference between the work and the front of the press during the operation. All the illustrated parts of the die are made of cast iron.

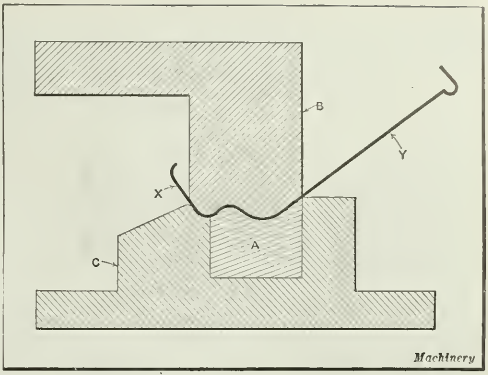

Fig. 2. Forming Die used to bend One End of the Work at Right Angles to One of its Other Surfaces

The third and final operation on the panel is performed by the die shown in Fig. 3. This consists of bending surface *X* once more, the illustration showing the appearance of the work and the position of the various moving parts at the end of the downward stroke of punch *A*. Blank-holder *B* is in a raised position prior to the downward stroke so as to permit the panel to be seated on the blank-holder with surface *X* of the work resting upon the upper surfaces of part *C* and die-block *D*. The raising of blank-holder *B* is accomplished by means of springs, which also permit it to eject the work from the die at the end of the operation. Punch *A* is offset for the same reason as the punch in the preceding operation. It is made of cast iron, but is provided with a tool-steel inserted piece *E*, because cast iron would not be sufficiently strong to sustain the stress produced in the peculiar shaped forming portion of the punch which provides clearance for the curved end of the work. The inserted die part *C* is also made of tool steel and is held to die-block *D* by machine screws. Blank-holder *B* and die-block *D* are also made of cast iron.

* * *

Due to the shortage of coal in France, oil-burning locomotives have been introduced on the French railroads. Two advantages have been gained by the use of oil: It has been found that time can be saved in getting up steam and that an engineer alone, without a fireman, is able to man a locomotive, thereby saving labor, which is one of the prime necessities in France at this time.

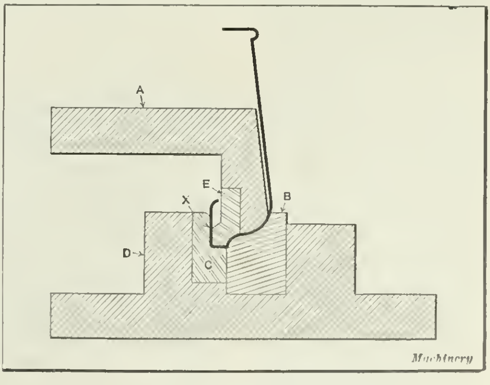

Fig. 3. Die with Offset Punch used in the Final Shaping Operation on the Automobile Body Panel

Training Future Mechanics

Methods Employed by the R. K. LeBlond Machine Tool Co., in Educating Future Mechanics in an Apprenticeship School where One Hundred and Fifty Boys Receive their Mechanical Training

By ERIK OBERG

AMERICAN machine tool manufacturers appear to be more aware than ever of the necessity of training skilled mechanics by the apprenticeship method. Conditions during the war, and perhaps even more so since the war, have made it apparent that the supply of skilled mechanics is strictly limited, and that while machine operators can easily be obtained, the all-around machinist and toolmaker is becoming more and more scarce. The only way in which this condition can be improved and the future supremacy of the machine industries insured, is by systematic and careful training of young men duly apprenticed for a specified training course.

It is recognized that the old-fashioned apprenticeship where the boy was merely taken into a shop and passed from foreman to foreman, picking up what training he could according to the ability and inclination of the foreman of each department to impart knowledge to him, no longer meets either the requirements of the industries or of the boy himself. The young men of today are not satisfied to apprentice themselves if they are not assured of a better training than can be obtained in this manner; and the American industries of the future require men better trained than would be possible if this old system of apprenticeship were used.

General Principles of LeBlond Apprenticeship School

The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, has developed an apprentice system which combines the best features of the old-time apprenticeship with the best features of the modern trade school. The boys not only receive theoretical instruction in an actual school, but they also receive their preliminary shop instruction in a special training shop conducted for this purpose alone, and are not placed in the actual shop departments until they have received such preliminary training in the operations of the machines as will insure that they will be able to handle the work without too much personal instruction from the foreman. Hence, a boy entering this apprenticeship system receives his education and training in three separate departments: The school-room, where he is given instruction in mathematics and drawing, so that he may be able to perform any ordinary shop calculations and read blueprints readily; the training shop, where he is given preliminary training in the use of all standard machine tools; and the factory, where he serves the major part of his apprenticeship and becomes thoroughly familiar with modern manufacturing methods.

For years American manufacturers have been so busy increasing plant facilities, devising more efficient means of production, and designing and building new machinery and tools, that but little attention has been given to the training of all-around mechanics, fitted to become the future mechanical executives and leaders in the machine building industries. The old-fashioned type of apprenticeship has broken down, and few manufacturers have provided anything to take its place. Recently, however, there has been a general recognition of the fact that the future supremacy of American machine industries depends upon the systematic and careful training of the men who are to become the skilled mechanics, foremen, and superintendents in our shops ten, twenty, and thirty years hence.

Selecting Boys for Apprenticeship

One of the features characterizing this well-planned apprentice school is the care taken to select the right kind of boys for training. Cincinnati being pre-eminently a machine manufacturing city, it is perhaps easier to interest a sufficient number of boys in becoming skilled mechanics than would be the case in other cities. At any rate, there is a sufficient supply of bright, intelligent, well-educated boys to draw upon to make it possible to carefully select those best fitted for the apprenticeship course. Preference is given to boys having a high-school or equivalent education, although grammar school graduates with a good school record are also accepted. The course is four years for grammar school graduates and for those who have not completed a high-school course. High-school graduates from accredited high schools serve an apprenticeship of three years only, while graduates of recognized technical schools serve two years only. This article deals only

with the apprenticeship course as far as it relates to high-school and grammar-school graduates. The boys must be between sixteen and twenty years of age when beginning the course.

Application for Apprenticeship Course, Interviews, and Examinations

The boys make application to enter the apprentice course to the regular employment manager, Carl Breeding, who interviews them and obtains as much information as possible relating to the boy by questioning him and by observation. The care exercised in selecting boys for the course is not limited to matters of education, but relates to many other conditions that have an influence upon the boy's fitness for the calling he has chosen. The application blank contains the usual information, giving the boy's name, date of interview, age, address, his father's name and occupation and where employed, the boy's previous education, and where and how long he has been at work, if previously employed elsewhere. It has been found of considerable importance to investigate the father's occupation and the general home conditions, as these have a considerable effect upon the boy's success. Generally speaking, the boys whose fathers are themselves engaged in mechanical pursuits are better satisfied and accomplish more than those who come from families in other walks of life.

An opinion of the boy's fitness for the work is also formed by observation, taking into account his general knowledge of things and his judgment. This is done by bringing up subjects in a conversational way about which the boy might be expected to be informed or upon which he could have formed a judgment. If he shows intelligence and ability of independent thought, it counts in his favor. The employment manager also tries to obtain some ideas as to his mental attitude in general and his opinion about the class of work that he will be doing in the shop. On each of the points brought up he marks him with a certain percentage and by adding these percentages together, a general grading of the boy is obtained, which gives quite an accurate estimate of his qualifications.

The interview with the employment manager does not by itself determine the boy's eligibility for the course, but he is next sent to the classroom instructor, O. Martens, who examines him in mathematics and who also, if deemed necessary, obtains his school record and rating, thereby checking up the boy's statements, and visits his home. After the boy has been approved by both the employment manager and the classroom instructor, he is admitted to the course, but is first accepted for a three months' probation period only, the same as in most apprenticeship courses.

The Training Shop for Apprentices

When reporting for work, the boy is first placed in the training shop, which is a separate department in charge of the instructor, Robert Buckton, and the assistant instructor, B. Konnerman. The first week in the training shop is devoted chiefly to teaching the use of measuring instruments, scales, micrometers, verniers, etc. The boy is also taught the names and purposes of the more common tools used in the shop, such as dogs, mandrels, reamers, drills, taps, milling cutters, standard gages, etc. Having obtained a general idea about these matters, he is given some simple machine work. It has been found that different boys show considerable difference in aptitude in the operation of different machine tools, and that some boys will do much better if they are started, say, on a milling machine, while others will do better on a lathe. By trial, the type of machine tool that the boy likes the best is determined, and he is given his first training on this type of machine. He will remain at this machine for the rest of his stay in the school shop, which varies from two to six weeks, according to the ability of the boy. From the school shop he will then be transferred to that department in the shop for which he has been trained in the school shop, so that, if he has received training on a milling machine, he will be

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The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, has developed a system of training that differs in many important features from the systems used by other manufacturers. This system combines the best features of the old-time apprenticeship with the characteristics of the modern trade school. The boys not only receive theoretical instruction in an actual school, but they are also given preliminary shop instruction in a special training shop conducted for this purpose alone, and are not placed in the actual shop departments until they have received such training in the operations of the machines of each department as will insure that they will be capable of handling the work that is given to them in a satisfactory manner, without too much personal instruction from the foreman.

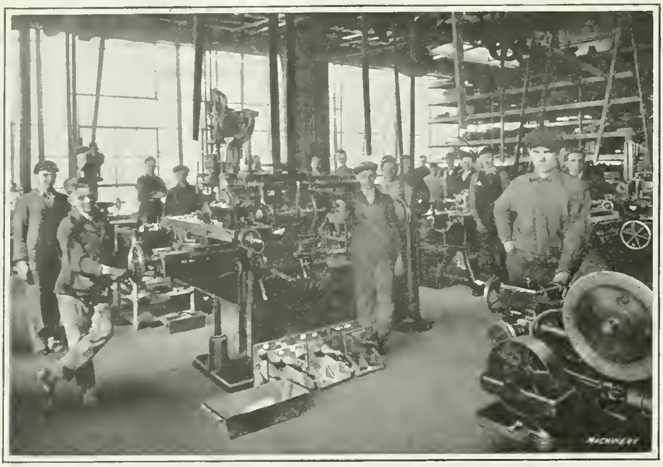


Fig. 1. Training Shop for Apprentices at the R. K. LeBlond Machine Tool Co.'s Plant

transferred to the milling department in the shop. A record of the boy's performance is kept on a blank as shown in Fig. 3.

When he has finished his training period in the milling department, he will come back to the school shop and will then receive his preliminary training on the next type of machine, after which he will be transferred to the department in the shop where that type of machine is used. The special training in the school shop for subsequent departments lasts usually only about one week, but at the time of each transfer from department to department the boy always comes back to the training shop for preliminary training before he is sent to work in the next manufacturing department.

Equipment of the Training Shop

The training shop is completely equipped with standard machine tools including three LeBlond engine lathes, one LeBlond chucking lathe, one upright Cincinnati-Bickford drilling machine, one Kern sensitive drilling machine, one LeBlond universal milling machine, one Brown & Sharpe cylindrical grinder, one Brown & Sharpe gear-cutter, one Gray planer, one Atlas arbor press, five vises, together with the necessary equipment and accessories, chucks, arbors, cutters, tools, etc. The school shop accommodates twenty apprentices at a time, and is engaged on both production and tool-room work, thereby giving the boys an accurate idea of the work in the shop departments before they are transferred to the shop.

Shop Training for Apprentices

The shop work is divided approximately as follows: One year in the lathe department, six months each in the drilling department, the milling department, the planer department, and the grinding department, gear-cutting department, or tool-room; and one year in one of the assembling departments, making four years in all.

At the end of the trial period, when the apprentice agreement is signed, the boy is provided free of charge with a tool chest and such tools as are necessary for him in his work. The title to the tool chest and the tools remains with the LeBlond Machine Tool Co. until the apprentice has completed his apprenticeship, when the tools are presented to him together with a bonus of $100 and a diploma. The set of tools provided for the boys entering on their apprenticeship, is as follows: One No. 1 ball peen hammer, one 7-inch screwdriver, one 4-inch screwdriver, one pair of 6-inch hermaphrodite calipers, one pair of 6-inch inside calipers, one pair of 10-inch outside calipers, one pair of 4-inch outside calipers, one pair of 4-inch spring dividers, one 12-inch combination square, one center-punch, one 3/16-inch pin punch, one 5/32-inch pin punch, one ⅛-inch pin punch, one 6-inch scale, one center gage, one 2-foot rule, one thickness gage, one surface gage, one India oilstone, one cold chisel, one gouge, and one tool chest. The value of the tools supplied to the apprentice exceeds $50. The boy signs for these tools and is required to be able to account for them at any time during his apprenticeship period. Other tools are added from time to time during the apprenticeship as they become necessary in the apprentice's work. In that manner, at the end of the four years, the boy will have tools worth about $100 provided by the firm, which become his property upon the completion of the apprenticeship period.

Compensation Paid Apprentices

The subject of compensation for apprentices is one of great importance. Many manufacturers have stated that it is difficult to obtain apprentices because boys can enter shops with a view to learning to operate one type of machine tools and earn so much more than ordinary apprenticeship wages, that it is difficult to induce young men to enter upon a four-year apprenticeship. The R. K. LeBlond Machine Tool Co. has found no difficulty in this respect. In the first place, the course is so planned that it is truly educational, and the boy views it in the same light as he would a technical education. In addition, he is paid a living wage, which is necessary if the best class of boys is to be attracted under present labor market conditions. Apprentices' wages may have to vary according to locality or conditions, but they must be attractive enough to obtain a good class of apprentices.

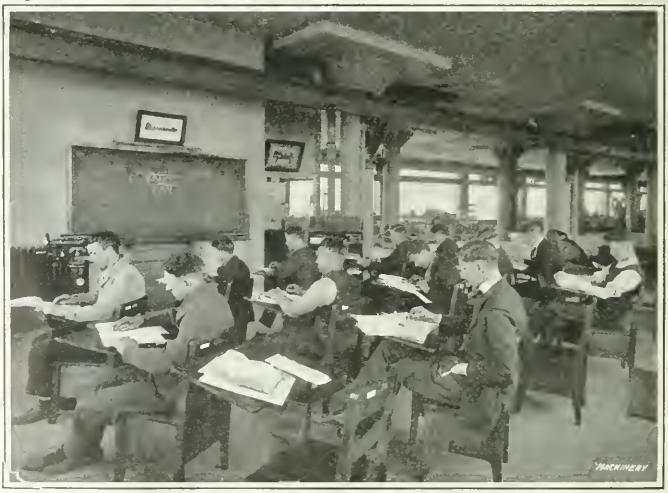
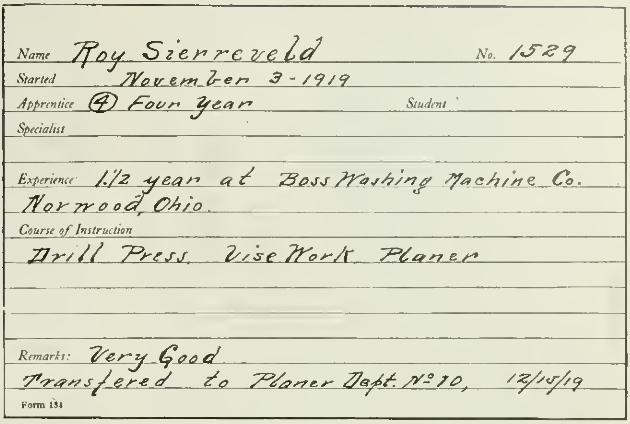


Fig. 2. A Class of Apprentices studying Mathematics

The Classroom Training

At the present time there are about 150 apprentices in the LeBlond plant. These are divided into classes of from sixteen to twenty boys to a class. Each class is given classroom instruction twice a week during the regular working hours, for a period of one and one-half hours each time. One of these periods is devoted to mathematical instruction and the other period to drawing. No effort is made to teach mechanical drawing in the ordinary sense, but the boys are taught to make free-hand sketches, following the rules laid down for mechanical drawing, and are thereby enabled to acquire a rapid and accurate knowledge in the reading of blueprints. The boys are also encouraged to attend night classes in mechanical subjects. There are many excellent night classes in Cincinnati, especially at the Ohio Mechanical Institute, the Y. M. C. A., and at the various high schools. Some of the apprentices are diverted from the shop into the drafting-room after they have served at least two full years in the shop. The boys selected for the drafting-room training are those who show the greatest proficiency in the subjects of importance to a machine designer and draftsman. Mathematical and inventive ability, and a general inclination for mechanical drawing, are the main considerations in this connection.



Name Roy Sierreveld No. 1529

Started November 3-1919

Apprentice ④ Four Year Student

Specialist

Experience 1/2 year at Boss Washing Machine Co. Norwood, Ohio.

Course of Instruction

Drill Press, Vise Work Planer

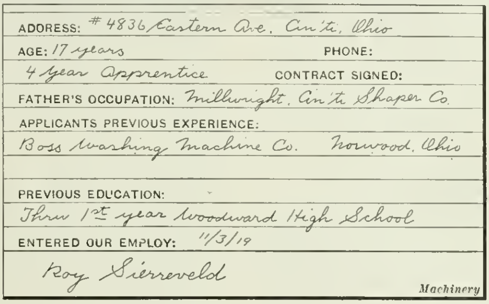
Remarks: Very Good

Transfered to Planer Dept. No. 10, 12/15/19

Form 134

Fig. 3. Training Shop Record of Apprentice

In the same manner, those who show the highest degree of mechanical skill are diverted into the tool-room at the end of two years in the general production departments and receive in the last two years a thorough training upon tool-room work. Patternmakers are trained in the same way. They are given two years' machine shop work, after which the last two years of their apprenticeship are spent in the pattern shop which has proved ample.



ADDRESS: #4836 Eastern Ave. Cin'ti, Ohio

AGE: 17 years PHONE:

4 Year Apprentice CONTRACT SIGNED:

FATHER'S OCCUPATION: Millwright. Cin'ti Shaper Co.

APPLICANTS PREVIOUS EXPERIENCE:

Boss Washing Machine Co. Norwood, Ohio

PREVIOUS EDUCATION:

Thru 1st year Woodward High School

ENTERED OUR EMPLOY: 11/3/19

Roy Sierreveld

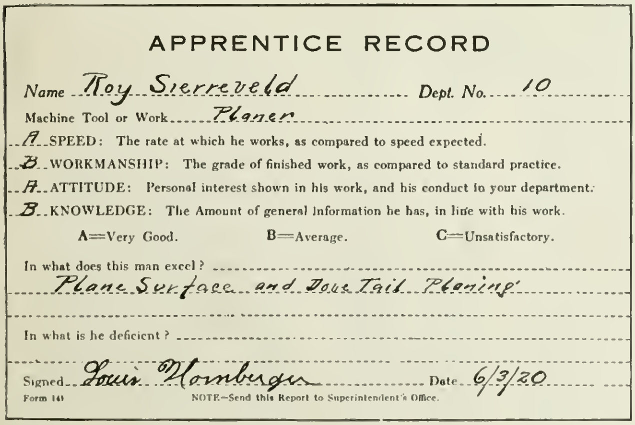
Machinery

Fig. 4. Card from the Index recording all Apprentices

The Courses in Mathematics and the Examinations

The classroom course in mathematics includes a review of grammar school mathematics, followed by mensuration, shop problems, cutting speeds, elements of algebra and geometry, trigonometry, logarithms, and the elements of strength of materials, gearing, etc. A series of twenty-five lessons or unit instruction books has been prepared, each one covering one subject. These instruction sheets contain brief rules and problems to be solved. One week, the mathematical classroom work is devoted to the solution of these problems by each boy working by himself, and alternate weeks the work is carried on along the lines of regular classroom work, with the whole class instructed as a unit.

To insure that the boy is obtaining the full benefit of his shop experience, he is given a series of thirty to forty questions relating to shop work at the time when he enters a new department. These questions he answers in writing and must turn in the replies at the time when he is to be transferred to another department. He is required to do most of this work at home, as well as the work required in the solution of the problems on the unit study sheets. As he completes each unit, he is given a test in school to insure that he has thoroughly grasped the subject, and has not obtained merely a superficial knowledge.



APPRENTICE RECORD

Name Roy Sierreveld Dept. No. 10

Machine Tool or Work Planer

A SPEED: The rate at which he works, as compared to speed expected.

B WORKMANSHIP: The grade of finished work, as compared to standard practice.

A ATTITUDE: Personal interest shown in his work, and his conduct in your department.

B KNOWLEDGE: The Amount of general Information he has, in line with his work.

A=Very Good. B=Average. C=Unsatisfactory.

In what does this man excel?

Plane Surface and Dove Tail Planing

In what is he deficient?

Signed Louis Hornberger Date 6/3/20

Form 141 NOTE—Send this Report to Superintendent's Office.

Fig. 5. Department Foreman's Report to Superintendent

The Apprentice School Library

An important feature in connection with the apprentice school is the library system which has been inaugurated. The company maintains a well-supplied mechanical library, with books indexed and taken care of on the regular public library plan. The boys are permitted to borrow books for home study, and note is taken of the interest that the boys show in this respect. The instructor advises the boys as to the best information obtainable on any one subject, referring them to the book or section of a book that will give them the information they are seeking. Naturally, when a boy is working in the lathe department, he will be encouraged to study books on lathe work, and so on, according to the department in which he is working. MACHINERY'S Mechanical Library has been found very useful in this connection, as it has been prepared especially with a view to furnishing instruction along the practical lines required in training mechanics.

Maintaining the Records of the Apprentices

The supervision of the apprenticeship course is in the hands of the assistant superintendent, Frank C. Lang, who has charge of the entire apprenticeship course. He is assisted by the mathematical instructor, and the instructor in the training shop and his assistant, as well as by the employment manager. Records of the boy's performance are kept by the employment department, where he is listed in the regular employment card index as an employe, and also in a separate card index covering all apprentices. (See Fig. 4). This card index is used in connection with the Rand visible vertical file. Colored celluloid riders are placed at the lower right-hand corner of the card one month in advance of the date when the boy is to be changed to the next department. This gives time to prepare another apprentice for the vacancy at the time of the change. A record is also kept by the classroom instructor covering the details of the boy's classroom work.

At the end of each six months, or at the end of each period in a department, the foreman of the department makes a written report, Fig. 5, to the superintendent of the company, giving completely and in detail his opinion of the boy's work and progress. These reports are placed in a permanent file and constitute a continuous record of the boy's progress. The employment department also keeps a card index record, which, in addition to the information given by the boy on his application blank, contains data relating to when he actually started work, dates of transfer from department to department, etc. The records of the classroom instructor contain the marks obtained by the boy in his various examinations and the record of his attendance. An attendance record is also kept by the employment department.

An individual efficiency record of the boy's work in the shop, similar to the chart maintained for recording the individual efficiency of the men in the plant, which was shown in the article "Time Study and Rate Setting in a Machine Tool Plant," published in the July, 1919, number of MACHINERY, is also maintained for each boy. From these various records a complete history of the boy's performance from the time he enters the apprenticeship course until he completes it can be obtained at any time.

Conclusion

As a result of the care with which the company selects its apprentices, an unusually fine body of young men has been assembled, and it is believed that it is well worth taking great care in choosing the right boy for the course because of the expense connected with it. It costs more to try to train and educate a less well qualified boy than one with better qualifications, and the result, of course, is less satisfactory. Hence, with the same time and effort spent upon the training of a boy of the right kind, there is an assurance of a man who will ultimately become a first-class mechanic and who, if he possesses in addition to mechanical skill the required executive ability, will some day become a mechanical leader in the industries.

* * *

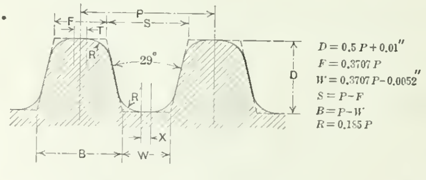
SPECIAL FORM OF ACME THREAD

By H. A. PEARSON

The standard Acme screw thread on a male member frequently roughs up and injures the thread on the mating part, especially in cases where the male member is made of harder material than the female part. A case in point is encountered frequently in valve work, where the stem is of harder composition than the bonnet in which it fits. Upon investigation the presence of burrs on the edges of the male thread will often be seen, the action of which, when the stem is turned will produce the injurious effect mentioned, and in time will completely wear away the bearing surfaces of the female thread. These burrs are difficult to remove from the standard form of Acme thread on account of its sharp edges, and it is rarely that these threads are produced without leaving a few burrs. To meet this condition, a special Acme thread having rounded corners has been designed which completely eliminates the difficulty. This form of thread can be cut much more easily than the standard form having sharp edges.

The accompanying table contains the specifications for this special form of thread for screws up to 10 threads per inch. The angle of the thread, its width *F* at the top, and the width *W* of the space at the bottom are the same as the standard Acme screw thread elements. Radius *R* depends on the pitch, and has been calculated so as to reduce the bearing surface of the thread as little as possible, or just sufficiently to produce the desired rounded edges. The form of the thread is shown in the accompanying illustration.

SPECIFICATIONS FOR SPECIAL ACME THREAD (Inches)



Threads Per Inch N	Pitch Single Thread P	Depth of Thread D	Width Top of Thread F	Width of Space at Bottom W	Width of Space at Top S	Thickness at Bottom B	Radius R	True Flat at Top T	True Flat at Bottom X
1	1.0000	0.5100	0.3707	0.3655	0.6293	0.6345	0.1850	0.0964	0.0912
1½	0.6670	0.3433	0.2471	0.2419	0.4196	0.4248	0.1233	0.0643	0.0591
2	0.5000	0.2600	0.1853	0.1801	0.3147	0.3199	0.0925	0.0481	0.0429
3	0.3330	0.1767	0.1236	0.1184	0.2097	0.2149	0.0617	0.0320	0.0268
4	0.2500	0.1350	0.0927	0.0875	0.1573	0.1625	0.0463	0.0242	0.0190
5	0.2000	0.1100	0.0741	0.0689	0.1259	0.1311	0.0370	0.0192	0.0140
6	0.1667	0.0933	0.0618	0.0566	0.1049	0.1101	0.0308	0.0160	0.0108
7	0.1429	0.0814	0.0530	0.0478	0.0899	0.0951	0.0264	0.0139	0.0087
8	0.1250	0.0725	0.0463	0.0411	0.0787	0.0839	0.0231	0.0121	0.0069
9	0.1111	0.0656	0.0412	0.0360	0.0699	0.0751	0.0206	0.0108	0.0056
10	0.1000	0.0600	0.0371	0.0319	0.0629	0.0681	0.0185	0.0097	0.0045

Machinery

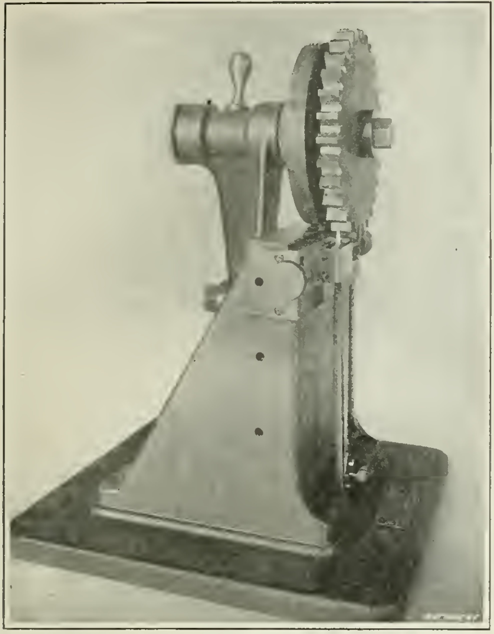


Fig. 1. Machine developed by Illinois Tool Works for testing Accuracy of Involute Gear Teeth

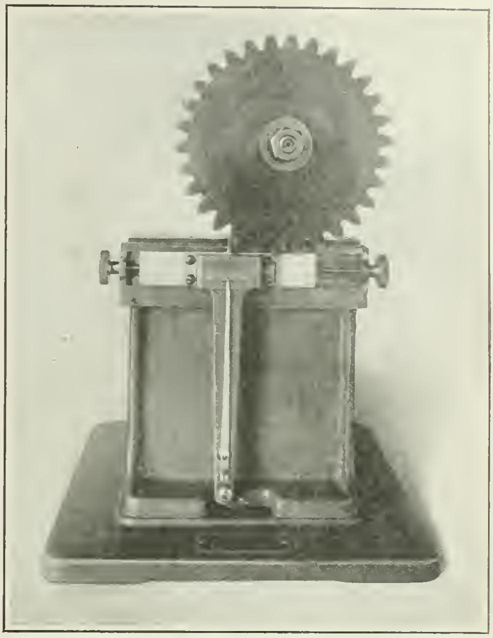


Fig. 2. Front View of Involute Gear Tooth Testing Machine showing Arrangement of the Indicator

Involute Gear Tooth Testing Machine

THE Illinois Tool Works, 154 E. Erie St., Chicago, Ill., have developed a machine for testing the tooth form of involute gears that provides for making such tests with a high degree of accuracy. Figs. 1 and 2 show two general views of this gear-testing apparatus, and Fig. 3 illustrates the mechanism in detail. At the top of the machine there is a track on which a disk *A* is rolled, this disk being of the same diameter as the base circle of the gear to be tested. The gear is secured at the front of an arbor that also carries disk *A*, so that the gear and disk rotate together. A contactor *B* engages the gear tooth to be tested, and has the center of its head level with the track on which disk *A* is rolled. This contactor is pivoted at *C*, and by means of a pin at its lower end, connection is made with an indicator needle *D*, which is supported by a pivot *E*. In this way a system of multiplying levers is made effective. As each gear tooth rolls in contact with the point *B*, any error in the tooth form imparts a corresponding movement to the contactor head *B*, and owing to the magnifying effect of the levers, even the slightest movement of the contactor head causes needle *D* to make a considerable movement over scale *F*, which indicates the error in tooth form.

No movement of the contactor head *B* will occur so long as the involute curve of the tooth is perfectly accurate. Hence, any movement of the indicator needle *D* over scale *F* shows that the form of the gear tooth is inaccurate, and the magnitude of this inaccuracy is indicated by the scale. A ratio of 100 to 1 for the system of multiplying levers that transmit movement from the contactor head *B* to the point of indicator needle *D* running over scale *F*, provides for a wide spacing of the graduations on this scale which indicate errors of thousandths of an inch, so that the operator can easily and accurately determine the exact magnitude of any error which is discovered. This is an important feature in the practical application of the device.

How the Machine is Constructed

Having made a general statement as to the purpose of this machine and the way in which the desired result is obtained, we are ready to describe the arrangement of the mechanism. It was explained that disk *A* is of the same diameter as the base circle of the gear to be tested and that this disk rolls on a track on top of the machine bed. Guides *G* support a cross-head *H* that carries a horizontal stud *I* on which a rocker arm *J* is pivoted. The function of this rocker arm is to cause the disk *A* to roll a predetermined path on its track. Cross-head *H* permits the necessary vertical movement of stud *I* as arm *J* rocks back and forth to roll the disk on its horizontal track. At its upper end, arm *J* is provided with a housing supporting ball bearings in which an arbor *K* is carried. Disk *A* is secured to the arbor *K* in such a manner that as the disk rolls on its track it causes the arbor to rotate; and as the gear *L* to be tested is rigidly clamped to the arbor by means of a nut and spacing collars, it will be evident that the gear rotates in unison with the disk. Both the gear and the disk may be taken off from the arbor by removing the clamping nut and drawing them off the forward end. Should it happen that the next test is to be made on a gear of a different diameter or pitch a disk *A* of suitable size will be substituted, and this will bring cross-head *H* into a different position in its guides on the frame of the machine. The handle at the top of rocker arm *J* forms a convenient means of rolling the disk *A* on its track.

Arrangement of the Indicator Actuating Mechanism

Contactor *B* is supported on a pivot *C* that is carried at the upper end of a panel *M*, this panel being rigidly fastened to a carriage *N* which travels in horizontal ways near the top of the main frame of the machine. The position of the carriage is controlled by adjusting screws *O*. At the lower end of the contactor arm there is a pin *P* which extends forward through an opening in panel *M* and enters a vertical slot *Q* formed in the lower end of the indicator needle *D*. As previously stated, this needle is pivoted at *E* on a stud carried by the panel slightly below slot *Q*. As shown in the illustration, the upper end of the indicator needle *D* runs over scale *F* which is graduated on the front surface of the panel, and the system of levers giving a multiplication of 100 to 1 enables the scale graduations to be broadly spaced so that they are easy to read.

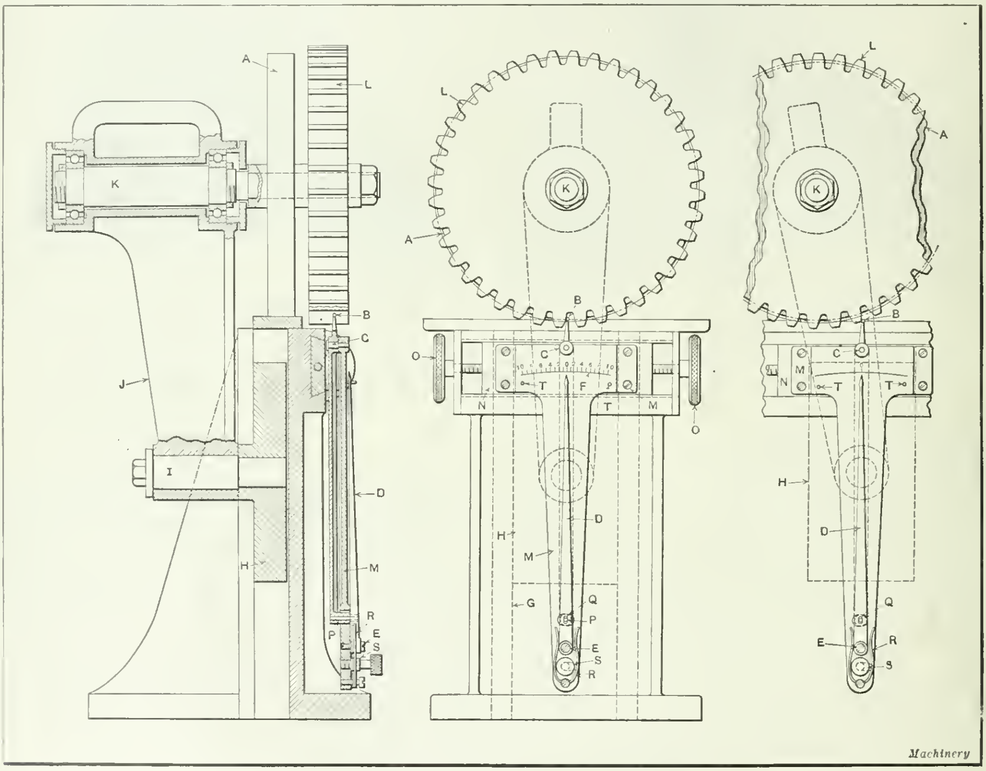


Fig. 3. Side and Front Views of the Involute Gear Tooth Testing Machine, illustrating Important Members of the Mechanism

Provision for Holding Contactor against Opposite Sides of the Teeth

Provision is made for holding the contactor head *B* in engagement with the surface of the gear tooth to be tested, and a simple adjustment enables the contactor to bear against either side of the tooth. The means provided for this purpose consist of a double spring *R* which is held to the panel *M* by means of a screw and projects upward to bear against either side of the lower end of indicator needle *D*. Pin *S* is mounted in the panel below the bottom of the indicator needle so that it is free to rotate, and it is provided with a finger which may be thrown into engagement with either side of the spring, thus relieving the pressure of that side of the spring from the indicator needle and causing the contactor *B* to engage the proper side of the gear tooth to be tested. When it is required to test the opposite side of the gear tooth, finger *S* is thrown over to reverse the action of spring *R* on the indicator needle. Stop-pins *T* are placed on panel *M* near the ends of scale *F* to provide for limiting the distance through which the indicator is free to swing.

Method of Using the Machine

In preparing to conduct a gear test on this machine, the disk *A* and gear *L* are mounted on the arbor *K*, as previously explained. Next the carriage *N* is adjusted by manipulating screws *O* until the contactor *B* is located in a central position when in engagement with the acting surface of the gear tooth to be tested, namely, in the position indicated in the front view of the machine in Fig. 3. Under these conditions, the indicator *D* will also occupy a central position over the zero graduation on scale *F*. After making these adjustments, the operator grasps the handle on rocker arm *J* and slowly moves it in a direction to move the engaged tooth away from the contactor. Thus, in practice, with the contactor engaging the right-hand side of the tooth as shown, the operator moves the handle of arm *J* in a direction that causes disk *A* to roll toward the left, as indicated by the partial view at the right-hand side of the illustration. A perfect tooth will not cause any lateral movement of the contactor *B*, but if the tooth is of imperfect form, the head of the contactor will be caused to move in one direction or the other, thus producing a corresponding but greatly magnified movement of the free end of the indicator *D* over scale *F*. In this way, the user of this machine is able to ascertain both the presence and magnitude of any imperfections in the form of the gear teeth. Gears of various pitch diameters may be tested on a machine of this kind, without changing anything except the size of roller *A*.

Principle Governing the Design of the Machine

This machine operates on the same principle that governs the tracing of an involute curve. According to definition, an "involute" is the path traced by a point at the end of a taut string during the period that it is being unwound from a cylinder. The same curve will be generated by a point in a straight line or tangent to the cylinder, which is rolled on the cylinder without slipping. In the involute gear tooth

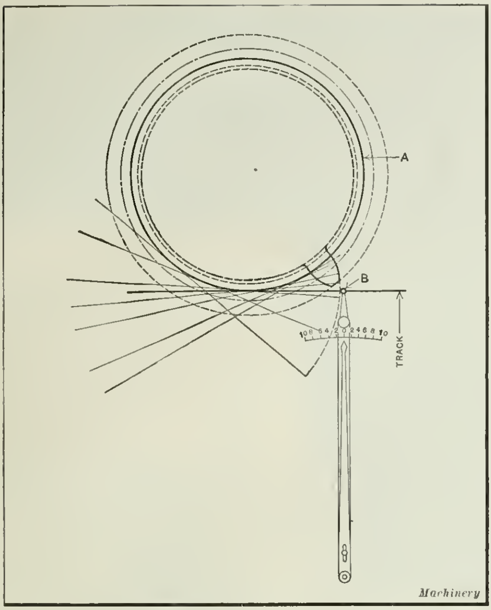


Fig. 4. Diagram illustrating Principle governing Design of Gear Tooth Testing Machine

testing machine, the cylinder is represented by a disk *A* of the same size as the base circle of the gear to be tested, and the straight line or tangent is represented by the track on which this disk is rolled. The tracing point on this tangent is represented by a small ball-shaped contactor *B* supported at the end of a multiplying lever and located with its center on a level with a track that carries the disk. The gear to be tested is mounted and clamped integral with disk *A* (see Fig. 4) and the contactor point *B* is adjusted until it presses on one tooth of the gear, with the indicator registering zero. The indicator dial is graduated in divisions representing 0.001 inch, and the multiplying levers increase the sensitiveness of the measurement by a ratio of 100 to 1. This large magnification makes it possible to detect the most minute errors in the involute tooth form by simply rolling the gear past the contactor point *B*. Quite obviously, if the gear tooth contour conforms to a true involute, the indicator needle will not move from its zero position; and, conversely, any movement of the needle shows an inaccuracy in the tooth form.

* * *

COLORED LIGHT SIGNAL SYSTEM FOR LOCATING EXECUTIVES IN A SHOP

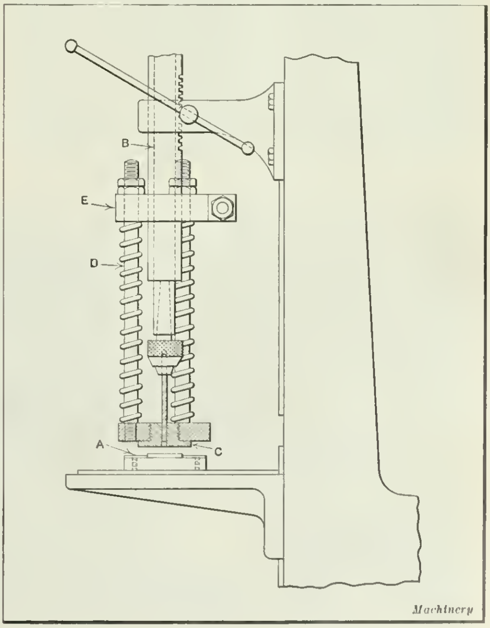
Various signal systems are in use in manufacturing plants for locating executives and foremen when they are not in their own departments. A system employed by the De Laval Separator Co., Poughkeepsie, N. Y., is the use of different colored lights in which a series of ten or twelve are mounted in a suitable socket board. These boards are prominently located throughout the shop and in various parts of the office, or even in the yard, so that no matter where the executive may be, his attention will be attracted by the flash of the lights. Single lights may be used for the executives and combinations of two or more for the foremen, so that when any particular light or series is flashed, the man sought will know at once whether or not it is a call for him. These lights are operated from the telephone switchboard so that when a telephone call fails to reach the official at his desk, the operator immediately plugs in his combination of lights with the result that he will be quickly brought into communication with the official.

ATTACHMENT FOR DRILLING MACHINE

By GUSTAVE F. BAHR

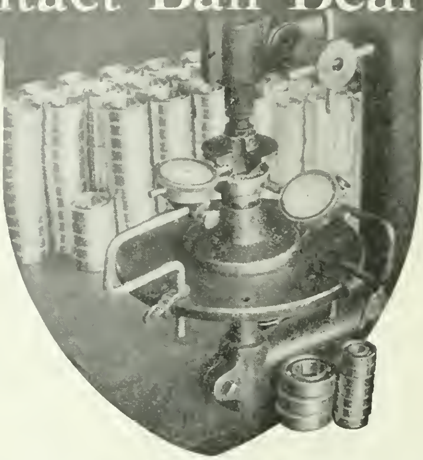
A reaming and drilling attachment, recently designed for use on a drilling machine, is here illustrated and described. This device was designed to do away with elaborate drill jigs and reaming blocks for holding work in which the hole need not be machined precisely. There are numerous small pieces of this kind which ordinarily employ a leaf jig or some other expensive holding device when drilling and reaming the holes. In the attachment illustrated, however, a locating plate *A* containing either a nest or a series of pins arranged to locate the work is employed. This locating plate is securely attached to the table of the machine in the proper relation to the machine spindle. If the spindle *B* is lowered, the holding pad *C*, which can be made to suit the shape of the work if necessary, will be brought down into contact with the work because of its connection to the spindle sleeve. A clamping ring *E* is attached to the sleeve, and carries three guide rods *D*, the lower ends of which are threaded and carry the ring in which the holding pad is assembled. The coil springs carried on these guide rods exert the necessary amount of pressure on the work, as determined by the position of ring *E* and the adjustment of the nuts on the guide rods. If desired, the drill may be guided in the holding pad by a bushing, but a simple clearance hole will often suffice. It is evident that as the spindle sleeve is lowered an increasing amount of pressure is produced so that the deeper the hole becomes, the greater is the force exerted. This, together with the arrangement for producing any desired initial spring pressure on the work, assures that the part to be drilled will be securely held at all times.

This arrangement has also been successfully used in reaming operations, the advantage being that, by reason of the spring pressure on the reamer, all chattering of the hole is eliminated. One other advantage of this attachment is that it is a safety device, in the sense that chips caught on the drill cannot cut the hand. An attachment of this type will speed up production, and can be made with less expense than the usual type of drill jig.



Drilling and Reaming Fixture which holds Small Parts by Spring Pressure

Manufacturing Three-area Contact Ball Bearings



A Detailed Description of the Manufacturing, Inspection, and Assembling Methods Used in the Shops of the Federal Bearings Co., Inc., Poughkeepsie, N. Y., in Producing Three-area Ball Bearings

Second of Two Articles

IN the first installment of this article, published in the August number of MACHINERY, a general description of the Federal three-area ball bearings was given, together with a detailed description of the operations that are performed in the manufacture of the various parts of which the bearing is composed. In the present installment the methods by which bearings of this type are inspected and assembled, and the final testing and truing up operations will be dealt with.

Inspection Methods

The inspection and assembling of the bearings is carried on jointly, and each bearing is given a running test before it leaves the factory. One of the inspection benches is shown in Fig. 11. After the inner rings have been delivered to the inspection department they are first inspected for eccentricity of the diameter of the raceway, the rings being held between centers on an arbor. A dial indicator mounted on a base which rests on a surface plate is employed in this operation. The eccentricity limit of the raceway diameter is 0.0003 inch. After the eccentricity has been inspected the diameter of the raceway is tested in a similar manner.

In this connection special attention should be called to the assembling methods followed, in which both the inner and outer rings of each bearing number are assorted, according to diameter tolerances, into various classes, each of which, starting with the lowest permissible diameter, establishes a series of slightly varying diameter sizes, so that the entire series is within the maximum and minimum limits allowed for that particular size bearing. It can readily be seen that if this means of sorting into sub-classes is followed on both the inner and outer rings a combination of two outer rings and one inner ring can be selected which will enable the same over-all limits to be maintained in the assembled bearing as would be the case if each ring were required to be machined without tolerance, or at least to exceedingly close limits. The results, however, are identical, but this practice of classifying the tolerances obviates the necessity of grinding the races in the rings to the accurate limits which, nevertheless, by this grading process finally become established in the bearing. In the general view of the assembling bench, Fig. 11, will be noticed on the right the ends of a number of long slender dowels. These dowels or pegs are set into boards which rest on the floor and over which the rings are placed by the inspector after being sorted. In following out this idea of assembling, special trays are employed on which component parts are placed, two outer rings and an inner ring together, and of such a combination that the over-all dimension will be correct in the assembled bearing. These trays may be seen in the left foreground of the illustration Fig. 11, where the assembling department is shown, and also very clearly in Fig. 14 which illustrates the loading operation.

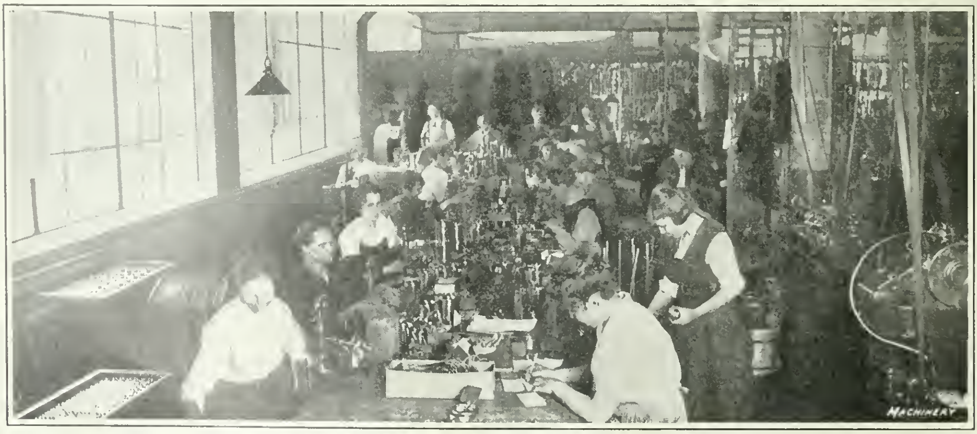


Fig. 11. Assembling and Inspecting Department showing Gaging Devices for inspecting the Raceway Diameters

The process of verifying the depth and definite location of the ball track in the outer race rings is illustrated in Fig. 12, in which the dial indicator arrangement employed is plainly shown. This is the inspection operation which determines the proper peg or dowel on which the rings are to be placed in the sorting of the parts.

The precaution of mating up the inner and outer rings would be of no avail if the balls used in the bearing were not similarly assorted. A standard high-grade commercial ball such as the well-known Hoover or Atlas product is used in these bearings, and these balls are graded after being received in the assembling room. It has been found that all the balls of one particular shipment, for instance, may be well within the required limits, but that the product of various shipments and possibly of various concerns will vary enough to warrant the precaution of testing each individual ball. The special equipment employed in this operation is shown in Fig. 13, in which each ball passes under the indicator point, all balls being graded into sizes varying by 0.0001 inch in diameter; thus all the balls that go into a bearing will be of uniform diameter within this close limit, and as nearly perfect in regard to roundness as commercial manufacturing methods will permit.

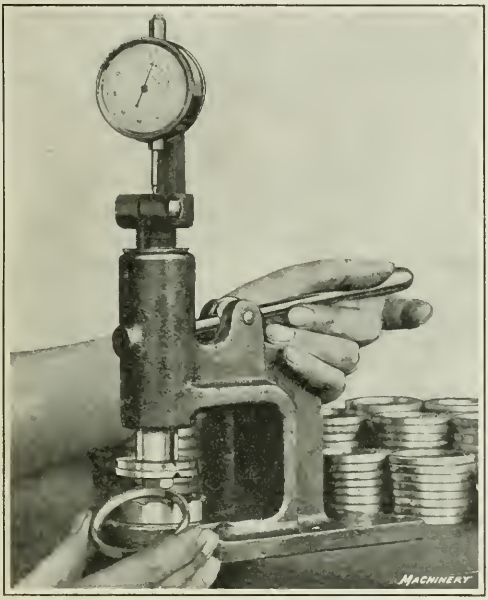


Fig. 12. Testing the Ball Race of the Outer Rings

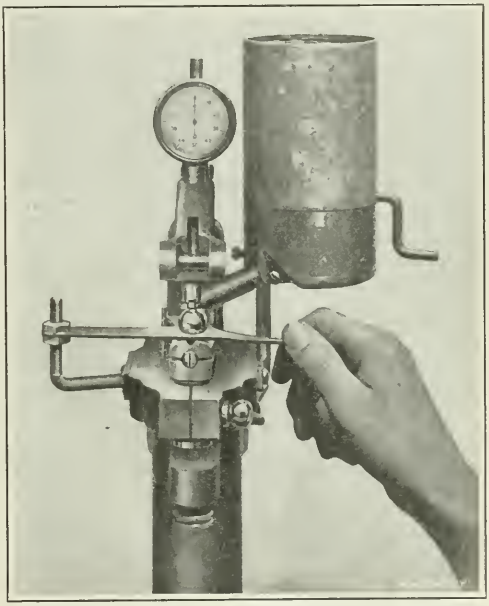


Fig. 13. Equipment for gaging the Diameter of the Balls

Assembling the Bearing

The process of assembling necessarily merges with that of inspecting. From the inspection bench the trays containing the paired inner and outer rings are taken to a power press, where one of the outer race rings is pressed into the case. It will be remembered that, in the manufacture of the case, a flange was produced on one side when the center hole was punched out, but that the opposite side was left open in order to permit assembly. The first outer ring to be assembled is forced against this flange and replaced on the board with the other outer ring and the inner race ring, and delivered to the bench where one of the most interesting steps in the entire assembly is performed. This operation is shown in Fig. 14, from which the arrangement of the parts in the assembly tray may be clearly seen. It consists of loading the bearings, that is, placing the inner race ring and the separator cage or retainer carrying the balls, into the case. The operation and the arrangement of parts on the assembly tray may be plainly seen in the illustration, as well as a collection of assembled bearing parts just before they are inserted into the bearing jacket. A male and a female interlocking retainer are locked together and slipped over an inner ring, the two being held between the thumb and forefinger, and the balls dropped in loosely while the hand is turned. It requires considerable dexterity on the part of the assembler to perform this loading operation without permitting the parts to become disassembled, as can easily be understood. After all the balls have been dropped into the cage, the entire collection of parts is slipped into the jacket against the outer ring which has previously been assembled.

The operation of assembling the other outer ring is performed on an arbor press, in which it is forced down into contact with the balls. The reason for employing an arbor press on this operation is obvious, because under no conditions should the ring be forced against the ball so hard as to cause any misalignment of the bearing, for it will be remembered that at this stage of assembly the balls are held loosely by the retainers. The use of a power press would not be practicable in such a case, where the work must form the stop.

The next operation consists of spinning-in the bearing jacket, and this is performed on a special machine employing two spinning heads. The machine and equipment employed in this operation are shown in Fig. 15, which also shows a bearing held in the chuck of the machine and the relation of the radial spinning tool to the edge of the bearing jacket. The horizontal head *A* which spins the stock parallel with the side of the bearing, and the radial head *B* which, when swung around, completes the spinning operation by folding the metal in against the outer race ring, may be clearly seen. By referring to the sectional view shown in Fig. 1 in the first installment, the condition of the case after this operation may be observed.

The loosely interlocking retainer ledges are next closed together about the balls, which produces the desired rigidity of construction as well as ease of operation, and in addition furnishes a wall on each side of the balls as a provision for increasing the axle-load capacity of the bearing. The ledges are the spacing provision made for the bearing balls.

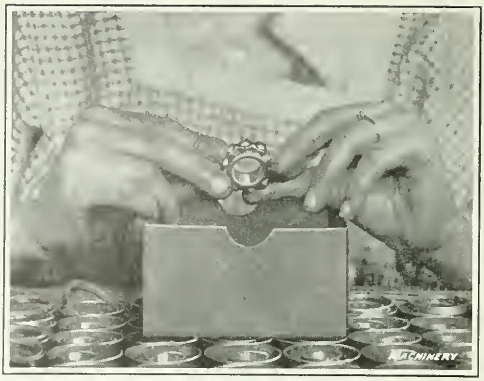


Fig. 14. The Loading Operation consists of inserting an Inner Ring into Two Interlocked Retainers in which the Balls are dropped. These Loose Parts are then inserted into the Bearing Jacket

Testing and Final Truing-up Operations

Each bearing after assembly is subjected to a running test under a known amount of end thrust pressure as determined by the size of the bearing. The bearing is centered on the inner race ring bore, held in a vertical machine especially arranged for the purpose, and the test is made at the maximum safe running velocity. The running qualities are then inspected to see if there is any looseness or binding in the operation, after which one side of the bearing is rough-ground. The purpose of rough-grinding at this stage of the manufacture is to furnish a bearing surface from which the running truth of the side of the bearing can be established. If the bearing is rejected at this point, whatever parts are possible to be salvaged are disassembled. If it passes this test, it is then taken to a Blanchard grinding machine equipped with a magnetic chuck and the rough-ground surface is used as a bearing surface for finish-grinding the opposite sides of the bearing. The work is then reversed and ground parallel on the other side. This machine is of the same general type and the arrangement is practically the same as for the grinding operation shown in Fig. 7, in the first installment, and the cleaning and demagnetizing operations which follow the grinding of the outer rings also follow this grinding operation.

All burrs and other irregularities on the inside edges of the bearing jacket or case are next removed in a speed lathe provided with a suitable chuck for holding the work, after which a number of bearings are mounted on an arbor and a light cut taken on the outside diameter of the case preparatory to the final grinding operation. In taking this step the bearings are held on an expansion arbor mounted between centers and ground on a Norton cylindrical grinding machine. Following the grinding operation, the bearings are dipped in gasoline and cleaned by air pressure.

After the bearings have been returned to the inspection bench the bore of the inner race is inspected, and then the eccentricity of the outside diameter of the bearing and the running truth of the sides are simultaneously inspected by employing a testing apparatus which consists primarily of two dial indicating gages mounted as shown in the heading illustration. Bearings which have passed inspection up to this point should show no inaccuracy as regards eccentricity or running truth. The inspection of the outside diameter for size, which follows the eccentricity inspection, completes the gaging work on the bearing. The limit established for outside diameter is plus 0.0000, minus 0.0006 inch. Finally the bearings are stamped with their bearing number and size, and are then treated to a coating of pure lubricating grease, which is run over the bearings while hot and which leaves a clean viscous coating after solidifying. Fig. 16 shows equipment used in the laboratory for the purpose of making the final tests to which every bearing is subjected before being put on the market.

* * *

INDUSTRIAL COST ACCOUNTANTS ASSOCIATION

The Industrial Cost Accountants Association was recently organized in Chicago, Ill., by representatives of leading manufacturers in various lines of industry. The object of the new association is the standardization of accounting and cost terminology and the adoption of standard governing principles; the promotion of active cooperation and interchange of average experiences between representatives of manufacturers engaged in similar activities; the education of the members and their business associates in the complex economic problems of industry; the assisting of standardization committees in each line of industry in establishing uniform accounting and cost practices; and acting as a clearing house in distributing to all members the development in cost practices to the end that uniformity, once established, may be maintained. The headquarters of the association will be in Pittsburg, at the office of the secretary-treasurer, 1501 Peoples Bank Building.

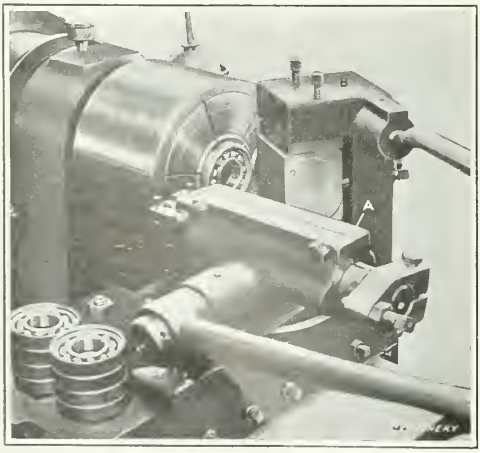


Fig. 15. Machine equipped with Spinning Heads for spinning in the Bearing Jacket after the Component Parts have been assembled

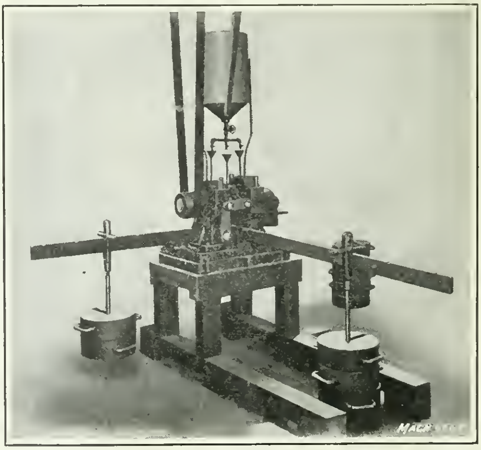


Fig. 16. Laboratory Equipment employed in testing the Bearings under a Known Amount of Both Axial and Radial Load

CALCULATIONS FOR INSPECTING SPECIAL PROFILE GAGES

By V. E. AYRE

When checking the gage shown in Fig. 1, first measure the angles a and b in relation to the finish-ground surface, by means of a sine bar. On page 1176 of the August number of MACHINERY, a formula was presented for finding a radius by means of a V-block, depth micrometer, and ground disk. This formula, $r = R - H\ (2.41422)$, may now be employed to test radius r, after which the distances A, B and C are measured and the heights D and E calculated from the measurements of the angles a and b and the radius r.

$$D = H + G \qquad (1)$$

$$H = F \tan a$$

But

$$F = A - r + r \sin a$$

$$= A - r\ (1 - \sin a)$$

Therefore

$$H = [A - r\ (1 - \sin a)]\ \tan a$$

Also

$$G = r \cos a$$

Substituting these values of H and G in Equation (1),

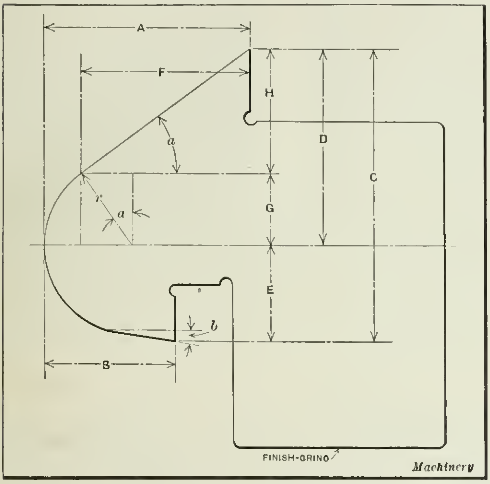


Fig. 1. Special Gage and Measurements Necessary in its Inspection

$$D = [A - r\ (1 - \sin a)]\ \tan a + r \cos a$$

By a similar method of calculation the value of E may be expressed by the formula

$$E = [B - r\ (1 - \sin b)]\ \tan b + r \cos b$$

It is evident that the sum of the values D and E should equal the measured distance C. Care must be taken when making calculations on this type of gage to use the actual point of tangency of the straight and curved surfaces of the gage when making the measurements.

Fig. 2 shows the set-up for inspecting a gage that is used to test the profile of a shell, while Fig. 3 is a similar diagram of the check for the profile gage. The inspection of these two gages includes a test of the radius of curvature R, as well as the location of the center of curvature with respect to the nose of the profile.

Two straightedges are first clamped to a surface plate at 90 degrees to each other, after which the curvature is checked by the disk method. This method consists, briefly, of locating two disks; first E is located according to the dimensions A, and B, and then reference disk F according to the radius R. An indicator, attached to rod G, Fig. 3, is swung like a compass about the center of disk E, first against the reference disk and then against the curvature. The error is then determined as explained in the article "Testing the Radius of Curvature of a Gage," published in the July number of MACHINERY, page 1076. The dimensions A and B may be varied by means of size blocks placed between the straightedges and the gage, as shown by the diagrams. Size blocks may also be employed to locate the reference disks. Should the indicator show any deviation between the radius of curvature and the established radius, simply correct the position of the gage by varying the dimensions A and B by means of the size blocks, until the indicator does not show any variation when swung over the curvature.

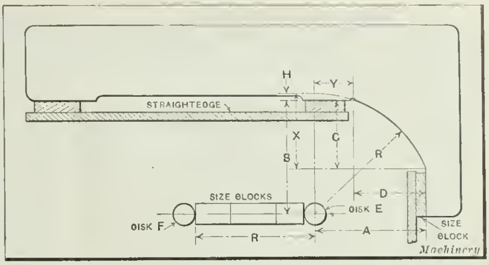


Fig. 2. Shell Profile Gage and its Inspection Set-up

Quite often the radius of curvature is correct but the position of the center with respect to the nose of the profile is not correct. As an illustration, if the radius R and one of the locating dimensions (for instance B) is nominally correct, the other dimension A, may be wrong, which would result in the dimensions C and D, which locate the intersection of the curvature with the straight faces, being correspondingly affected. These specified dimensions, C and D, Figs. 2 and 3, may be checked as follows:

$$H = R - B$$

$$Y = \sqrt{H(2R - H)}$$

equals one half the length of a segment of height H, which is an adaptation of a formula given in MACHINERY'S HANDBOOK, page 132,

and

$$D = A - Y$$

According to the formula for finding the height of a segment, also given in MACHINERY'S HANDBOOK, page 132,

$$h = r - \tfrac{1}{2}\ \sqrt{4r^2 - c^2}$$

In this case, therefore

$$X = R - \tfrac{1}{2}\ \sqrt{4R^2 - 4A^2}$$

$$= R - \sqrt{R^2 - A^2}$$

$$C = X - H$$

It is, of course, evident that dimensions C and D may be similarly checked, no matter which of the three dimensions A, B, or R is incorrect, and also that the result of this inspection will enable the relation between the center of curvature and the nose of the gage to be correctly established.

* * *

Where a belt is to be shifted automatically, as on a planer, the belt speed should not be less than 1000 feet per minute.—*From a catalogue of the Chicago Belting Co., Chicago, Ill.*

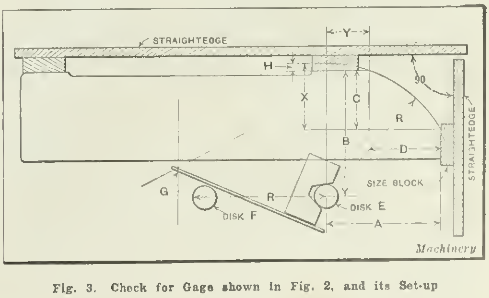


Fig. 3. Check for Gage shown in Fig. 2, and its Set-up

The Machine Shop Hospital

By SANFORD DeHART, Director of Hospital, R. K. LeBlond Machine Tool Co., Cincinnati, Ohio

The purpose of this article is to outline the requirements and point out the value of an industrial hospital in a plant of moderate size. Complete medical service has until recently been limited to large manufacturing plants; but health service is just as essential in a factory of moderate size as it is in a larger plant. Adequate service of this kind can be provided for the smaller shops at a cost that is not excessive, thus assuring them the same advantages in this respect as are enjoyed by the larger corporations.

IN the planning of an industrial hospital for a machine shop employing from five hundred to one thousand men, five rooms are required—a waiting room, a first-aid room or dressing room, an eye-room, a rest room or bedroom, and an office. The floor plan shown in the accompanying illustration indicates the equipment ordinarily needed for this purpose.

The most important requirement for the success of an industrial hospital is the experience and training of the personnel of the hospital for competent industrial service. The training of the average physician is somewhat foreign to that required in industrial service. He is trained to seeing only individual cases, and does not view health, or the lack of it, in its community aspect. Industrial hospitals have been failures in some instances, because the physician in charge has not had the necessary qualifications for this kind of medical work; the managers of the industrial undertaking selected him because he was a reasonably successful general practitioner. This, however, did not guarantee that he would make a success as an industrial physician. Failure to appreciate this point has caused a great many disappointments in the way of unsatisfactory medical service.

The Qualifications Required of the Medical Director in a Shop Hospital

To meet the present-day industrial situation, the medical director should be well informed on accident prevention as well as on sickness prevention; in the latter field particularly he will find unlimited possibilities. He must be a man who recognizes that he is no longer expected merely to treat symptoms but to prevent disease. He should be able to teach his patients that health cannot be administered from a teaspoon, and that there are only seven or eight out of about 150 diseases known to medical science for which there is a drug that can be given with any pretension to cure.

He should also be familiar with modern employment methods and group insurance, and thoroughly posted upon the occupational requirements of the shop; otherwise, he cannot attempt physical examination with a view to placing the physically unfit in positions that they are capable of filling without injury to themselves. He must have a general knowledge of safeguards, disagreeable or dangerous gases and dust frequently encountered in the shops, as well as heating, ventilation, locker rooms, rest rooms, shop restaurants, and some knowledge of housing, and recreational and educational features. He must also have some ability as a lecturer so that he can deliver talks to the employes on personal hygiene.

Cost of Health Supervision and Industrial Hospital Service

Figures compiled by the Conference Board of Industrial Physicians show that the cost of health supervision in the industries is much smaller than most employers who have not undertaken such work would be inclined to believe. Figures based on the experience of forty-one large plants in eleven industries, serving 223,416 employes show an average annual cost of $1.88 per employe. This includes the salaries of physicians and nurses and the cost of outside medical and surgical service. Of these plants, twenty-nine were in the metal trades, having 163,789 employes, and in these plants the average cost per employe was only $1.68 per year. The approximate cost of a complete hospital, equipped as shown in the accompanying illustration, would, at present prices, be about $7000.

Advantages of the Shop Hospital

It has been found in the shop hospital of the R. K. LeBlond Machine Tool Co. that the average time spent in the first treatment of each case, and in retreatments, is about twelve minutes. A great deal of this time is spent in a diplomatic effort to keep the patient in a good humor and make him feel more ready and happy to go back to his work than to go home after the pain has been soothed or the wound dressed. The efficiency of a shop hospital is based upon the doctor's ability to keep the men on the job.

In many cases where the patient requires medical attention, sometimes fifteen minutes or so spent in the rest room with a little skillful attention brings the patient back to normal. Men suffering from various acute ailments would ordinarily go home, but in nine cases out of ten they can be kept on the job if the hospital director understands his work. It should be understood that all cases treated in the shop hospital are of the emergency type, and no attempt is made to interfere with the family physician. This policy should be strictly adhered to in every shop hospital, because the primary object of the shop hospital should be preventive rather than curative, so far as medical efforts are concerned.

It is conservatively estimated that a man will lose a minimum of six hours going to and from his family physician, and some will not go who ought to go. It has been estimated that with a working force of 1000 there will be 12,000 visits made annually to an industrial hospital, for all conditions. Of this number it is fair to assume that in the absence of an industrial hospital, 3600 cases would require outside treatment. Since it has been ascertained that the average time lost in going to and from an outside physician is six hours, it is fair to assume that the industry is saved approximately 21,600 hours or 2700 full working days, based on an eight-hour day.

The director of an industrial hospital can also prove of great help to the men employed by the advice and suggestions that he can make with regard to the employes' families. Many of the men take the doctor into their confidence and tell him of sickness or ailments of their relatives or dependents. The doctor investigates this, and in many instances this assistance proves very helpful to the men.

Records of the Activity of the Hospital

No shop hospital is complete without records. The details of those records are too voluminous for presentation in a mechanical journal, but the author of this article will be glad to send samples of the blanks used to any metal-working plant that is contemplating the installation of a shop hospital. These records can be kept up to date by a clerk devoting two hours a day to this work in a plant where one hundred patients a day receive treatment. The remainder of the day the services of the clerk can be utilized in the employment department or as a general assistant in the hospital, making gauze dressings, rolling bandages, and keeping the drug and store-room replenished.

Results Obtained by Shop Hospital

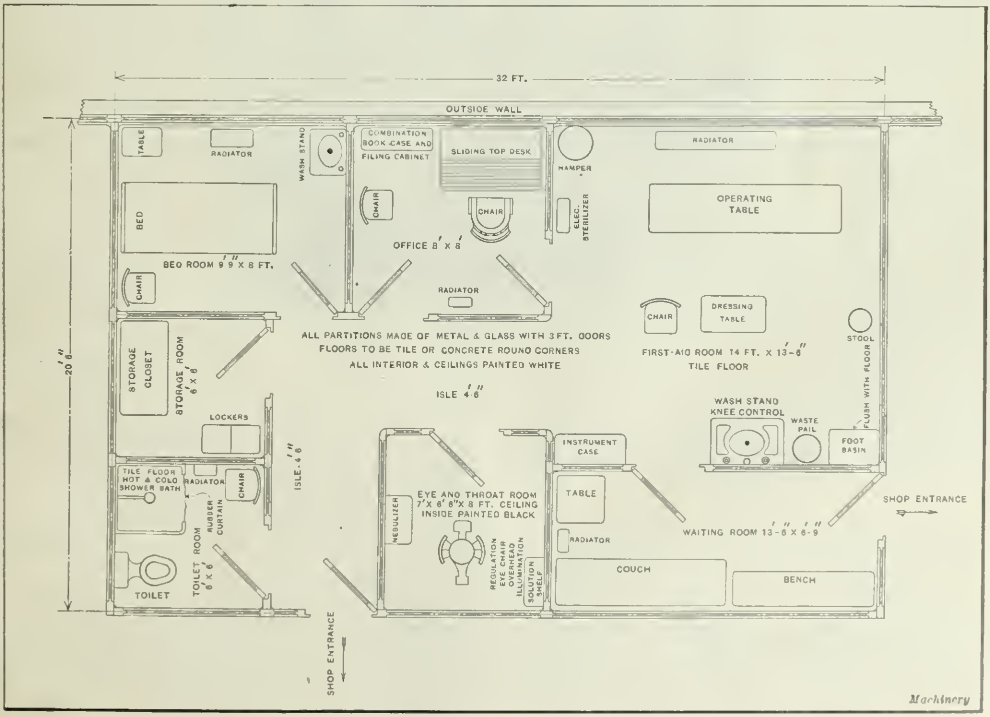
During the influenza epidemic of last year the medical work in the R. K. LeBlond Machine Tool Co.'s plant held the number of absentees down to 9 per cent of the working force during a period of three months, while several shops not equipped with an industrial hospital had an absentee rate of from 25 to 33 1/3 per cent, and one shop, 50 per cent. This shows the value of an industrial hospital, both in regard to preventive work among employes and results obtained from early treatment in case of sickness.

Last year, beginning with May 1 and ending September 30, an extensive campaign of accident prevention was inaugurated by the company. These months were selected because of the belief that fatigue is a prominent cause of accidents and that this cause would be present more frequently during the summer months. During the period, sixty hours were lost through injuries in the plant, and since about 1000 men were employed, this means an average loss of only 3.6 minutes per man for a period of five months. The company carries its own insurance, under the rulings of the Ohio Industrial Commission, but there was only $6.90 in compensation paid during the five months.

The Importance of Physical Examinations

Physical examinations of the applicants for employment should be an important part of the doctor's work. Benefits derived from physical examinations are shared by both the employes and the employers. A physical defect by no means prevents a man from being employed, but it does prevent him from being placed at work for which he is not fitted and which would become hard or dangerous to him because of his defect. Again, a physical examination often acquaints the person examined with some defects of which he did not know, and gives him an opportunity to take remedial measures. It also protects him from assuming undue risk of industrial accidents, if his physical condition is such as to invite injury. In a recent examination of 500 applicants between the ages of 16 and 62, it was found that of the 500 examined, 60 had defects that did not suit them for work requiring medium exertion of a somewhat hazardous nature.

Men suffering from attacks of heart trouble, for example, should not be employed at work where they may become frightened by sudden danger. There are cases on record where, due to accidental bursting of emery wheels, for example, men have died from heart failure because of fright, while they have been unharmed as far as being struck by pieces from the wheel was concerned. Large amounts of compensation have been paid to relatives of the unfortunate men in instances of this kind, under the compensation laws.



Floor Plan of Hospital at the R. K. LeBlond Machine Tool Co.

The shop hospital in which physical examinations are made can prevent the employment of men with such defects in any occupation that is likely to prove dangerous. There are so many occupations in any shop employing 1000 men that are not hazardous or that do not require great physical exertion, that men having some defects unfitting them for certain classes of work can be placed where the defects are of no importance.

As the doctor becomes familiar with the occupations in the plant, he is soon able to suggest placing men at the kind of work for which they are best fitted physically. He furthermore finds out what particular dangers are present in the plant and can cooperate with the engineering department for protective measures. The shop hospital is merely another link in the chain forged to create industrial efficiency. There can be no efficiency if the man employed to perform a certain task is physically unfit for the task assigned to him. It is the purpose of the shop hospital to select the men fitted for the work, and then to keep them fit.

* * *

The Engineering Foundation, created by an endowment of $300,000 from Ambrose Swasey of the Warner & Swasey Co., Cleveland, Ohio, past president and honorary member of the American Society of Mechanical Engineers, is seeking additions to this endowment with a view to raising it, if possible, to at least $1,000,000. Since 1915 the foundation has maintained cooperation in research between engineers and scientific workers, and the object of the foundation in building up the endowment fund is to make it of a size worthy of the engineering profession, as the results of this work will be approximately in proportion to the funds available. It is the purpose of the Engineering Foundation to stimulate, coordinate, and support research work in existing scientific laboratories, and to cooperate with the national research council. The foundation does not plan to build laboratories and conduct research work directly. The office of the foundation is in the Engineering Societies Building, 29 W. 39th St., New York City.

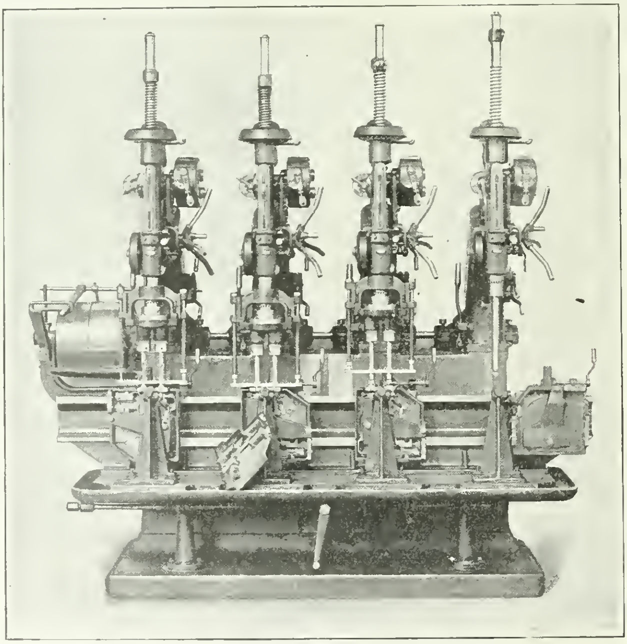
* * *

Vanadium steel is of comparatively recent origin. In a paper on ferro-vanadium, read by B. D. Saklatwalla of the Vanadium Corporation of America before the American Electrochemical Society, it was mentioned that until the discovery of a large deposit of vanadium in the Peruvian Andes in 1905, vanadium steel was not used to any great extent. In 1863, it was suggested by Lewis Thompson that vanadium might have an effect on iron similar to that of nickel. The first actual use of vanadium steel began in 1896, when it was experimented with for armor plates in France.

DRILLING MACHINE WITH SLIDING JIGS AND POSITIVE STOPS FOR RAPID PRODUCTION

The accompanying illustration shows a drilling machine built by the Barnes Drill Co., Rockford, Ill., which is used for drilling a number of holes in the body of the hydraulic gear-shifting device made by the United States Auto Gear Shift Co., Eau Claire, Wis. The holes are about one inch in diameter and are drilled from the solid, because it was found that better castings could be obtained when made solid than if the holes were cored. Absolutely sound castings are required on account of the fact that the mechanism is used for the hydraulic transmission of power.

In the first position, as shown at the left in the illustration, two holes are rough-drilled in one side of the casting. The jig in which the casting is held is then swiveled around, or indexed, and two holes in the bottom of the casting are drilled with the same drills. The guide bushings for the drills are part of the drill head, and are not attached to but fit into hardened bushings pressed in the swiveling jig. When indexing, a pull-pin is released by a lever shown at the right-hand side of the jigs at each drill spindle.


Multiple-spindle Drilling Machine equipped with Sliding Jigs

After the holes have been drilled, the jig slides along the rail to the second spindle, where the holes are rough-bored, using Kelly reamers. Two holes are first rough-bored on one side of the casting and then the casting is indexed around and the other two holes bored, the same as when drilling at the first spindle. The jig is then slid along to the third spindle, where the holes are finish-reamed in the same manner, and then the jig is moved along to the fourth spindle where all the holes are counterbored. In this case only one counterboring spindle is used and one hole is counterbored at a time, stops being provided to locate the jig accurately for each hole. The post shown at each spindle position, bolted to the table, is provided with a stop-pin that accurately locates the jig at each position. At the extreme left of the jig, in the position in which it is shown at the left-hand spindle, three notches will be seen at its edge. The center notch is used for locating the jig at the first three spindles, and the notches on each side are used one for each of the positions required when counterboring with the fourth spindle.

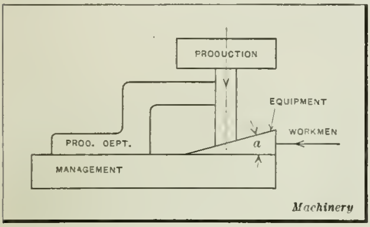
By the use of this machine it has been found possible to drill, bore, ream, and counterbore fifty hydraulic gear-shifter bodies per day. The machine is a 24-inch, four-spindle standard box-column all-geared gang drilling machine with coil springs and adjustable stop for automatic spindle return. Attention should be called to the design of the rail which is extended at each end of the machine for receiving and removing the work-carrier or jig.

FRICTION IN THE ORGANIZATION

By J. B. CONWAY

Perhaps the greatest obstacle to be contended with in an organization is friction. In the usual sense, friction implies disagreement between the employes, but when it applies to the functioning of an organization, it has a broader meaning than this. The word "friction" is defined as "resistance which a moving body meets with from the surface on which it moves." Friction acts opposite to and tends to retard the motion of a body. The body may be likened to production moving through a factory, the steady movement of which is dependent upon the proper functioning of the entire organization.

Under ideal conditions an organization, like a machine, would be one from which friction has been eliminated, but as this is an impossibility, it is desirable to reduce this factor to a minimum, just as the designer by the selection of proper materials and the application of various formulas reduces friction in the design and construction of a machine. The problem of reducing the factor of friction to the extent that it will not be objectionable in machine design is simple when compared with the task of modifying it in an organization. The reason for this is, of course, that the laws of mechanics, having been established after successful application for a long period, are better known than those applying to human nature. The laws of management are diversified, due to the human element involved. Laws governing finance, organization, departmental relations, employment, the movement of stock, selling policy, and financial returns on the investment are all well defined and, within certain limits, under the control of the management. A list of the most vital factors which produce friction in an organization would include insufficient funds, dissension, improper design of the product, improperly planned production, cost systems which tell only the profit and loss from one year to the next, strikes, breakdowns, delayed shipments, and labor turnover. Each of these factors tends to oppose the flow of production.



Graphic Presentation of the Relation of the Elements of an Organization as regards the Factor of Friction

Comparison between Mechanical Friction and that Found in an Organization

In the analogy between mechanical friction and friction in an organization, attention is directed to the accompanying illustration which shows graphically the application of this factor of friction to an industrial organization. The idea that the illustration is intended to show is that the workmen represent the power that exerts pressure on the wedge (equipment), which is supported by the management in raising the load (production), the latter being, in turn, supported or steadied by the production department. The friction between the load and the wedge is proportional to the load. In order to utilize this friction to advantage, the angle of inclination *a* should be such that it will sustain the load and at the same time prevent it from sliding by reason of its own weight. Any increase in the angle of inclination will result in a greater power requirement to raise the same load and will need more support from the production department. Conversely, a decrease in the angle will naturally result in lowering the production rate, unless greater man power is supplied. The angle of equipment is composed of such items as machines, prime movers, adequate stock, timely deliveries, cooperation, and all other factors entering into a modern organization. Each of these factors influences the angle and consequently affects all members of the mechanism.

The Coefficient of Friction in the Organization

It is evident that if the various factors involved in the functioning of the organization are known, the coefficient of friction can be easily obtained. For example, if in a 44-hour week, there is a loss of time due to delays to the equipment, or to tools for the equipment, assumed at 4.4 hours, the production week is 39.6 hours long, and if so desired these two factors, standard hours and production hours, may be plotted to show the time lost in percentage. This loss in the present case is 0.10 of the total time for the week, and may be considered as the coefficient of friction.

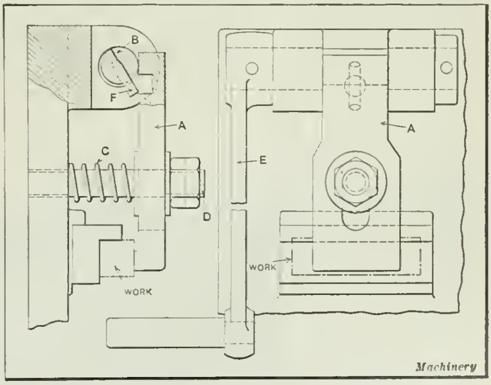
The writer has attempted to outline a graphic method of presenting the subject of efficient management, and has furnished merely enough information to convey the idea and enable the reader to work out his own method of applying it.

* * *

QUICK-ACTING CLAMP

By ROY V. TERRY

A quick double-acting clamp, the design of which may be adapted for use in fixtures where work having flat surfaces is to be clamped, is here illustrated. The operation of the clamp should be readily understood from the illustration. It will be seen that the clamping force is exerted through the medium of an eccentric cam *B*. This cam is operated by handle *E* and carries a drill-rod pin *F*. As the handle is raised, the cam pressure on strap *A* is released, so that as pin *F* engages a drilled hole in the strap, the latter will be carried back clear of the work. It will be observed that the release of the pressure and the removal of the strap are accomplished by a single motion of the operating handle. The strap should be guided between the cam bearings as well as on the stud *D*, so as to prevent it from turning on the stud. This stud carries adjusting nuts by means of which the amount of clamping pressure exerted on the work by the cam may be varied. The function of spring *C* is to keep the strap raised after the work has been removed so as to enable the fixture to be reloaded without difficulty.

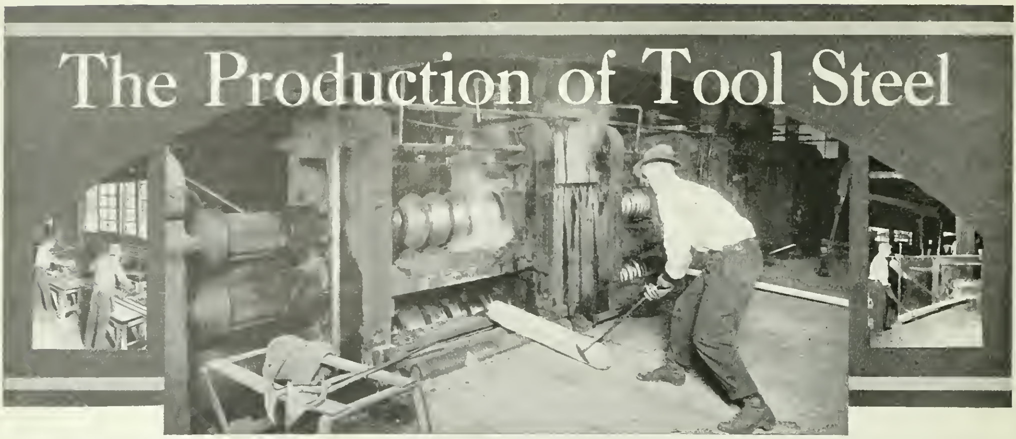


Cam-operated Clamping Arrangement which may be incorporated in Fixture Design

* * *

That progress is being made in the industrial development of Brazil is indicated by an item in a recent commerce report, in which it is stated that an electric smelting plant having a capacity of 60 tons of steel daily is to be established in Sao Paulo.

The Production of Tool Steel



Processes Employed in the Steel Mill of the Ludlum Steel Co., Watervliet, N. Y., which is Engaged Exclusively in the Manufacture of Tool and Special Alloy Steels

By FRED R. DANIELS

THE average toolmaker and machinist, whose daily occupation brings him into contact with the uses of tool steel, is more familiar with what the steel can do than with how it is produced. He knows that steel possesses certain qualities, such as red-hardness, the ability to harden, ductility, toughness, etc., by virtue of the addition of carbon, nickel, chromium, cobalt, vanadium, and various other metals, but the results of the combination of these ingredients in the steel are only vaguely understood. This is not surprising, for the alloying of metals is a science in itself, regarding which metallurgists themselves have much yet to learn; the exact result that will be produced in a steel, for instance, by altering the percentages of the various components or by the addition of certain elements in varying quantities, is not fully understood even by scientists. While it is not the purpose of this article to discuss chemistry, nevertheless the chemical action which transpires in the melting furnace is predetermined by the metallurgist and is the greatest single factor in the success of the manufacture of tool steel.

Good tool steel can be manufactured by either the crucible process or by the electric furnace. The manufacture of tool steel requires almost the entire removal of such impurities as sulphur and phosphorus, the limitation of segregation in the molds, the reduction in the grain size, and any other item which may be classified under the refining process. The crucible process does not refine, but merely melts the charge. The advantage of the electric furnace method of manufacturing is that the steel is refined during the process of melting. This results in greater homogeneity in the ingot casting and in improving the microstructure of the steel, so that the refining process starts in the furnace. The result is that the high quality of the ingot steel poured from an electric furnace ladle is a decided advantage in the manufacture of alloy tool steel. Although high-grade tool steel can also be made in the open hearth, the process is a much slower one, and not as satisfactory when quantity production is concerned. The electric furnace is steadily supplanting all other processes in this industry. It is not merely by choosing the right process, however, that a high quality of the product is insured, but also by exercising the greatest care in every detail entering into the production. After the steel has been properly made in the furnace, a large amount may be ruined by casting it too hot or too cold or by using ingot molds of improper design.

The methods used by the Ludlum Steel Co., Watervliet, N. Y., will be described in this article, and some of the more interesting sides of the industry dealt with. Manufacturers of high-grade tool and alloy steels today are making detailed studies of their customers' individual requirements, and by using the information thus obtained, have made decided progress in the manufacture of steel, by furnishing the buyer with the quality which will meet the exact requirements of his product. The production of alloy steel is not different from that of structural or straight carbon steel, so far as the equipment is concerned, except for the use of an electric furnace. It is the methods employed and developed by the manufacturer engaged exclusively in the production of tool and special alloy steels which differentiate this industry from that found in steel mills where all kinds and grades of steel are manufactured.

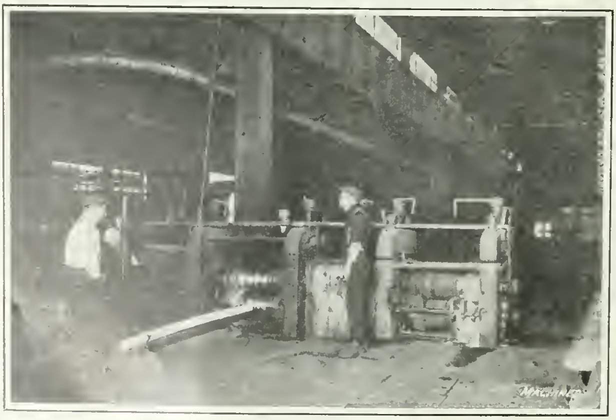


Fig. 1. View in the Bar Mill showing Two-high Stands for rolling Billets into Bars

The Melt Shop and Its Equipment

The crucible process may be defined as a remelting process, in which the crucible charge consists of either charcoal, refined or puddled iron, with suitable additions of carbon, manganese, alloys, etc., and as previously stated, the charge does not become refined. On account of the ability of the electric furnace to remove the undesirable metalloids, it is not necessary to use as high grade raw material as is required in the crucible. The raw material used is high-grade analyzed scrap, which at the Ludlum mill is deposited in huge concrete bins, located at one end of the melt shop in close proximity to the freight yard. An electric magnet crane is employed to transfer the scrap from the cars to the proper bins, each of which is suitably designated so that when preparing the scrap for the charge, raw material having a known amount of carbon, manganese, or other material can be selected. Preparatory to charging the furnace, the electric magnet crane drops the material on a scale in front of the furnace in quantities and proportions determined by the grade of steel to be made, and according to specifications prepared and furnished by the chemical laboratory.

Fig. 2. A Corner of the Chemical Laboratory in the Metallurgical Department, in which the Various Tests are made

Before proceeding further with the description of the melting process, a brief reference to the design of the Ludlum electric furnace will be made. The furnace is of the arc-resistance type and is furnished with three 9-inch diameter graphite electrodes about 6 feet long, which are arranged in the furnace roof in a straight line rather than triangularly, and which extend down into the oven of the furnace so that after the raw material has been added they may be lowered with their extremities resting on the charge, from which position they melt their way down to the bottom furnace lining where the first pool of molten material is produced. The shape of the furnace interior resembles a clam shell with the deepest portion directly under the electrodes. The advantage claimed for this design is that owing to there being no side walls to absorb heat and consequently reduce the temperature of the melt at the points that are farthest removed from the source of heat, a more even temperature is maintained throughout the molten mass. To assist in maintaining an even temperature, the shape of the roof is such as to radiate the heat into the melt increasingly as the distance from the center to the "horizon" increases.

The electrodes are supported in suitable overhanging arms, and means are provided for lowering or raising them as required. Provision is made in the design of these electrodes so that they may be entirely consumed. This is accomplished by making one end of the electrodes with a threaded shoulder and the other end tapped to receive a similar threaded shoulder. As an electrode burns down, it is simply necessary to screw a new electrode into the tapped hole of the one that is nearly consumed, with the result that a continuous electrode is obtained. The electrodes are consumed at the rate of about 2 inches per hour at the highest temperature, or about 10 inches for a heat of six hours' duration. In order to cool the top, the electrodes are surrounded with water jackets which are installed in the furnace roof.

The electric current is received from a three-phase transformer which delivers 90 volts of energy at 10,000 amperes to the furnace. The maximum temperature required is seldom greater than 2775 degrees F., this being the maximum heat for teeming or pouring the melt. The furnaces are lined with firebrick and magnesite or dolomite to a thickness of about 9 inches and are provided with two doors on opposite sides of the furnace, but have no pouring spout. Either one of these two doors may be used for charging, and the other is usually used when pouring, for the performance of which operation mechanical means are employed for tilting the furnace. The length of time required to complete a melt varies with the charge and may be anywhere from 3½ to 4 hours for straight carbon steel, to from between 4½ and 6 hours for high-speed and other alloy steels. This does not include the intermittent period be-

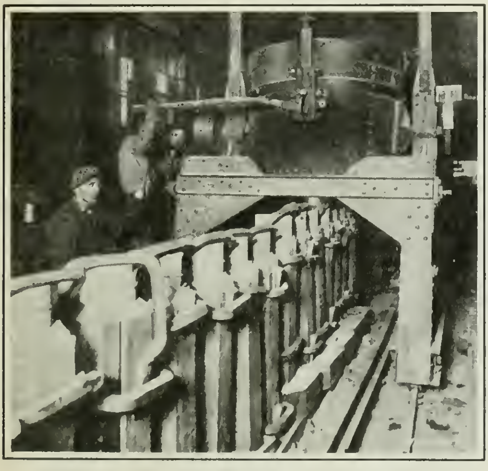


Fig. 3. View showing Row of Ingot Molds being poured and Track Carriage for supporting Ladle

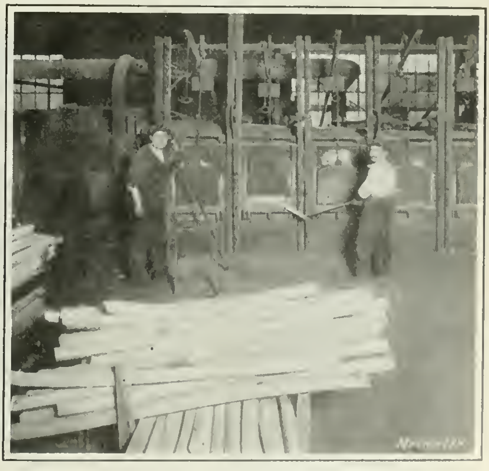


Fig. 4. Reheating Furnaces of the Type employed for heating Ingots and Billets before cogging

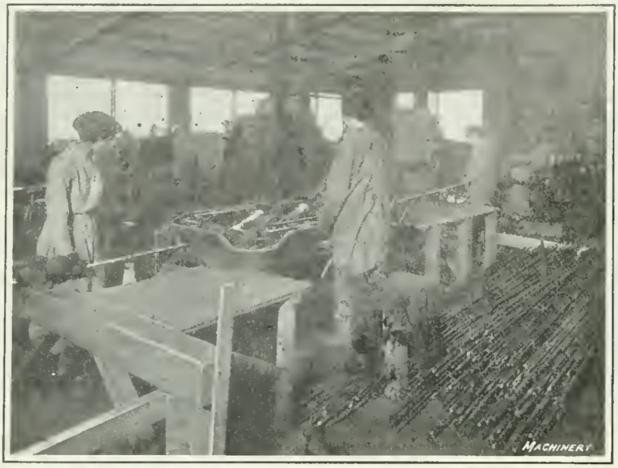


Fig. 5. In the Warehouse the Bars are straightened before being prepared for Storage

tween melts which is required to patch the furnace lining and prepare to make the next charge. Three complete melts per twenty-four-hour day is about the average output of one furnace. After teeming, the lining is repaired, and as soon as practicable a new charge added. In the Ludlum mill one 10-ton and one 8-ton furnace are constantly at work night and day in the production of tool steel.

Charging the Furnace and Teeming

From the weighing scale, where the raw material has been deposited by the crane, the scrap is charged into the furnace, and after it has been reduced to the molten state, the previously mentioned refining process commences. As soon as this state has been reached, the melter covers the surface of the melted steel with a flux consisting of lime and fluor-spar for the purpose of producing a slag covering. This is known as the oxidizing slag and oxidizes out the impurities, such as phosphorus, sulphur, silicon, etc. Great care is exercised during this operation in regard to maintaining a definite temperature. The melter next rakes the slag off, and from its color and general appearance after it has cooled on the melter's stirring rod or rabbler, he judges the progress of the refinement. The proper stages of the melt are determined by the melter, who must be a highly skilled workman and whose knowledge in regard to this part of the industry is of the greatest importance. Obviously, pyrometers or other heat-measuring devices cannot be employed at such excessive temperatures.

If the condition of the melt is right, a second addition consisting of fluor-spar and silicon is made for the purpose of producing a reducing slag; that is, the oxides are reduced to their metallic state by the chemical action of the second silicious slag. This second slag is also removed, and is tested frequently during the process of refining, the results of these tests performed in the laboratory being furnished to the melter so that he may regulate the chemical content of the melt by the addition of carbon or other material or by the use of a third slag coating of lime and fluor-spar, if that should be required. Small iron molds are used for pouring the specimens which are to be analyzed during the melting process. Ordinarily, two slags are sufficient to produce the desired refinement.

After the necessary additions have been made in the melt, sufficient time must be allowed for the added alloys to mix thoroughly before the steel is ready to be teemed from the furnace to the ladle. The final slag is poured with the steel into the ladle, and acts as a blanket to keep the molten material at the proper temperature during pouring. Any increase in temperature above the necessary pouring heat, is made at the expense of the quality of the steel.

The ladle into which the steel is poured is supported on trunnions in a track frame under which a row of ingot molds is arranged between the tracks, as shown in Fig. 3 so that the ladle may be brought to the dead center of the mold during the pouring. The steel is bottom-poured, so that the slag will not be carried down with the metal. Since the bottom of the ingot mold is coned, by placing the nozzle of the ladle directly over the center, the splash that would otherwise occur at the bottom of the mold is eliminated. This is the ideal condition, as the mold is allowed to fill evenly and quietly. The "hot top," as may be seen by referring to Fig. 3, consists simply of a cylinder made of refractory material which is luted to the top of the mold. The hot top serves to keep the metal inside in a molten condition so that this acts as a feeder to the shrinkage cavity in the ingot caused by contraction of the metal as it cools, to the end that a more perfect ingot is produced.

One of the most serious objections to pouring the metal at too high a temperature is that a long time elapses before the metal will solidify and in this time crystals will form which have a tendency to throw off the various alloys. Alloys, as far as iron is concerned, are impurities, although some of these impurities are desirable and very valuable in the steel. In cooling, the tendency of the alloys is to segregate in the mold. If the cooling time is lessened, therefore, the degree of segregation will be reduced. Segregation also offers a means of ridding the steel of the impurities of phosphorus and sulphur, for under the proper pouring conditions this segregation can be confined to the top of the ingot which is subsequently cropped off in forging.

The forging department or hammer shop to which the ingots are delivered from the melt shop is equipped with specially designed coal-fired furnaces in which the ingots

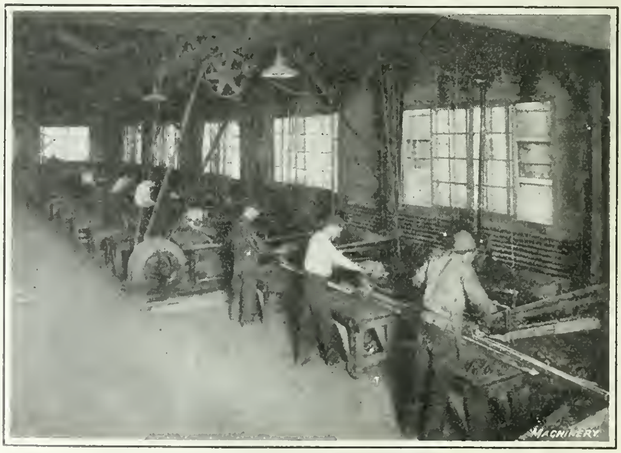


Fig. 6. Grinding out the Seams, Laps, and Similar Surface Blemishes from the Tool-steel Bars

are reheated prior to forging. These furnaces are provided with pyrometer installation, which is rather unusual for reheating furnaces. The ingots are allowed to heat slowly and thoroughly to the correct forging temperature, which is predetermined in the laboratory, the specifications for each heat being furnished the furnace man so that exact results can be obtained and no guesswork resorted to.

The correct temperature, the speed at which the steel is heated, and the length of time that it is soaked all have a refining effect upon the steel, so that when it is placed under the hammer and carefully worked, the crystal sizes will be reduced to extreme smallness. The smaller the crystal size, the higher the refinement in the steel. This forging down to such sizes as can be conveniently handled in the rolling mill must be carefully done, as otherwise the steel may easily be ruined. The pressure to which the steel is subjected under the hammer must be applied at right angles to the face of the hammer, and the contact under the hammer head and on the anvil must be on a line parallel to the axis of the hammer; otherwise a shearing action will occur which will cause the center to become fractured.

This first mechanical reduction in the ingot produces what is known in the steel mill as a "bloom" or "billet." In working the ingot down it must be kept in square form during the reduction process, and then if the final bar is to be hexagonal, circular, or some other shape, this shape is produced after the approximate size has been attained. If the forging of ingots into billets of shapes other than square started by producing the desired shape at first, the bar would have a split center. Here is another phase of the tool steel industry in which the highest degree of workmanship is essential. The almost perfect shapes that can be produced by simply hammering are a testimonial to this fact. The writer noticed a circular bar 8 inches in diameter and about 8 feet long which had been produced in this manner from an ingot. This bar was very straight and was practically perfect as regards roundness, and on the surface the hammer marks were barely perceptible. The equipment of the hammer shop comprises single- and double-frame steam hammers of various capacities, the largest size being 12,000 pounds.

Cogging, Inspecting, and Annealing

The reheating furnaces in the rolling mill are of the same general design and are operated under the same general conditions as those in the hammer shop. A battery of these furnaces is shown in Fig. 4. The reduction of the billets in the rolling mill and of the resulting bars in the bar mill, Fig. 1, is the same as the process employed in other steel mills, and for that reason will not be described. Before the billets are reheated in the rolling mill furnace, they are inspected for seams, blemishes, laps, and similar surface defects which are either chipped or ground out so that in cogging, these imperfections will not be rolled still farther into the bar.

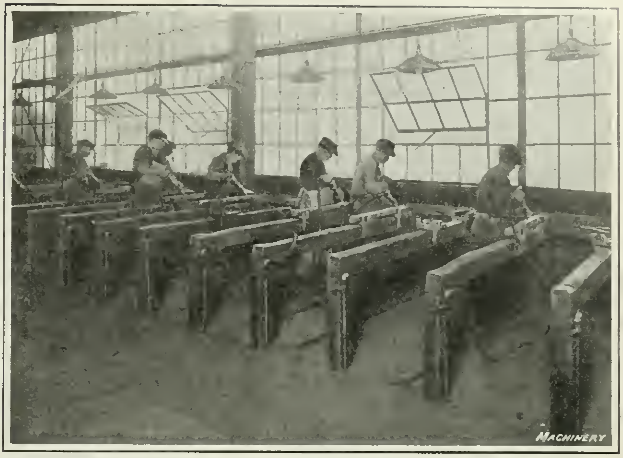


Fig. 7. Surface Defects are removed from Carbon Steels by the Use of a Pneumatic Chipping Tool

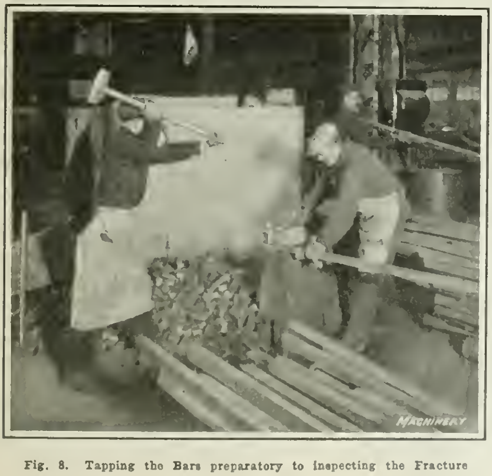


Fig. 8. Tapping the Bars preparatory to Inspecting the Fracture

There is one feature in the cogging mill, however, which is deserving of especial attention, and that is the checking of the finishing temperature by an inspector by means of an optical pyrometer. By "finishing temperature" is meant the temperature of the billet or bar after having passed through one entire reduction process, for instance, having passed through the 18-inch cogging mill. Between each series of cogging rolls, the same procedure occurs, that is, the elongated bars caused by reducing the area are cropped to suitable lengths and reheated in furnaces such as are illustrated in Fig. 4. A pile of these cropped bars is shown lying near the reheating furnaces. Surface defects may show up at any stage, and they are diligently looked for and removed. Figs. 6 and 7 show the methods employed in removing these defects, Fig. 7 showing the use of the pneumatic chipping tool on carbon steel, and Fig. 6 the process employed in removing the defects from high-speed and other alloy steel by grinding. The grinding wheel carriage has a telescopic tube connection with the machine, whereby the grindings are carried away by means of a blower, and an arrangement for swinging the position of the grinding wheel as desired. Every bar that has any indication of a surface flaw is subjected to this grinding or chipping treatment, for the most minute surface defect is often indicative of a more serious defect.

After the steel has been reduced to the desired size, it is sent to the final inspection department where a fracture is taken of every bar and each bar is inspected for mechanical faults, such as seams, cracks, and general imperfections. Fig. 8 shows how each bar is tapped so as to enable a visual inspection of the ends of the bar to be made. If a bar does not meet the requirements when thus inspected it is cut into scrap and remelted. This department is furnished with suitable straightening machines (Fig. 5), and after the steel has passed through the rolls of these machines it is ready to be weighed, coated with rust preventive, painted with suitable identification numbers, bundled and shipped, or else sent to the annealing department, for practically all tool steel is annealed before being finally shipped.

Oil furnaces are used in the annealing department on account of the more even heat that can be obtained with this fuel. The furnaces are of the car-bottom type, and are equipped with Wilson-Maeulen pyrometers. The bars are packed in charcoal ashes in long, cylindrical tubes which are sealed or luted with fireclay and loaded on the flat car which forms the bottom of the furnace. The loaded car is then rolled into the furnace and the temperature raised to the required degree.

The procedure in the annealing department is like that in other departments of this mill in that it is furnished with specifications from the laboratory regarding the furnace regulations. The annealing process for alloy steel is not necessarily a straight slow cooling process, and each steel of different analysis is provided with carefully determined instructions which the man in charge of the furnaces is required to follow. He must drop the temperature an exact number of degrees per hour between certain temperatures, the determination of which for each different analysis of steel is arrived at after careful research work in the laboratory. In this way only, is a satisfactory anneal accomplished.

The annealed stock is then sent back to the warehouse, where after being examined and straightened it is prepared for final shipment in the same way that the unannealed stock was handled. This latter work is taken care of by the shipping department.

Those who are familiar with the manufacture of steel will not recognize any new procedure included in this description, but will no doubt realize that in handling alloy steel in the electric furnace and in the other refining processes a great deal more individual attention is given to each lot of steel that passes through than would be the case under ordinary conditions. For instance, the pyrometer installation in the reheating furnaces, the use of the optical pyrometer at the end of each cogging reduction, the exactness attendant upon the removal of surface imperfections, and the great amount of detail entering into the annealing process, all tend to accentuate the statement that it is the details employed and not the special appliances that differentiate the manufacture of the ordinary machine, structural, and mild steels from the manufacture of high-grade refined tool and special alloy steel.

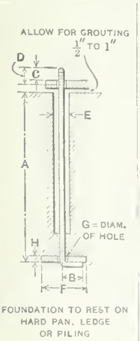
* * *

FOUNDATION BOLT DIMENSIONS

By EDWARD W. THEILIG

Supplementary to the article "Fastening Machines to Concrete Floors and Foundations," which appeared on page 820 of the May number of MACHINERY, the dimensions relative to setting foundation bolts given in the accompanying table may prove valuable. It will be noted that for bolts 2 inches or over in diameter, a nut is used under the washer or anchor plate instead of the bolt being clinched, as indicated by dimension *B*.

STANDARD DIMENSIONS FOR SETTING FOUNDATION BOLTS (Inches)



Bolts						Washers		
Dia.	A	B	C	D	E	F	G	H
¼	..	...	...	...	..	....	...	...
⅜	..	...	...	...	..	....	...	...
½	12	2½	¾	1	2	5 by 5	⅞	⅝
⅝	15	2½	1	1¼	2	5 by 5	⅞	⅝
¾	18	2½	1⅛	1½	3	5 by 5	⅞	⅝
⅞	21	3	1⅜	1¾	3	6 by 6	1¼	¾
1	24	3	1½	2	3	6 by 6	1¼	¾
1⅛	27	4	1¾	2¼	4	8 by 8	1⅝	1
1¼	30	4	1⅞	2½	4	8 by 8	1⅝	1
1½	36	5	2¼	3	4	10 by 10	2	1¼
1¾	42	5	2⅝	3½	5	10 by 10	2	1¼
2	48	Nut	3	4	5	12 by 15	2¼	1
2¼	54	Nut	3⅜	4½	6	12 by 15	2¼	1
2½	60	Nut	3¾	5	6	12 by 20	3	1½

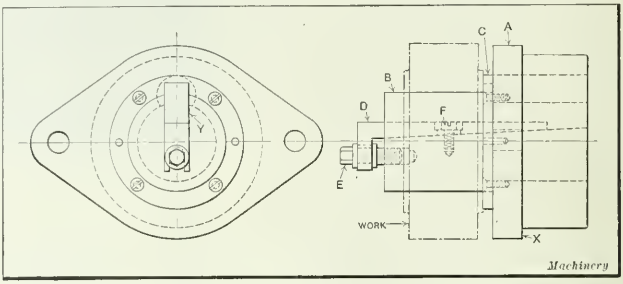
Machinery

* * *

WORK-HOLDING FIXTURE FOR BROACHING MACHINE

By F. WILLIAM STEIN

The accompanying illustration shows a fixture designed for holding work on a broaching machine when cutting a single keyway in a part. A feature of this design is that the broach can be readily readjusted after it has been removed for grinding. The cast-iron part *A* is bolted to the faceplate of the broaching machine, surface *X* being in contact with the front of the faceplate. The work, which is indicated by dot-and-dash lines, is mounted on the steel broach guide *B*, which is a press fit in part *A*. In this guide is a slot *Y* in which the broach operates. The bottom surface of the slot is tapered to correspond with the taper surface on the adjusting wedge *D*. This wedge is clamped to guide *B* by means of a fillister-head machine screw *F*. The head and a portion of the body of this screw are contained in a counterbored elongated slot in the wedge, which permits a certain amount of longitudinal movement of the wedge when the collar-head screw *E* is turned.



Broaching Machine Work-holding Fixture which permits Vertical Adjustment of Broach

When this movement of the wedge takes place, the position of the upper surface of the wedge is altered slightly, because of the taper of its bottom surface. Therefore, as the bottom of the broach rests upon the upper surface of the wedge, this arrangement permits a vertical adjustment of the broach. The screw *F* must be loosened, of course, before making an adjustment, and retightened after the adjustment has been accomplished. The clearance hole for the broach in part *A* is comparatively large, and so a steel washer *C* is provided to furnish a backing for the work when broaching work made of a soft metal. This washer is attached to part *A* by means of dowel-pins and flat-head machine screws and has a slot in it that slightly clears the teeth and sides of the broach. The surface on guide *B* upon which the work is mounted is hardened and ground to suit the hole in the work, while the surfaces of slot *Y* are hardened and ground to suit the broach. Washer *C* and adjusting wedge *D* are also hardened and ground.

* * *

The volume of aluminum castings, especially those containing copper, may be permanently changed by heat-treatment. Their degree of hardness may also be changed. These facts are considered when heat-treating aluminum parts such as pistons, which are intended for operation at a high temperature. The pistons are generally given a heat-treatment which will cause a permanent change in the volume to such an extent that no additional change will occur when running.

MACHINE SHOP EQUIPMENT FOR TRADE SCHOOLS

A question that is often asked by those who are responsible for the equipment of trade schools or technical high schools is, "What equipment is most suitable and how much equipment is required?" This question has been answered by a booklet published by the South Bend Lathe Works, South Bend, Ind., and copyrighted by J. J. O'Brien and M. W. O'Brien. From the information contained, the accompanying table of standard trade school equipment has been compiled. Five different equipments are given, because the size of the equipment for any one school depends upon the number of boys that are to be trained. Equipment No. 1, suitable for a small school shop, would cost only from $800 to $1000 at present prices. The other equipments would cost correspondingly more; for instance, equipment No. 5, for a school with ninety boys, would cost from $15,000 to $18,000.

STANDARD TRADE SCHOOL EQUIPMENT

Equipment No. 1—Cost, $800 to $1000
Suitable for Small School Shop

1 engine lathe, 15-inch swing, 6-foot bed
1 tool-room grinder, 8 by ¾ inch, with column
1 electric motor, 2 horsepower
10 feet of shafting, 1 15/16 inches; 2 hangers, belting, and pulleys
1 independent four-jaw chuck, 8-inch
1 straight turning tool
1 right-hand turning tool
1 left-hand turning tool
1 right-hand side tool
1 left-hand side tool
1 straight cut-off tool
1 threading tool
1 drill chuck, 0 to ¾ inch
1 set of straight-shank twist drills, 1/16 to ¾ inch in sixteenths
1 vise, 4½-inch jaws
1 adjustable hand hacksaw frame, 10-inch
1 ball-peen machinist's hammer, 1½ pounds
6 files, assorted
1 ¾-inch lathe dog
1 1¼-inch lathe dog
1 2-inch lathe dog

Equipment No. 2—Cost, $1200 to $1500
Suitable for Vocational School Machine Shop with 24 Boys in Vocational or Industrial School Course

2 engine lathes, 15-inch swing, 6-foot bed
1 back-gear power-feed drilling machine, 20-inch
1 tool grinder, 8 by ¾ inch, with column and water pot
1 power hacksaw
1 electric motor, 3 horsepower
20 feet of shafting, 1 15/16 inches; 4 hangers, belting (double ply) and pulleys
1 independent, four-jaw 10-inch chuck (reversible jaws)
1 universal, three-jaw 8-inch chuck (reversible jaws)
2 straight turning tools
2 right-hand turning tools
2 left-hand turning tools
2 right-hand side tools
1 left-hand side tool
1 straight cut-off tool
1 right-hand cut-off tool
1 threading tool
1 small boring tool
1 large boring tool
1 drill chuck, 0 to ¾ inch
1 set of straight-shank twist drills, 1/16 to ¾ inch in thirty-seconds
1 vise, 4½-inch jaws
1 adjustable hand hacksaw frame, 12-inch
2 ball-peen machinist's hammers, 1½ pounds
1 ball-peen machinist's hammer, 12 ounces
12 files, assorted
2 ¾-inch lathe dogs
2 1¼-inch lathe dogs
2 2-inch lathe dogs

Equipment No. 3—Cost, $3000 to $3500
Suitable for Vocational School Machine Shop with 44 Boys

4 engine lathes, 15-inch swing, 6-foot bed
1 metal-working shaper, 14-inch (swivel vise)
1 back-gear power-feed drilling machine, 20-inch
1 sensitive drilling machine, 15-inch
1 tool grinder, 12-inch
1 power hacksaw
1 electric motor, 5 horsepower
20 feet of shafting, 1 15/16 inches; 4 hangers, belting (double ply) and pulleys
4 independent, four-jaw 10-inch chucks (reversible jaws)
1 universal three-jaw 9-inch chuck (2 sets of jaws)
5 straight turning tools
4 each, right-hand and left-hand side tools
3 right-hand cut-off tools
2 straight cut-off tools
2 each, small and large boring tools
1 drill chuck, 0 to ½ inch
1 drill chuck, 0 to ¾ inch
1 set of straight-shank twist drills, 1/32 to 1 inch in thirty-seconds
2 vises, 4½-inch jaws (swivel)
1 vise, 5-inch jaws
1 adjustable hand hacksaw frame, 10-inch
4 ball-peen machinist's hammers, 1½ pounds
1 cross-peen machinist's hammer, 1½ pounds
1 straight-peen machinist's hammer, 1½ pounds
1 ball-peen machinist's hammer, 12 ounces
12 files, assorted
1 set of lathe dogs, ⅜ inch to 2 inches

Equipment No. 4—Cost, $8000 to $10,000
Suitable for Shop with 66 Boys

6 engine lathes, 15-inch swing, 6-foot bed
1 metal shaper, 16-inch (swivel vise)
1 universal milling machine, No. 1
1 metal planer, 24-inch by 24-inch by 6-foot, with 18-inch planer chuck
1 back-gear power-feed drilling machine, 20-inch
1 sensitive drilling machine, 15-inch
1 power hacksaw No. 1
1 tool grinder, 12-inch
1 electric motor, 10 horsepower
28 feet of shafting, 1 15/16 inches; hangers, couplings, pulleys, and belt (double ply)
6 independent four-jaw 10-inch chucks (reversible jaws)
1 universal three-jaw 9-inch chuck (2 sets of jaws)
14 turning tools (8 straight, 4 left-hand, and 2 right-hand)
9 cutting-off tools (4 straight, 3 right-hand, and 2 left-hand)
6 side tools (4 right-hand and 2 left-hand)
2 each, small and large boring tools
1 drill chuck, 0 to ½ inch
1 drill chuck, 0 to ¾ inch
1 set of straight-shank twist drills, 1/32 to 1 inch in thirty-seconds
1 set of drills, No. 0 to No. 60
4 vises, 4½-inch jaws
1 vise, 5½-inch jaws
2 hacksaws, 10-inch
6 ball-peen machinist's hammers, 1½ pounds
2 cross-peen machinist's hammers, 1½ pounds
1 straight-peen machinist's hammer, 1½ pounds
2 straight-peen machinist's hammers, 12 ounces
1 set of lathe dogs, ⅜ inch to 2 inches

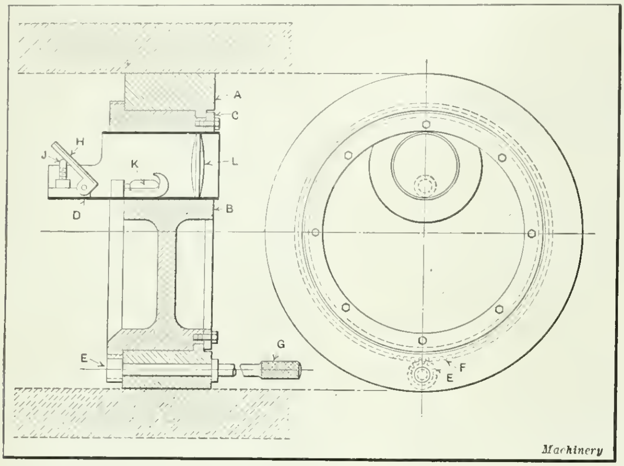
Equipment No. 5—Cost, $15,000 to $18,000
Suitable for Shop with 90 Boys

10 engine lathes, 15-inch swing, 6-foot bed
2 engine lathes, 18-inch swing, 8-foot bed
1 planer 24-inch by 24-inch by 6-foot with chuck (swivel base)
1 universal milling machine with vertical attachment
1 universal grinding machine
1 shaper, 15-inch (swivel base vise)
1 back-gear power-feed drilling machine, 20-inch
1 combination and dry tool grinder, 14-inch
1 sensitive drilling machine, 15-inch
1 arbor press
1 power hacksaw
64 feet of shafting, 1 15/16 inches; couplings, hangers, pulleys, and belting (double ply)
1 electric motor, 15 horsepower
10 independent four-jaw, 10-inch chucks
2 independent four-jaw 12-inch chucks
3 universal three-jaw 9-inch chucks
21 turning tools (12 straight, 6 left-hand, and 3 right-hand)
12 side tools (10 right-hand and 2 left-hand)
11 cut-off tools (8 straight and 3 right-hand)
3 threading tools
2 each, small and large boring tools
1 knurling tool
1 set of lathe dogs, ⅜ to 2 inches
10 ball-peen machinist's hammers, 1½ pounds
2 cross-peen machinist's hammers, 1½ pounds
2 straight-peen machinist's hammers, 1½ pounds
4 straight-peen machinist's hammers, 12 ounces
1 drill chuck, 0 to ½ inch
1 drill chuck, 0 to ¾ inch
1 set of straight-shank twist drills, 1/32 to 1¼ inches in thirty-seconds
1 set of drills, No. 0 to No. 60
1 drilling machine vise
6 vises, 4¼-inch jaws
2 hacksaw frames, 10-inch
24 files, assorted
1 planer tool
1 set of horizontal milling cutters
1 set of vertical milling cutters

REFLECTING DEVICE FOR INSPECTING BORES

By L. E. OLSEN

The reflecting instrument illustrated, while primarily developed for use in inspecting the bores of guns, may be used with equal advantage for examining the interior of any cylindrical work, where a visual inspection of the walls is desired. This reflecting device was developed by Major R. Cockburn while engaged on ordnance inspection work in France.



Instrument used in examining Interior Cylindrical Walls, such as Gun Bores

The reflector consists of a tube *D* in which, at one end, is mounted a bi-convex lens *L*. The opposite end of the tube is cut away as shown, and has mounted within it a mirror *H* which can be adjusted, by means of screw *J*, to the desired angular position. Midway between the mirror and the lens is an electric lamp *K*, its position being such as to illuminate portions of the wall, or bore, so as to bring them into direct observation. When the device is used on large-diameter work, the tube is carried in a spider *B* which may be revolved in drum *A*. This drum may be made to suit the diameter of the work being inspected, and is provided with the plate *C* which is attached to the spider by means of screws for the purpose of holding the parts together. The flange on the inner side of the spider has gear teeth cut in it, which engage pinion *E* carried on handle *G*. The operating handle may, of course, be extended to suit the length of the bore being inspected. It will be seen that the instrument can be adjusted longitudinally in the bore; also, by revolving spider *B* the wall may be observed from any angular position, both adjustments being made by means of the operating handle. When used on cylindrical work over 200 inches in length, no difficulty is experienced in discerning any portion of the wall, but for work which is longer than this a pair of binoculars should be used in connection with the reflector.

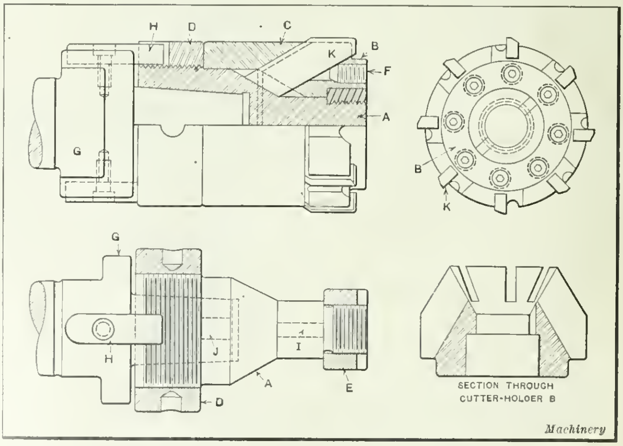
It has previously been mentioned that an instrument of this kind is especially valuable for inspecting gun bores. The need of such an instrument will be more fully appreciated when it is stated that erosion manifests itself in guns by the hardening and cracking of the rifled surfaces, as well as by the formation of pockets. The result is disastrous to the effectiveness of the gun. The bore also becomes enlarged so that the projectile does not fit tightly, with the result that the gases generated by the explosion escape between the projectile and the surface of the bore, and do not exert the contemplated pressure. A surprisingly low number of rounds is required to place a gun in a condemned or nondependent stage; for example, a 75-millimeter gun is condemned at 1000 rounds, and as the size of the gun increases the length of life decreases so that a 406-millimeter howitzer is not dependable after 83 rounds. From data such as this, it is found that the active life of a 75-millimeter gun is only about 25 seconds. It may be of interest to note that the 381-millimeter German gun which was used in the recent war could not be used for more than 30 rounds.

* * *

ADJUSTABLE BORING HEAD OR REAMER

By FRANCIS CONDIE

The boring head or reamer here described was developed by the writer for boring gasoline engine cylinders and is slightly different in design from the usual type. This tool may be inexpensively made, and its cost of upkeep is correspondingly low. It may be made either integral with the shank or separable, as desired. The illustration shows a part-sectional assembly view of the tool, a view of the tool with the cutter-holder and the cutters removed, as well as a section through cutter-holder *B*. A description of the method of adjusting the tool should not be necessary. The main body *A* carries two adjusting nuts *D* and *E*, threaded to it, as shown in the lower part of the illustration. The backing-up collar *C* fits over the body *A* and bears against nut *D* so as to support the individual inserted steel blades *K*. These blades are adjustable in slots in the cutter-holder *B* in which they fit, each being secured in its respective slot by means of a set-screw *F*. The cutter-holder *B* and the backing-up collar *C* are prevented from rotating by means of the keys *I* and *J*. If the reamer is not made integral with the shank, it may be driven by means of two dogs *H* which are attached to the shank *G*, and which engage suitable slots in the nut *D*. All the parts of this tool, except the cutter blades, should be made of machine steel, pack-hardened and ground all over. The blades, which preferably should be made of stellite or high-speed alloy steel, should be ground all over and made a sliding fit in the slots of the holder.



Special Tool used in boring Gasoline Engine Cylinders

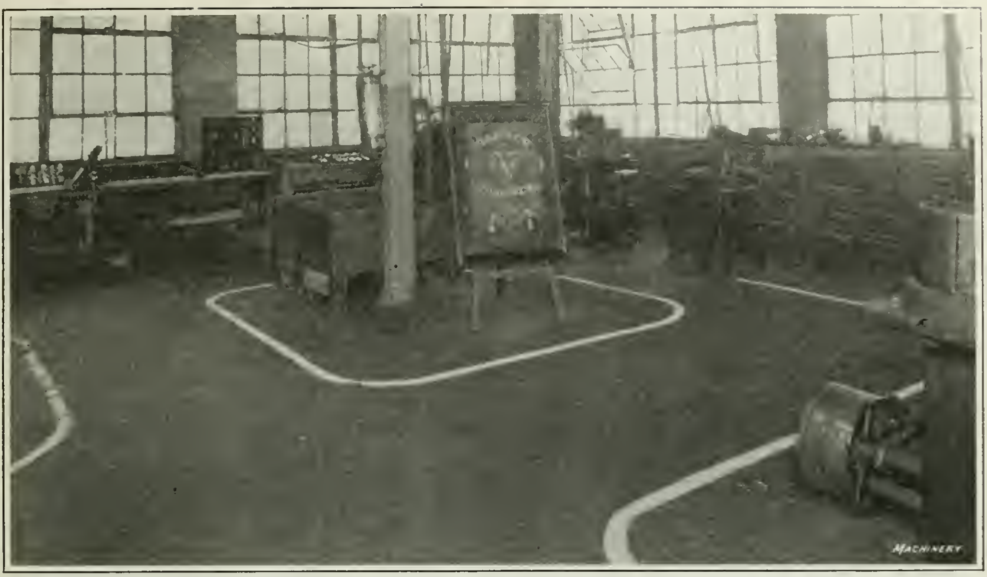


Fig. 1. Banner which remains for One Month in the Department receiving the Highest Rating for Cleanliness

Encouraging Cleanliness in the Factory

System Adopted by the Timken-Detroit Axle Co., Detroit, Mich., for Promoting Cleanliness and Efficiency

At the plant of the Timken-Detroit Axle Co., Detroit, Mich., a campaign has recently been inaugurated to encourage foremen to keep their departments neat and clean. A superficial consideration of the subject might lead to the conclusion that this is not a factor that vitally affects efficiency in manufacturing; but since the records of foremen whose departments have been found in the best condition by inspectors who conduct a monthly investigation have been available for comparison with the records of foremen whose departments have reached the highest efficiency in manufacturing, it is noteworthy that the men who have been getting out the greatest amount of work with the least quantity of spoiled parts are those who also keep their departments the cleanest and in the most presentable condition throughout.

There are two competitions constantly in progress in the Timken plant in which all foremen are competitors. The awards for one competition are made to the two men whose departments are found to be in the most orderly condition, and the awards in the other competition are based upon the degree of efficiency attained in the performance of manufacturing operations. Each award is made monthly. For cleanliness, there are two trophies which circulate from department to department and remain for the month following their award. The first prize is a banner, shown in Fig. 1, and the second award is a shell, illustrated in Fig. 2. The name of the department foreman is engraved on the shell opposite the month for which it remained in his section of the plant; and a shell of exactly the same design remains permanently in the office of the general superintendent.

Fundamentally, this campaign to encourage cleanliness was inaugurated with a view to improving conditions that have a direct bearing upon the efficiency with which manufacturing operations can be performed or those which affect the health of the operatives. For instance, it was the aim to see that aisle spaces were kept clear to facilitate efficiency in trucking, but the scope of this work has now been extended to a point where the inspectors in conducting their monthly investigations take into account such points as the presence of unused clothing hanging on the walls or posts; the presence of dirty rags, old gloves, etc., on benches or window sills; the cleanness of the windows and all similar conditions. Special blanks are provided for the inspectors' reports.

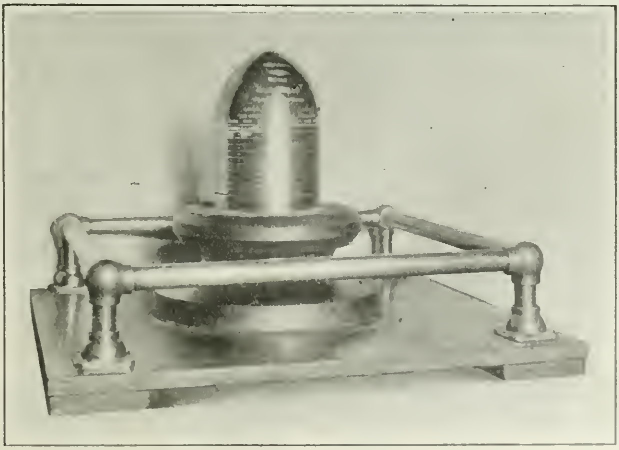


Fig. 2. Shell which remains for One Month in the Department receiving Second Highest Rating for Cleanliness

For the competition for efficiency attained in the performance of manufacturing operations there is another shell which remains in the office of the factory manager, the names of the foremen winning this prize being engraved month by month, as in the case of the shell which is awarded for cleanliness. Each foreman in the plant is also awarded a bonus on his regular rate of pay, which is based upon the manufacturing efficiency that is attained by his department, the method by which the bonus is calculated being as follows: The normal rate of production is fixed at 600 sets of axles per day, and for an output equal to 80 per cent of this standard the foreman receives a bonus of 0.5 per cent, the bonus increasing uniformly from that figure up to 30 per cent of his pay for the attainment of an efficiency of 100 per cent of the normal rate of output. Thus, for each 1 per cent increase in efficiency from 80 up to 100 per cent of the plant's normal capacity, the foreman receives a bonus of 1½ per cent of his wages. For each 1 per cent of increased efficiency over 100 per cent of the normal plant capacity, the bonus rate is 2 per cent, so that for a production of 900 axles per day, which is 50 per cent over the normal rate of output, the foreman would receive a 100 per cent bonus on his wages.

In connection with this bonus plan an effort is made to impress upon foremen the vital importance of reducing the spoilage of parts to a minimum, and with that idea in mind, deductions are made from each foreman's bonus credit for an excessive amount of spoiled work. The normal rate of spoiled work is fixed at 2 per cent of the daily output, and for each 0.5 per cent in excess of the normal rate, a deduction of 1 per cent is made from the foreman's efficiency record and, consequently, from his credit for the special bonus. It will be apparent from the preceding discussion that the foreman who earns the highest bonus for the month is also the man who has his name engraved on the shell which remains in the office of the factory manager.

* * *

Good electrolytic copper, according to the *Scientific American*, should have approximately the following analysis: Copper, 99.95; silver, 0.001; oxygen, 0.039; sulphur, 0.003; arsenic, 0.0015; antimony, 0.0020; nickel, 0.0015; iron, 0.0025; lead and bismuth, none; selenium and tellurium, trace.

ANDREWS RUSTPROOFING PROCESS

To provide for the rustproofing of ferrous metals in order that they may be used as a substitute for copper, brass, bronze, etc., a process has been introduced into this country by the Andrews Rustproofing Laboratories with offices at 821 Book Bldg., Detroit, Mich., which was successfully used by British munition plants for protecting cast-iron fuse bodies during the last two years of the war. This process is applied by subjecting the work to a temperature of from 1150 to 1180 degrees F. in the presence of an oxidizing atmosphere, which results in opening the pores of the metal and sealing them with a layer of iron oxide. It is stated that the process was used by the British Government under conditions which thoroughly proved that it does not distort the work nor alter its dimensions. As a result of this feature, the Andrews rustproofing process can be used for protecting the surfaces of threaded work and similar parts which will later be required to assemble with corresponding close-fitting parts. On a production of over 100,000 fuse bodies rustproofed in March, 1918, there was less than 2 per cent of rejections for distortion which is a remarkably low average, bearing in mind the close limits that were required on these parts. This method of rustproofing applies a rich ebony-colored finish, which is of pleasing appearance and is said to be permanent as regards durability. The cost of operation is low, as unskilled labor may be utilized after the furnaces have been regulated and the burners sealed to assure operation under specified conditions that are adapted for the work in hand. An idea of the low cost at which parts can be rustproofed by this process will be gathered from the fact that the cost of rustproofing one type of parts weighing 2½ pounds was only ½ cent.

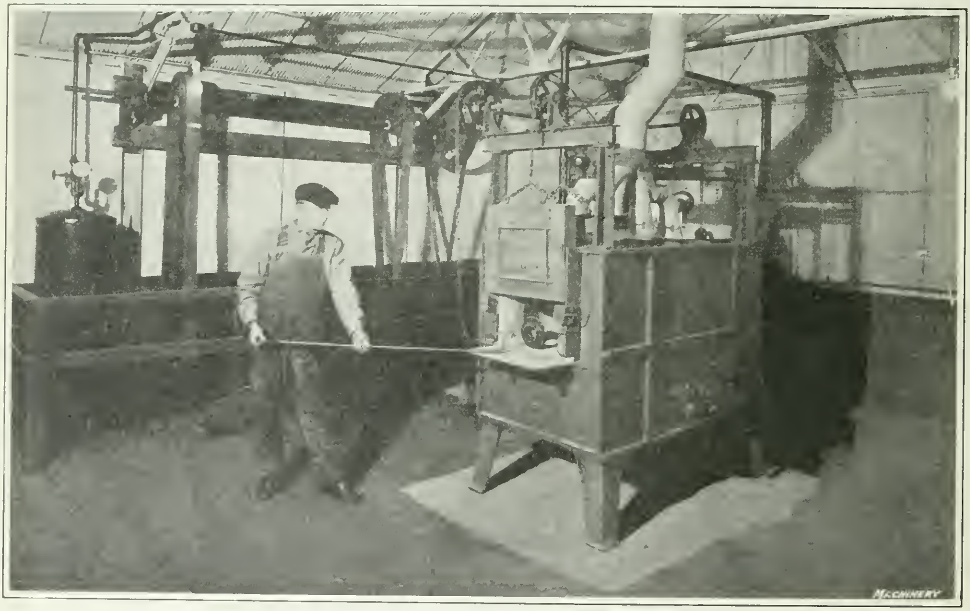


Fig. 1. Furnace used for rustproofing by the Andrews Process

How the Method is Applied

The Andrews process of rustproofing may be used in finishing machine parts or those which have been cast, rolled, stamped, etc. It is conducted by supporting the work on racks or some other convenient form of holder that will allow the oxidizing atmosphere of the furnace to come into intimate contact with all surfaces of the work to be rustproofed. Care should be taken not to lay the work on a rack or other form of supporting member which has a flat surface of any appreciable size in contact with the work, as such a condition would tend to retard the rustproofing process and prevent the obtaining of a uniform surface. In addition to detracting from the appearance, such a failure to rustproof the entire surface uniformly would also greatly detract from the efficiency of the treatment in preventing the formation of rust.

If moisture or any other corrosive element is able to penetrate beneath the rustproof surface at any point, it will start a formation of rust which will then proceed without restraint. The work to be treated is placed in the furnace and allowed to remain for a period of approximately fifteen minutes, after which it is removed and quenched in oil of a special composition. The work is then removed from the oil and dried in sawdust or by any other means, and finally it is rubbed to remove any slight traces of oil which may still adhere to the work, and to impart the desired degree of luster. Not only does this process afford an opportunity to substitute parts made of inexpensive ferrous metals in place of more expensive brass, copper, or other materials formerly employed, but it is also claimed to be the means of making a substantial improvement in the appearance of the work. The Andrews Rustproofing Laboratories are licensing manufacturers to use this process on a royalty basis.

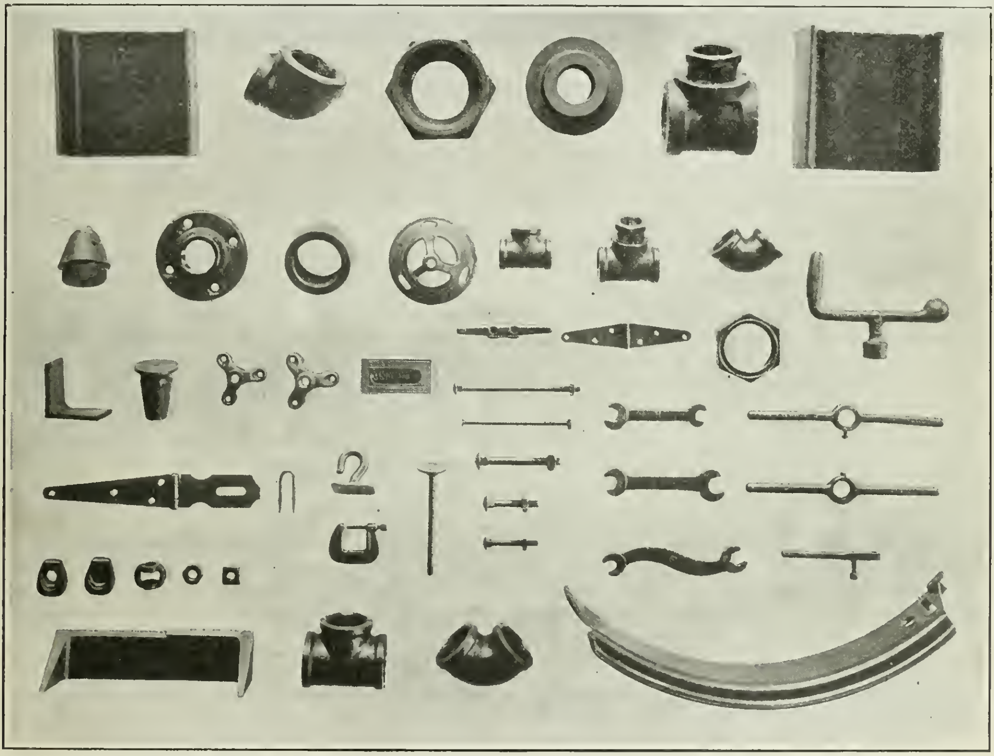


Fig. 2. Exsmples of Work rustproofed by the Andrews Rustproofing Process

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According to a recent commerce report, the price of French steel cannot be reduced materially for some time owing to the existing wage scales and the present cost of living, both of which are three times what they were before the war, while coal is six to ten times higher than before the war.

ELECTRO-DEPOSITION OF IRON IN REPAIRING MOTOR VEHICLES

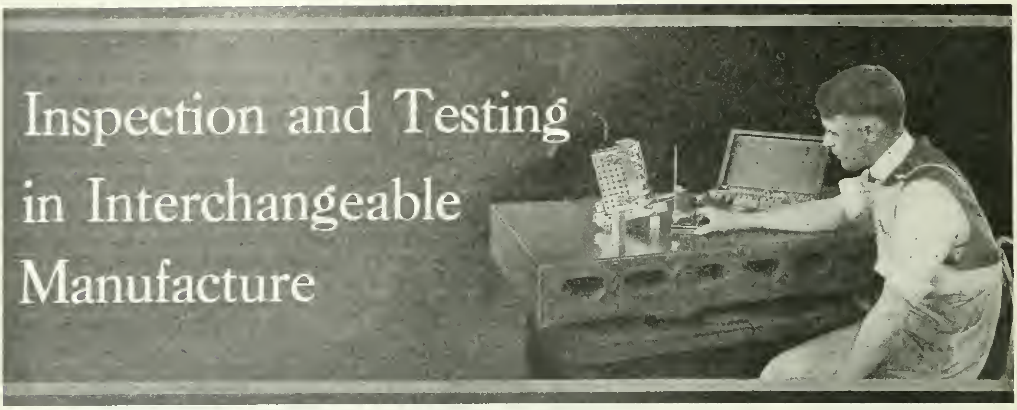
Methods of obtaining the electro-deposition of iron in the repair of motor vehicles were described recently before the Institute of Automobile Engineers by B. H. Thomas who developed the process. It has been found possible to deposit a layer of iron up to about 1/16 inch in thickness on any simple cylindrical surface of wrought iron or steel. This layer adheres firmly to the base metal when the work is properly done, and it is practically impossible to chip it away with hammer and chisel. The surface on which it is deposited does not require preliminary coppering. The layer can be subjected to a red heat without apparent deterioration, can be carburized and hardened, and presents a very smooth surface. This surface can be filed or ground and takes a high polish. The process has proved entirely satisfactory on such parts as brake- and clutch-shaft ends and starting-handle spindles.

* * *

DEMAND FOR STEEL PRODUCTS IN FRANCE

It is reported that steel manufacturers and merchants throughout France believe that the present demand in France for foreign steel products, including plates, sheets, beams, channels, iron rods, tubes, and angles for railroad car construction will continue for at least a year. No home-made plate is available for the independent shipbuilding plants, and such ship plate as is now produced passes directly from the mills to shipyards in which the mills are financially interested. Lack of coal and coke has already reduced the iron and steel production to one-third, but conditions are gradually improving and it is predicted that two-thirds the pre-war capacity will be attained within a year.

Inspection and Testing in Interchangeable Manufacture



Principles Involved in the Inspection of Interchangeable Parts, and Duties of Inspection Department

By EARLE BUCKINGHAM, Engineer, Pratt & Whitney Co., Hartford, Conn.

With any system of inspection, the tendency of the productive departments is to neglect all thoughts of the ultimate use of the parts in process and to concentrate on efforts to increase production, the standard of quality apparently being anything that the inspector will not reject. Thus, an unfortunate situation almost inevitably arises, the production departments considering only the detailed manufacturing problems and constantly seeking the line of least resistance as regards the machining; while the inspectors either connive at this or arbitrarily insist on the exact letter of the drawings and specifications without regard to the ultimate use of the part in question.

Neither of the above forms of inspection is satisfactory. In previous articles on interchangeable manufacturing published in Machinery, it has been pointed out that seldom, if ever, are the drawings and specifications complete or correct enough to be followed blindly. The mere meeting of the drawing requirements is not in itself the prime object of manufacturing. The main purpose in all branches of interchangeable manufacturing is to promote the economical production of satisfactory mechanisms. If the inspection is to accomplish its part in this work discretion should be used, and due consideration should be given to many factors.

Discrepancy between Part and Drawing

When a piece of work is not in accordance with the component drawing, any one of several conditions may be present: First, the part may be wrong and the drawing correct. Second, the part may be correct and the drawing in error. Third, both the part and the drawing may be correct. And fourth, both the part and the drawing may be wrong. In the first case, if the part cannot be salvaged, it must be scrapped. In the second case, the part should be accepted and steps taken immediately to have the drawing corrected. The third case requires more consideration. For almost every problem there is more than one satisfactory solution. If the part as made can be reproduced at a lower cost than one in accordance with the drawing, the part should be accepted and the drawing corrected accordingly. But if the part as made is more difficult to reproduce, the drawing should remain unchanged, although the part need not be rejected. In the fourth case, if the part cannot be salvaged, it is, of course, scrapped; but the necessary corrections should be made on the drawing as soon as possible.

In all of this work, due consideration must be given to the succeeding manufacturing operations and the equipment provided for performing them. When elaborate manufacturing equipment is provided, it is often cheaper to scrap parts that might otherwise be salvaged, because of the difficulty of completing them with the existing equipment. It is obvious that when a great volume of production is involved, discretion can be exercised by but few of the inspection personnel. Hence any abnormal volume of rejections by the inspectors should be the occasion for a re-inspection of the rejected parts by suitable persons competent to locate the error, whether in parts or drawings.

Incomplete Drawings and Specifications

The original drawings seldom give information complete in every detail which is necessary to produce every part. The production departments, however, must complete the parts with or without the assistance of the drawings and specifications, while the inspection department must decide whether or not the parts thus produced are satisfactory. The first solution of some of these indefinite points may not be the best one, and several different methods may be tried out before one that is entirely satisfactory is reached. During all this development, the inspector must give a great deal of consideration to the problem so as not to delay production unnecessarily and still insure a satisfactory product. As soon as any problem is solved, the inspection department should be responsible for passing the information along to the proper persons so that it may be recorded.

Position of Inspection Department

This makes it clear that the inspection department, among its other duties, must act as eyes for the engineering department. For this reason, in some plants the inspection department reports to, and is virtually a part of, the engineer-

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The proper inspection of the many parts of an interchangeable product is one of the most important as well as most difficult tasks in manufacturing. On the one hand, if inspection is carried on in an arbitrary and exacting manner, it will retard production and increase the cost of manufacture. On the other hand, if it is done in a perfunctory and lenient manner, it is worse than useless, as it will not prevent the sending out of an unsatisfactory product. The principles of inspection formulated in this article, if correctly applied, will promote the economical production of parts on an interchangeable manufacturing basis and will insure that all requirements are met.

ing department. In other plants, it is a distinct department and is responsible to the management. Either plan usually works out well. In no event should it be a part of, or subordinate to, any production department. The duties of the production and inspection departments are so incompatible that they should never be combined, and if they are, one or the other is bound to suffer. Nevertheless, the inspection should be carried on in close cooperation with the production departments, as well as with all other departments of the organization.

The mechanical inspection of component parts falls logically into two main divisions: The first is the shop inspection which is performed while the parts are in the process of manufacture. The object of this inspection is to cull out defective work as early as possible and to discover any defects in the manufacturing equipment which result in faulty work. The second division is the final examination of the completed parts. The object of this is to see that all components that will function properly are accepted, and all unserviceable parts rejected. There is also the inspection, or testing, of the assembled mechanism to detect faults that have not been detected prior to assembling the parts.

Shop Inspection Methods

When the production is continuous, the shop inspection should be so established that the parts are rigidly inspected after each machining operation on every important functional surface. The requirements of these surfaces should be definitely determined and recorded as early as possible, and these requirements should be rigidly maintained. These inspections are as important as any of the productive operations, and should be maintained accordingly. The inspection of non-functional and other unimportant surfaces can usually be handled by an inspector who passes from department to department and periodically checks a small percentage of the product at each machine. If errors are discovered, the machine should be stopped and the set-up corrected, but the parts at fault should not necessarily be rejected.

> **The person in charge of inspection has one of the most difficult positions to fill. A great part of his work in promoting economical production is to prevent faulty parts from being made—not only to prevent them from being used. When an operation is first set up, the product should be checked. Even when it is satisfactory, succeeding parts must be watched so that errors may be corrected before any appreciable amount of work is spoiled. To fulfill these duties properly without antagonizing those engaged in production, is a task requiring tact and diplomacy. An arbitrary inspector would stop production entirely; while on the other hand, an inefficient inspector can soon ruin the reputation of the firm. A grave mistake on the inspector's part in either direction will cause much needless expense.**

The inspectors are, of course, supplied with the necessary gages, limit gages being essential for most of the important functional surfaces, while "Go" gages alone are usually sufficient for surfaces of lesser importance. Definite lists of the essential inspections or important functional surfaces should form a part of the specifications. These may be combined with the operation lists or may be made up as separate schedules. Whether or not each individual piece of work should be inspected depends largely on the character of the operation. On many automatic operations, a percentage inspection is sufficient; while on most hand operations, where each piece is handled individually and the personal skill of the operator is a factor, a one hundred per cent inspection is usually required.

The inspection of screw machine parts made from bar stock is a case where the inspection of a minor percentage is sufficient. The practice in one plant is as follows: Each automatic screw machine has, as part of its equipment, several small metal work boxes or baskets which are numbered consecutively. These are used in order, and about every fifteen minutes the one on the machine is removed and placed on a bench, while the one with the next number is placed on the machine. An inspector makes periodical visits and inspects a few parts from each basket. If these are satisfactory, all the parts are removed and the empty basket is returned to the machine operator. If a faulty piece is found in any basket, the entire contents of that basket, all succeeding ones, and also the one preceding it, are set aside for a one hundred per cent inspection while the machine is stopped immediately and its set-up corrected.

This general plan is adaptable to many other operations, such as sub-press die work and other punch press operations, for example, where the set-up and condition of the tools alone practically control the uniformity of the product. The shop inspection should be carried on as soon after the machining operations as possible. In the case of very large parts, the piece is often inspected before it is taken from the machine, which saves a new set-up if corrections are necessary.

Personnel of Shop Inspection

Much of the detail work of testing the parts with gages, particularly on small work, requires little mechanical knowledge or skill, and is often satisfactorily performed by girls. When the quantity of production is large, and the inspections are subdivided into elementary tasks, a relatively small amount of training will develop efficient detail inspectors. The supervisor of such work, however, should be not only a good mechanic, but also a person well acquainted with the requirements of the product. The successful chief inspector must be firm but diplomatic; his duties must never degenerate into faultfinding.

The person in charge of the shop inspection has one of the most difficult positions to fill. A great part of his work in promoting economical production is to prevent faulty parts from being made. When an operation is first set up, the product should be checked. If it is satisfactory, the succeeding parts must be watched so that the set-up may be corrected before any work is spoiled. If the first parts do not meet the requirements, the set-up must be corrected before production in quantity is started. To fulfill these duties properly, without antagonizing those engaged in production, is a delicate task and the closest cooperation is necessary. An arbitrary inspector will soon stop production entirely. On the other hand, an inefficient inspector can soon ruin the reputation of the firm. A grave mistake on the inspector's part in either direction will inevitably cause much needless expense.

Final Inspection of Work

In many ways the function of the final inspection is quite different from that of the shop inspection. The latter deals with the parts as they are being shaped from the raw material. Nothing should be left undone to promote their completion in accordance with the drawings and specifications. The final inspection, on the other hand, deals with the parts after all the machining operations have been completed. Its main function is to see that all parts which will give satisfactory service are accepted, and that those which will not are scrapped. This result alone should be striven for, regardless of technical violations of the drawings and specifications. Under normal conditions, such violations should be rare. If conditions are abnormal, steps should be taken to correct them, but such steps should never involve the rejection of serviceable parts.

In general, gages used in the final inspection should be functional gages only. If the detailed shop inspection is properly organized, there is no need to duplicate it here. If it is not functioning properly, the trouble should be corrected at its source. Both the shop inspection and the final inspection should be under the general direction of the same person. All final decisions as to the acceptance of questionable material, whether questioned by the shop inspection or the final inspection, should also be made by the same person.

One of the duties of the inspectors who perform the final inspection should be to watch the work of assembly, in addition to testing the assembled product. If the component parts assemble properly, and the completed mechanisms function as they should, no further evidence is needed that the productive work has been properly done. If the parts give trouble in assembling, or the mechanism fails to function, immediate steps should be taken to locate the trouble and correct it at its source. Thus the assembling departments form the best points of vantage to watch and judge the results that are being obtained.

Inspection of Gages and Material

The inspection of the gages used in the course of manufacture is one of the vital functions of the inspection department. As gages become worn, they permit parts larger or smaller, as the case may be, to pass inspection. The adjustment of a machine or tool is not changed as long as the parts produced satisfy the gages used in their inspection, and so all gages should be checked periodically and corrected or replaced as found necessary. Too often this is not done until trouble has developed. One of the principal objects of inspection is not to locate the cause of trouble after it has happened, but to forestall and prevent it. A systematic inspection of gages is one of the surest means of accomplishing this end.

One of the duties of the inspector who performs the final inspection should be to watch the work of assembling, in addition to testing the assembled product. If the parts can be assembled easily and the completed mechanism functions properly, it is the best possible evidence that the work of the production department has been properly done. If the parts give trouble in assembling or the mechanism fails to function, immediate steps should be taken to locate the trouble and correct it. Thus the assembling department forms the best point of observation for judging the results obtained by the productive organization.

Most of the inspection of the composition and physical strength of materials belongs in the chemical and metallurgical laboratories. When a part is subjected to unusual stress, it is customary to make a chemical analysis of each bar of stock as it is received. This, and other specified physical tests are seldom considered in connection with the mechanical inspection of the product. Often, however, after such operations as forging, hardness tests are made in conjunction with the other inspections to insure that the metal is in proper condition to be readily machined. Such tests are usually made with simple testing instruments, such as a Brinell testing machine or a scleroscope, the mechanical operation of which requires no more skill than the proper handling of gages, and are, therefore, usually conducted by the regular mechanical inspection personnel.

Testing of Assembled Mechanisms

Whenever possible, the assembled mechanism is tested by actually having it perform the work it is intended for. Thus, a newly completed automobile is usually sent out for a road test before being shipped; a typewriter is manipulated by an operator; a rifle is tried out by a marksman, etc. These tests, of course, only prove the condition of the mechanism while new. The test of service depends upon the materials used in its construction and the honest workmanship which has been built into it at every stage beginning with the designing and followed by the careful and watchful work of the productive operators, the vigilance and good judgment of the inspectors, and the care and attention of the assemblers. No one factor is predominant. All are essential and each one must be carefully studied in order to develop and maintain a smooth flow of production.

DRILL JIG FOR CREAM SEPARATOR FRAMES

The machining of the cast-iron frames of cream separators involves some interesting drilling work on account of the many holes which they contain, some of which are not readily accessible. The interior of the casting contains many cored pockets of irregular shape into which holes are drilled at various angles. It is imperative that these holes be accurately located with respect to each other, and it is equally imperative, for this reason as well as for economy in machining, that they be machined without relocating the castings any more than is absolutely necessary. A jig for this work was designed by the engineers of the De Laval Separator Co., Poughkeepsie, N. Y., by means of which these operations can be performed accurately and with a minimum amount of handling. This jig and the Cincinnati-Bickford radial drilling machine on which the work is performed are shown in various positions in the accompanying illustrations, together with the set-up for drilling some of the holes in the casting.

The jig, as will be apparent by referring to the illustrations, is a heavy cast-iron frame which is supported by trunnions that have bearings in, and are supported by, two substantially ribbed standards. By supporting the frame in this manner, provision is made for tilting the work to any desired angle from the horizontal when locating the frames during the drilling operations. The work is held on pilots which fit previously bored holes in the top and bottom of the frames, so that all holes machined in this jig are located from the center line of the castings. These pilots are clearly shown in the illustrations, and it will be seen that the one which engages the hole in the bottom of the casting, shown at *A*, Figs. 1 and 2, contains a rack with which a gear meshes to advance the pilot into the hole when locating the casting in the jig. The handle *B* employed to revolve this gear also operates a locking device which prevents the work from moving from its points of support.

An upright arm *C*, containing a number of bushed holes, enables the jig to be set at various angles from the horizontal, and a plug *D*, Fig. 1, is employed to lock the jig in the position desired for any particular operation. The three views of the jig illustrated show this heavy yoke frame in three different positions, the one in Fig. 2 being the extreme angle above the horizontal, for the location of which, the use of an extension arm is required. When the maximum angle below the horizontal is required, use is made of the lowest hole in the upright arm, in which position the work is about 15 degrees from the vertical. During these various operations, the work may also be rotated on its axis to permit the holes to be machined at any desired angle. The head *E* of the jig, Figs. 1 and 3, has a number of bushed holes in it and a lock-pin *F*, Fig. 3. This illustration shows a good view of the head of the fixture. It will be apparent that a jig of this construction is universal in adjustment, in the sense that any angle including the vertical, can be obtained by making suitable allowances in the design.

Fifty-two operations are performed on the frames, and an idea of some of the tools used in these operations may be gained by observing the contents of the tool-board and work-table, Fig. 2. There are twenty-eight drilled holes, nineteen of which are tapped, four of which are faced, and one countersunk. Four auxiliary fixtures are used, so designed as to fit and fasten readily to previously planed surfaces on the

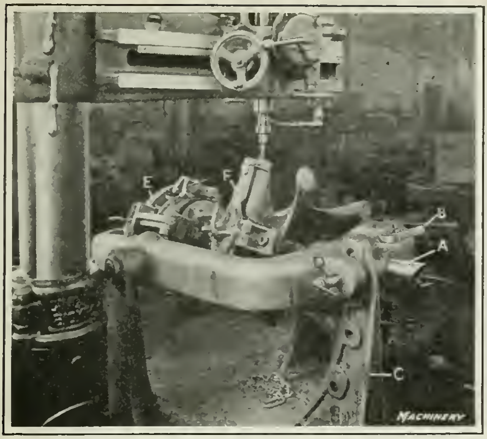

Fig. 1. Yoke Type of Jig for supporting Cast-iron Frames when machining on a Radial Drilling Machine

casting. One of these attached fixtures is shown in position at *F*, Fig. 1. It is unnecessary to enumerate each operation performed on this cream separator frame; however, mention will be made of one operation in which a hole is drilled through the bosses *G* and *H*, Fig. 2, and the ends of the bosses are faced to an accurate over-all length.

The hole is first drilled through one of the bosses, passing through the cored chamber of the casting, and is then faced with an ordinary pilot counterbore. A gage *J* is then dropped into this hole, in which it is supported by means of a drift-key driven into the keyslot in the gage. There is an opening on the side of the casting which permits the drift-key to rest on the wall of the casting, so that when driven in, its taper will wedge against the wall and hold the gage in the hole as a stop for the counterbore pilot of the tool used in facing the boss on the opposite side to the desired over-all length. It will be seen that "Presto" quick-acting collet chucks and collets are used, and also that a number of extension drills and taps are employed. The production time for the drilling operations in this jig is one hour and thirty-five minutes, floor to floor.

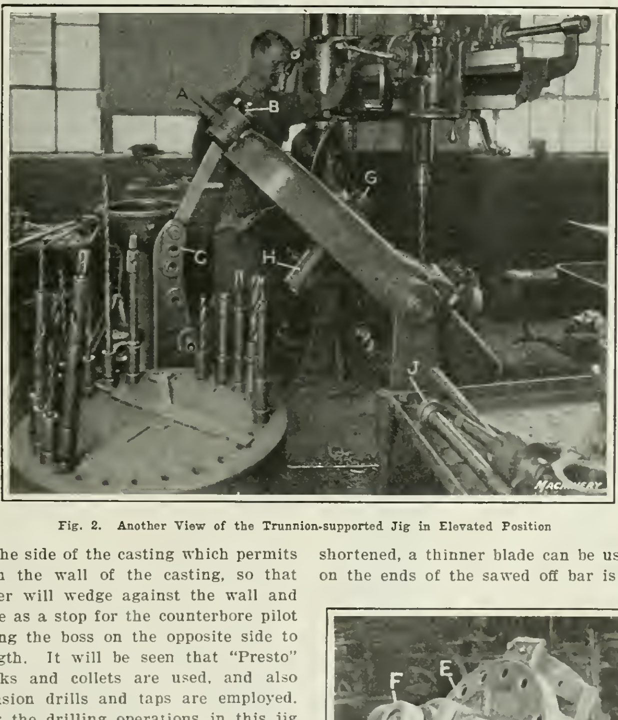

Fig. 2. Another View of the Trunnion-supported Jig in Elevated Position

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The Westinghouse Research Laboratory conducted experiments to determine what treatment would make iron-nickel alloys more readily forgeable at ordinary forging temperatures. Aluminum, chromium, magnesium, and silicon have been found to have hardly any effect, but 2 per cent of either manganese or titanium imparts the desired characteristics and makes the alloys forgeable. The theory is that these elements have the ability to so strengthen the uncrystallized material that it possesses greater strength than the crystals.

RAPID CONSUMPTION OF OIL SUPPLY

A paper was presented before the American Iron and Steel Institute by George Otis Smith, director of the United States Geological Survey, in regard to the rapidly diminishing oil resources of the United States. Ten years ago the wells were adding 15,000,000 barrels per year to our reserve stocks, while in the last nine months the stored petroleum has been drawn upon to the extent of 15,000,000 barrels. The first three months of 1920 have established a rate of domestic production that will mean a total of 415,000,000 barrels for the year, while the consumption will be about 490,000,000 barrels. The estimated quantity of petroleum remaining available in the ground in the United States is 7,000,000,000 barrels; thus, if the present rate of consumption of almost half a billion barrels per year continues, the estimated supply will only last about fifteen years longer.

* * *

SAWING METAL BY HAND

Experiments have been undertaken in France to determine the best method of sawing metal by hand. These experiments indicate that it takes less time to saw off a rectangular bar of steel when the saw is moved parallel to the shorter side of the rectangle than when it moves parallel to the longer side. It was also found that the shorter the stroke of the saw, the quicker would the bar be sawed off. In sawing off a rail by a hacksaw, it required nearly three times as long when the stroke was 4 inches in length as compared with when it was somewhat less than ½ inch in length. The work performed per minute decreases regularly for each half inch increase in the length of the stroke. It is also stated that by holding down the end of the saw farthest away from the workman—not by hand but by a weight—the time required for sawing through a bar is shortened, a thinner blade can be used, and a better surface on the ends of the sawed off bar is obtained.

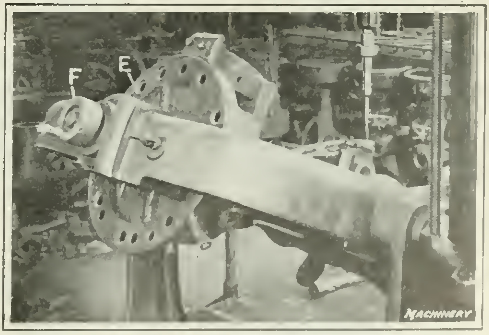


Fig. 3. View showing the Head End of the Jig and a Third Position in which the Work is held

Preventing Distortion in Hardening Tools

It is a matter of general knowledge that during the process of heat-treatment to which metal-cutting tools are subjected to give them the requisite degree of hardness, there is a tendency for the steel to be distorted. This may not be a serious matter in many cases, because, after heat-treating, the tool is subjected to a grinding process which brings it back within the required limits of accuracy. However, in the case of such tools as slitting saws, broaches, etc., the distortion may prove serious unless special precautions are taken for its prevention. In the following article a description will be given of some fixtures which have been developed by the Illinois Tool Works, Chicago, Ill., which afford means of overcoming difficulty of the kind just mentioned.

With two of these fixtures, the practice is to remove the heated tool from the furnace and clamp it in place before quenching, so that there will be practically no opportunity for the metal to spring out of its proper form. In the case of the third fixture, for use in hardening broaches and similar shaped tools, which are of very great length in comparison with their diameter, the method of procedure is quite different from that just mentioned. At the time that it is immersed in the quenching bath, the tool is being rotated at high speed. This thoroughly agitates the bath and assures a uniform cooling action on the tool. Consequently, there is very little chance of developing unequal strains in the steel and the resultant distortion that is produced by such a condition. The following description and illustrations fully explain the features of these three equipments which are used for the elimination of distortion in heat-treating tools.

Method of Hardening Circular Saws

For use in hardening circular saws and other work of the same general form, successful results are obtained through the use of a machine illustrated in Fig. 1. Briefly stated, this method consists of securely clamping the work between pointed steel pins which are able to hold the saw securely enough to prevent distortion but, owing to the extremely small areas in contact with the heated work, these pins do not tend to withdraw heat rapidly. After the work has been clamped in this way, it is submerged in the quenching bath, and as the work is rigidly held, it will not be warped out of shape during the process of hardening. Having made this preliminary statement, the following description will be readily understood. Mounted on the quenching bath *A* there are two bearings *B* and *C* which support a horizontal shaft *D*. Secured to this shaft there is an arm *E* that has a horizontal arbor *F* and a disk *G* mounted at its upper end, and distributed over the inner face of the disk there are concentric rings of pointed pins, the circular rows of pins being distributed at intervals of ½ inch from the center of the disk.

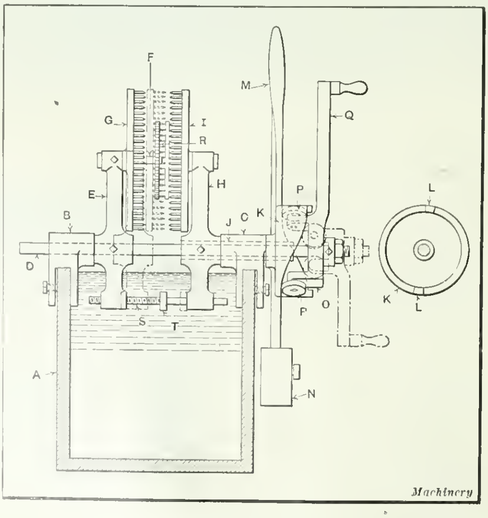


Fig. 1. Fixture for clamping Circular Saws and Similar Tools preparatory to quenching

It will be seen that there is a second arm *H* and disk *I* which are of essentially the same form as *E* and *G*, respectively; but arm *H* is secured to a sleeve *J* and abuts against the left-hand end of bearing *C*. Secured to the right-hand end of sleeve *J* there is a double-tracked cam *K* which abuts against the right-hand end of bearing *C*. The best idea of the arrangement of the two tracks on cam *K* will be gathered from the detailed end view, where it will be seen that the two tracks are divided by stops *L*. Immediately before reaching the stop *L* each cam track has attained its maximum rise and assumed a horizontal position. Secured to cam *K* there is a handle *M* which projects beyond the cam to support a counterweight *N*, the mass of which may be varied according to the size of disks *G* and *I* and of the work to be placed between these disks.

Secured to the extreme right-hand end of shaft *D* there is a yoke *O* on which two rollers *P* are mounted to run in contact with the two tracks on cam *K*. Yoke *O* is extended at one end to form a crank handle *Q*, which provides for turning the yoke through half a revolution so that the rollers *P* may run over the cam track until they come into engagement with stops *L*. In riding up the incline of the cam tracks, these rollers force yoke *O* to the right, and through positive engagement through shaft *D* and arm *E* the arbor *F* and disk *G* are also moved toward the right. The work to be hardened is shown at *R*, and as disk *I* occupies a fixed longitudinal position, it will be evident that the movement of disk *G* results in clamping the work between the two sets of pointed pins, as indicated by the dotted lines which show disk *G* in its right-hand position.

While turning handle *Q*, handle *M* is held in a stationary position to prevent sleeve *J* from turning and, as previously mentioned, when the rollers *P* come into engagement with stops *L*, they have run on the two horizontal portions of the cam tracks so that the mechanism is locked. After this has been done, lever *M* is turned through a half revolution, which causes the two disks *I* and *G* to swing downward and submerge the work in the fluid contained in quenching bath *A*. It will be evident that lever *M* is directly connected to arm *H* through sleeve *J*, and connection between arms *H* and *E* is accomplished by extending the lower ends of these arms and having a rod *S* threaded at one end to enter a tapped hole in arm *E*, while the smooth end of rod *S* slides in a reamed hole in arm *H*. An adjustable stop *T* is provided, which is set on rod *S* according to the thickness of the work *R*, so that this stop abuts against the lower end of arm *H* when the pins on disk *G* have clamped the work firmly aginst the pins mounted on disk *I*. It will be evident that when arm *M* is turned through a half revolution to submerge the work in the quenching bath, arm *Q*, which is secured to the end of shaft *D*, also turns through another half revolution. As previously stated, an arrangement of this kind rigidly clamps the work in a perfectly flat position, making distortion practically impossible.

Hardening Circular Saws between Metal Plates

Fig. 2 illustrates another method of hardening circular saws which has given very satisfactory results. In this illustration, the saw is shown at *A* where it will be seen that it rests upon pointed pins *B* which are arranged in concentric circles at intervals of ½ inch to provide for holding saws of various sizes. However, attention is called to the fact that in this case, the pins are merely utilized to support the work preparatory to clamping, and they do not exert any permanent clamping effect. Referring to the detailed illustration of a pin shown at the left-hand side of the illustration, it will be apparent that each pin *B* is supported by a compression spring *C* so that the pin may be pushed back level with the face of plate *D*. After a saw has been raised to the proper quenching temperature, it is removed from the furnace and laid on pins *B*, after which valve *E* is opened to admit air to a cylinder *F*. This causes rod *G* to rise and carry up with it the box of which plate *D* forms the upper part. If the saw were placed on plate *D* instead of on the pins *B*, one side of the saw would be cooled before the other, and cause the tool to be warped.

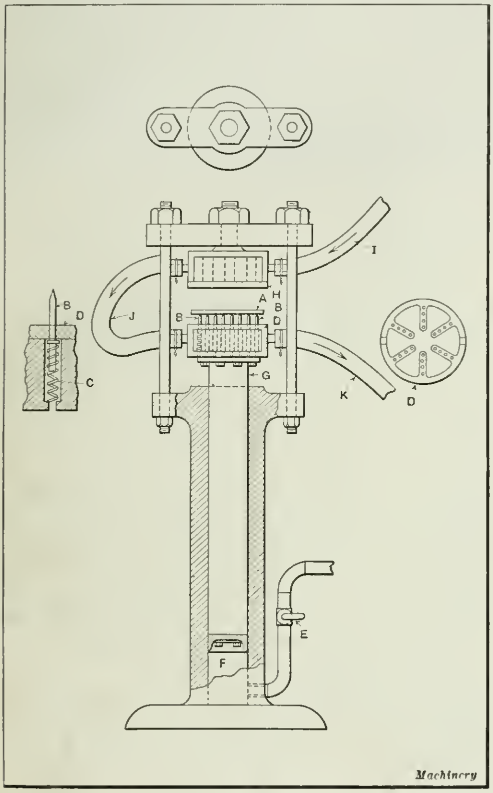


Fig. 2. Method of quenching Circular Saws between Water-cooled Copper Plates to prevent Distortion

When saw *A* comes into contact with plate *H*, further movement of rod *G* causes pins *B* to recede against the tension of springs *C*, this movement continuing until the saw is rigidly clamped between plates *D* and *H*. These plates are preferably made of copper, which is one of the best known conductors of heat; but brass, bronze, or some similar metal may be satisfactorily used as a substitute. The rapidity with which the work is quenched is further facilitated by maintaining a constant flow of water through the boxes of which plates *D* and *H* form parts. Water enters the upper box through tube *I* and thence passes through tube *J* to the lower box, finally emerging through tube *K*, the direction in which the water flows being indicated by arrows. The compressed air cylinder *F* applies sufficient pressure to hold the work tightly between plates *D* and *H* and thus prevent any danger of distortion. Valve *E* is so arranged that when turned into the position that shuts off the air, this valve also allows the air contained in cylinder *F* to be exhausted.

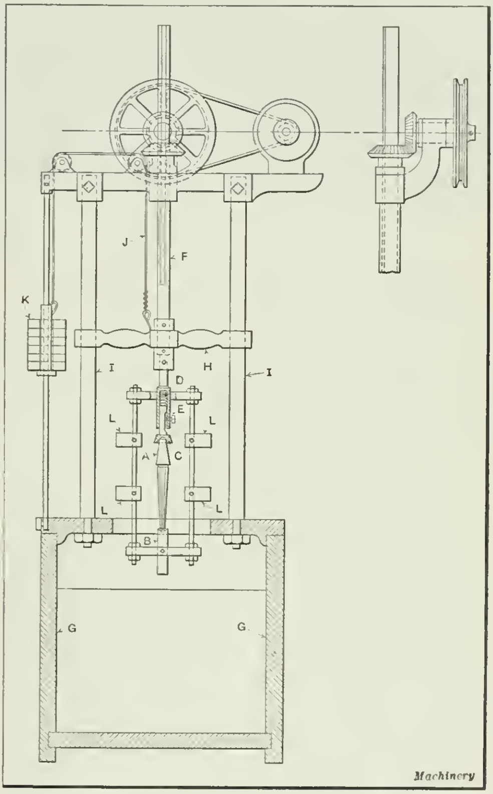


Fig. 3. Method of rotating Broaches and Similar Shaped Tools to prevent Distortion while quenching

Fixture for Preventing Distortion of Long Slender Work while Hardening

In hardening long slender tools such as drills, reamers, taps, or broaches, the prevention of distortion is successfully accomplished through the use of a fixture of the form shown in Fig. 3. Such an apparatus could also be employed with satisfactory results for handling the heat-treatment of many types of shafts, among which those used in the construction of motor cars are a typical example. After the work has been raised to the proper hardening temperature, it is subjected to a spinning action while quenching, the work being submerged in the bath in a vertical position while being rotated at high speed by the machine. A reamer *A* is shown, but the method of supporting the work would be similar in all cases. Two cup-centers *B* and *C* support the tool to be hardened, the lower center *B* being fixed, while the upper center is free to slide back in its socket against the force exerted by a compression spring *D*. A set-screw *E* projects through the wall of the socket and enters a slot in the shank of cup-center *C* to prevent it from falling out of the socket when the work is removed. Power for rotating the work is provided by an electric motor, which transmits motion to the vertical shaft *F* by means of a belt and bevel gears; and it will be seen that the shaft is splined into the driving gear to allow for imparting the necessary vertical movement.

To provide for submerging the work *A* into the quenching bath, which is located at the bottom of the machine and indicated at *G*, the operator grips handle *H* which is provided with a bearing in which the driving shaft *F* is free to rotate; handle *H* also embraces the two guide rods *I*, and is free to slide on them. Connected to the handle there is a cable *J* that runs over pulleys to a counterweight *K*, which is made of the independent disk type, so that it may be adjusted to counterbalance the weight of the work that is being handled in the machine. It will be apparent that the two work-holding centers *B* and *C* are connected by a yoke consisting of two vertical and two horizontal rods. This yoke rotates with the work, and secured to the vertical members of the yoke there are four agitators *L*, which thoroughly stir up the quenching fluid, so that its temperature is maintained uniform instead of becoming locally heated near the hot piece of work; also, this agitation prevents danger of the formation of steam pockets near the work, which would retard the process of hardening. With an equipment of this kind, uniform hardness and freedom from distortion are secured through the possibility of having heat withdrawn at the same rate from all surfaces of the work, thus preventing the development of uneven strains.

* * *

MOLDING AN ANNEALING BARREL

By M. E. DUGGAN

The following deals with a molding proposition in which the production of a casting for the rotary annealing barrel shown in Fig. 1 is involved. The casting contains no openings at either end, but has an opening, 5 by 24 inches, at the side, for charging the barrel. As first planned, the pattern was made split through the center, to be molded on its side. For the production of the body core a skeleton core-box was furnished. This method of molding was deemed inefficient by the foreman of the foundry, with the result that the problem was handled in a radically different way.

The pattern was made solid so as to mold it on end, and the skeleton core-box was changed to a regular half core-box. The assembled core weighed 575 pounds, and in molding, the pattern had to be supported on four chaplets, which are shown in Fig. 2, resting on the slab cores *F*. These cores were rammed in the bottom of the mold directly under and next to the pattern. The thickness of the walls of the barrel was ¾ inch, so that by using three wooden strips of this thickness, the core was centered in the mold. The core was held down and secured at the top by means of the four chaplets *G*, which press down on the core, their stems passing up through the cope and against a wooden cross-bar secured to the cope flask. An air vent was made consisting of two vertical channels *B*, which were connected by a cross-channel *C* located near the top of the core. This cross-channel continued on out through the core *E*, thence into the molding sand and up to the top of the mold. The slab core *E*, provided for the charging door in the side of the casting, was fastened to the body core *A* by five 20-penny nails. In using nails to hold this core to the body core, it was necessary to drill holes in the cores. Five holes were drilled with a piece of core wire through the slab core, these holes being used to locate those in the body core. The slab core was then pasted in position and nailed securely in place. The two half cores, after being pasted together, were reinforced by three binding wires *W*. Two lifting rods *D* were provided in the heavy core for lifting it from the mold.

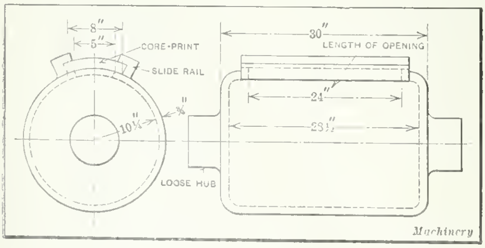


Fig. 1. Pattern of Rotary Annealing Barrel which was molded on End

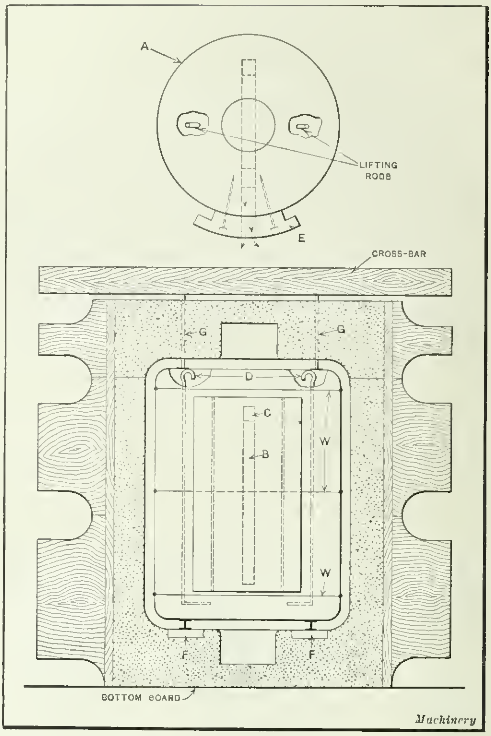


Fig. 2. Section of Mold and Arrangement of Core used in producing the Annealing Barrel shown in Fig. 1

The advantage gained by molding this pattern by the method just described is that only two and one-half hours is required to make the core with the half core-box, whereas four hours was required when using the skeleton core-box. In addition to this, the core made from a skeleton box is not as satisfactory as when made in a regular half core-box.

* * *

In a paper recently read before the American Society of Mechanical Engineers, it is stated that the principal aluminum alloy used for castings in the United States consists of about 92 per cent aluminum and 8 per cent copper. This composition is generally known as the No. 12 alloy of the Aluminum Co. of America, or as the Society of Automotive Engineers' specification No. 30. When a ½-inch testing bar is cast in green sand from this alloy and tested without machining off the skin, an average tensile strength of approximately 20,000 pounds per square inch and an average elongation of about 1.5 per cent in two inches will be obtained. A modification of this alloy having somewhat better physical properties is now being used to some extent in the production of castings for the automotive industry. This alloy has an analysis of 7.5 per cent copper, 1.5 per cent zinc, 1.2 per cent iron, and the remainder aluminum. The tensile strength averages about 21,000 pounds per square inch, and the elongation is somewhat greater than that of the No. 12 alloy.

Quantity Production of Combination Limit Plug Gages

Description of a New System of Limit Plug Gages Developed by the Taft-Peirce Mfg. Co., and the Methods Employed in their Manufacture on a Quantity Production Plan

THERE have been several different periods in the evolution of machine and tool equipment for metal manufacturing plants, each of which is marked by the development of some special kind of machine tool or accessory. While at all times since America became the leader in the machine tool building industry of the world, there has been simultaneous progress along all lines of machine tools, gages, and equipment, there nevertheless was a certain period when, for example, the milling machine received more attention and was more rapidly developed than other lines of machine tools. Later, the grinding machine entered into a similar era of development. During the last five years, stimulated mainly by the requirements of the war industries, the development of gages and gaging systems has occupied the most prominent place in the evolution of machine shop methods; and it is safe to say that compared with five years ago, no one large branch of metal-working equipment has developed to the same extent as gage making.

One of the new developments along the lines of gage making that deserves to be recorded is the combination limit plug gage introduced by the Taft-Peirce Mfg. Co., Woonsocket, R. I.—a gage that for want of a better name might be termed an "interchangeable" plug gage, the word "interchangeable" in this case being used, not in the same sense as in the term "interchangeable manufacturing," but rather in the sense in which it is used in the expression "interchangeable counterbore."

Principles of Design of the Combination Limit Plug Gage

Fig. 1 shows at *A* the design of the combination limit plug gage. As indicated, a double-ended limit plug gage made to this system consists of five parts: (1) a gage handle; (2) a "Go" plug gage unit; (3) a "Not Go" plug gage unit; (4) and (5) screws for holding the gage units to the handle.

At *B* in the same illustration is shown a single-ended plug gage made along the same lines, and at *C* a single-ended limit gage having both the "Go" and the "Not Go" limits incorporated in the same gage unit. These are merely variations in design, the standard type being illustrated at *A*, and it is this type that will be particularly dealt with in the following description. It is evident, however, that the gage units employed in connection with gage *A* are also equally applicable to gage *B*, the gage units being interchangeable with any type of handle.

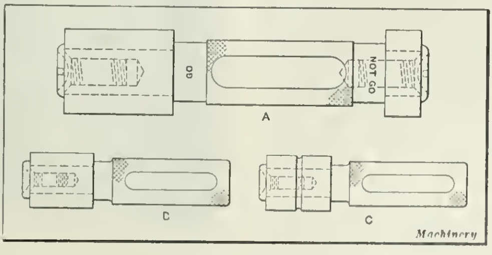


Fig. 1. Design of Gages having Interchangeable Gaging Units

Object of Design Illustrated

At first sight it might be thought that the object of the gage designs shown in Fig. 1 is merely to permit the handle to be made of a cheaper material while the gage units are made from a higher grade of steel. While this is an object that would not be overlooked in economical manufacturing practice, it is not the principal aim sought by the manufacturers in the design of this type, because the principle of the gage involves far more interesting features than the mere assembling of gage units with a handle. The chief idea, and the one that will particularly appeal to users of these gages, is the advantage obtained by the possibility of interchanging the gage units according to the actual limits required in any one case, it being possible for the Taft-Peirce Mfg. Co. to keep in stock a sufficient number of sizes of gage units that can be assembled into limit gages for different tolerances to meet practically every ordinary manufacturing condition. With this in view, gage units for both the "Go" and the "Not Go" ends are made for every 1/16 inch from ½ inch to 3 inches, with three different limit sizes on the units below 1 inch, and five limit sizes on the units over 1 inch. Furthermore, the construction permits easy replacement of gage units, and they may be reversed on the handle when one end is worn, thereby insuring double life to the gage.

The preceding statement will require more detailed information. For example, the "Go" gage units for a 1-inch limit gage will be made with five different diameters—1.000, 0.9995, 0.999, 0.9985,

TABLE OF GAGE COMBINATIONS

Maximum Size, Inches	Minimum Size, Inches	Tolerance, Inch	Maximum Size, Inches	Minimum Size, Inches	Tolerance, Inch
1.500	1.4995	0.0005	1.501	1.4985	0.0025
1.500	1.499	0.001	1.501	1.498	0.003
1.500	1.4985	0.0015	1.5015	1.500	0.0015
1.500	1.498	0.002	1.5015	1.4995	0.002
1.5005	1.500	0.0005	1.5015	1.499	0.0025
1.5005	1.4995	0.001	1.5015	1.4985	0.003
1.5005	1.499	0.0015	1.5015	1.498	0.0035
1.5005	1.4985	0.002	1.502	1.500	0.002
1.5005	1.498	0.0025	1.502	1.4995	0.0025
1.501	1.500	0.001	1.502	1.499	0.003
1.501	1.4995	0.0015	1.502	1.4985	0.0035
1.501	1.499	0.002	1.502	1.498	0.004

Machinery

and 0.998 inch, respectively. The "Not Go" gage unit will also be made with five different diameters—1.000, 1.0005, 1.001, 1.0015, and 1.002 inches, respectively. In other words, all gages over 1 inch are made for the "Go" gage to standard size and with four limits, namely, 0.0005, 0.001, 0.0015, and 0.002 inch smaller than standard size; and the "Not Go" gage units will be made to standard size and the same amounts larger than standard size, as specified. In the case of gages between ½ inch and 15/16 inch inclusive, the "Go" gages are made to standard size and to 0.0005 and 0.001 inch less than standard size, while the "Not Go" gages are made to standard size and to the same limits larger than standard size.

Advantages Gained by Making Unit Gages to Sizes Indicated

It is apparent that with unit gage ends made to the sizes specified and kept in stock, it is possible to assemble at a moment's notice a plug gage for practically any ordinary tolerance used in interchangeable manufacturing work. With three "Go" plugs and three "Not Go" plugs it is possible to obtain eight practicable gage combinations. With five "Go" plugs and five "Not Go" plugs it is possible to obtain twenty-four practicable gage combinations according to the limits and tolerances required for any particular line of work. It is evident that it would not be practicable to keep in stock twenty-four kinds of solid gages, as some of these combinations might seldom or never be called for; but by keeping the gage ends in stock and assembling them according to the customer's requirements, it is feasible to keep a sufficient stock to meet all ordinary requirements. In addition, heat-treated and rough-ground gage blanks are kept in stock for intermediate sizes, which can easily be ground and lapped down to the required diameter for special gage requirements. In order to show the combinations that can be obtained with a 1½-inch limit gage set such as described, the accompanying table has been prepared.

The Manufacture of Combination Limit Plug Gages

The material from which the gage units are made is a high-carbon alloy crucible steel containing chromium and vanadium with a low phosphorus and sulphur content. The chromium in the steel increases its wearing qualities and also aids in resisting corrosion. The vanadium also has a decided influence upon the wearing qualities. The combination of chromium and vanadium in the proportions used produces the greatest hardness and wearing qualities possible in conjunction with a properly workable steel, making it exceptionally well suited for use as a material for plug gages. The handles are made from cold-rolled mild steel. All the work on the handles is plain automatic screw machine work, and after having been completed they are merely blackened for finish and then left soft so that the customer may mark them with his designation of the job to which they belong.

In the manufacture of the gage units the Taft-Peirce Mfg. Co. employs standard manufacturing processes throughout, and the making of gages to a guaranteed accuracy of 0.0001 inch is reduced from a tool-room proposition to a quantity manufacturing production plan. The operations required in the manufacture of these gages are briefly as follows:

The gage blanks are first turned and cut off from bar stock in the automatic screw machine department, at which time the hole through the blank is also drilled and reamed and the blanks are cut off 1/16 inch longer than the finished size. In turning the blanks for the gage units, from 0.010 to 0.015 inch over the finished size is left for grinding. After passing from the screw machines, the ends of the blanks are faced off square with the hole by a straddle tool to the correct finished length, this work being done on a Porter-Cable lathe.

In order to prevent the gage unit from revolving upon the handle, a half round keyway is provided in the gage unit corresponding to a similar keyway in the handle, a pin key being used. This keyway is broached, after which one end of the gage is stamped with the Taft-Peirce trademark under a drop press. From this operation the gage blanks pass to the inspection department, where the finish on the ends and the keyway are inspected and the diameter is measured to make sure that the gage will finish up to the required size.

The gage blanks are now ready for hardening. They are heated for hardening in a Leeds-Northrup electric furnace, Fig. 2, having a Leeds-Northrup temperature-recording potentiometer. This instrument shows by a curve, which it records, the exact decalescence temperature, and hence there is no need to determine exactly for each batch of steel whether it should be heated to 1375, 1400, or 1425 degrees F., for example, because the recording instrument shows for every heat when the moment has come for its removal from the furnace. Generally speaking, however, the steel from which these gears are made is heated to a temperature of about 1400 degrees F. for hardening, after which the gage blanks are quenched in oil and drawn to a temperature of about 325 degrees F., which is sufficient to relieve the strains produced in hardening.

Grinding Operations

The gage blank is now ready for the grinding operations. The hole is first ground to such a diameter that it will slip

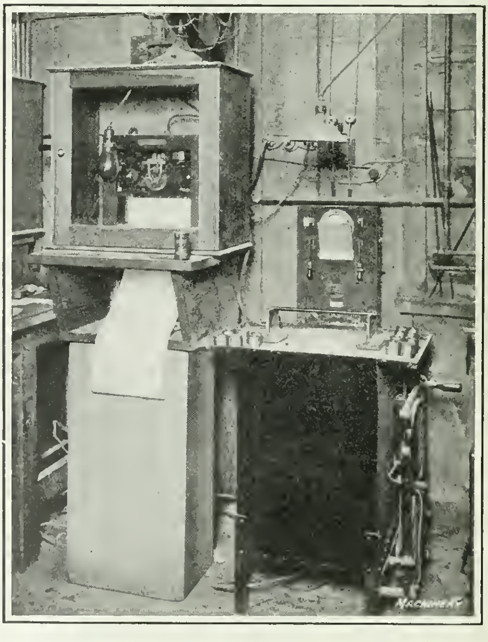


Fig. 2. Electric Furnace and Temperature-recording Potentiometer used in heat-treating Gages

freely, but not loosely, on the gage handle. After the hole is ground, the gage blanks are ganged up on arbors and are rough-ground on the outside without any regard to diameter, just merely to clean off the black color produced by hardening. The blanks are then given a heat-treatment which takes the place of the usual seasoning. In fact, this heat-treatment may be called an artificial seasoning process. It consists of heat-treating the blanks in oil to a temperature of 300 degrees F., after which they are cooled in oil, and then again heated in oil to 300 degrees F. and cooled. After this double heat-treatment, all internal strains are found to be relieved, and there will be no further changes in the steel due to its internal structure.

The blanks are now ready for finish-grinding, at which operation they are ground to within 0.0003 inch of the finished size, after which they are lapped to within 0.0001 inch above the actual stated gage size. The amount the gage is made over size allows for wear. The lapping is done with plain cast-iron ring laps, using flour emery and oil. From this operation the gages pass to the inspection room, where every gage is measured on a sensitive measuring machine capable of determining inaccuracies to within 0.00001 inch. As the gages are guaranteed to an accuracy of 0.0001 inch above the specified size, this machine makes it possible to easily detect any errors that would be greater than the guaranteed limit.

Manufacturing Snap Gages for "Grinding Sizes"

Another of the interesting types of gages manufactured by this company is the snap gage for "grinding sizes," which is made to provide proper limits on work that is turned preparatory to grinding, and which is based upon careful investigations as to the best practice in this respect. These gages are of the limit gage type as illustrated in Fig. 4, and are provided with three classes of tolerances according to the size being gaged. For work up to 1 inch in diameter the maximum size is 0.012 inch and the minimum 0.008 inch larger than the finished diameter of the work. For sizes from 1 to 2 inches, the limits are plus 0.014 and plus 0.010 inch; and for sizes over 2 inches, the limits are plus 0.015 inch and plus 0.010 inch.

The object of these gages is to provide a simple means for gaging work that is turned preparatory to grinding. No further thought need be given to the allowance necessary, if these gages are used. Suppose a shaft is to have a finish-ground diameter of 1½ inches. All that is necessary to provide the proper allowance for grinding when this shaft is being turned is to use a "grinding size" limit gage, which, in the case of the 1½-inch shaft will insure that the shaft will be turned within the limits 1.510 and 1.514 inches, and this will provide the proper allowance for the subsequent grinding.

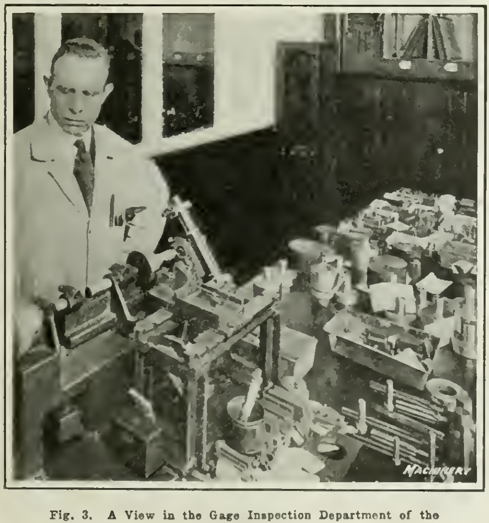


Fig. 3. A View in the Gage Inspection Department of the Taft-Peirce Mfg. Co.

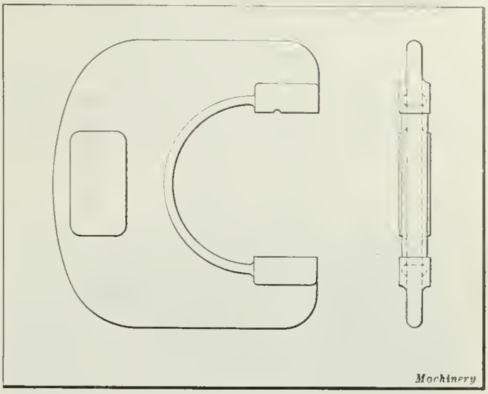


Fig. 4. Type of Limit Snap Gage for "Grinding Sizes"

These gages are made from soft machine steel forgings and the various operations that they pass through during the process of manufacture are as follows: (1) inspect drop-forging; (2) snag drop-forging; (3) straighten forging; (4) rough-grind to thickness; (5) inspect grinding and surfaces exposed by the grinding operation; (6) mill gaging jaws and front side of gage square with the surfaces previously ground; (7) file off burrs; (8) mark; (9) sand-blast to produce smooth surfaces; (10) carburize; (11) harden; (12) clean and submit to Barff finish; (13) finish-grind sides and gaging surfaces; (14) inspect grinding operations; (15) lap gaging surfaces with flat hand lap; (16) inspect gage size with Johansson blocks and put in stock.

The adjustable limit gage made by this company, having two gage points that may be set for any required limits or tolerances, is produced by the same operations, with the addition of the drilling, threading, and counterboring operations required for the holes holding the adjustable gaging points; these operations are performed between Operations (6) and (7) in the preceding list.

* * *

SUGGESTIONS TO BELT USERS

The following suggestions to belt users are contained in a recent catalogue published by the Chicago Belting Co., Chicago, Ill.:

In order to obtain a given amount of power, it is better to use a narrow belt running at a high speed than a wide belt running at a low speed.

If possible, use a belt speed of about 3000 feet per minute, but not more than 3600 feet per minute.

Use a pulley that is wide enough so that a small amount of irregularity in the belt does not make it run off. Allow at least one-half inch on machine pulleys and one inch or more on countershaft and lineshaft pulleys. Use crowned pulleys wherever possible.

If possible, use a horizontal belt with large center distances and with the pulling side at the bottom. In a horizontal drive, the slack side of the belt at the top of the drive increases the belt contact.

When using a vertical belt, do not have more center distance than is absolutely necessary, because the weight of the belt reduces the efficiency of the drive.

Avoid crossed belts on short center distances. Avoid the crossing of wide belts. If it is necessary to cross belts, see to it that the rubbing of the belt surfaces does not have a tendency to open up the laps.

Keep belts flexible and as clean as possible. Do not use belt dressing containing mineral oils or resins.

HORSEPOWER CHART FOR GEAR TEETH

By WILLIAM W. GAYLORD

The horsepower chart for gear teeth published in the May, 1919, number of MACHINERY, page 820, will be found very valuable as a time-saver when calculating the horsepower requirements of gear teeth. In calculating horsepower by the use of this chart, the required values are substituted in the following formula:

$$\text{H.P.} = \frac{2\pi RNW}{33{,}000}$$

where R = radius of pitch circle in feet;

N = number of revolutions per minute;

W = safe working load in pounds.

The value $2\pi RN$ equals the velocity in feet per minute, and W the safe load as found from the chart; therefore these two values, if substituted in the above equation, will give the horsepower. This is a simple calculation, but if a number of gears are to be figured, an auxiliary chart, as shown, will greatly reduce the amount of time consumed, by eliminating all calculations and enabling the horsepower which the gear is capable of transmitting to be read directly.

For the purpose of finding the velocity in feet per minute, it will be noticed that in addition to the pitch line speed or velocity scale, the chart also includes scales for pitch diameter, and revolutions per minute. The value $2\pi RN$ can be directly found by drawing a line through these two scales and extending it to the velocity scale, as shown. From the point where this line intersects the velocity scale, a line is then drawn to scale W—the safe working load scale—to the point representing the load determined from the previously published chart. This line will pass through the horsepower scale from which the horsepower may be directly read.

Example—If the identical conditions given in the previous problem are taken, the gear will have 30 teeth, 3 diametral pitch, 5-inch width of face, 10-inch pitch diameter, and will revolve at 690 revolutions per minute, or with a pitch line speed of 1800 feet per minute. From graduation 10 on scale D in the accompanying chart, draw a line to graduation 690 on scale N and continue it until it intersects scale V, which in this case will occur at point 1800. The load W, as determined from the previously published chart, for this particular condition is 3200 pounds, so that if a line is drawn from the graduation 1800 through point 3200 on the

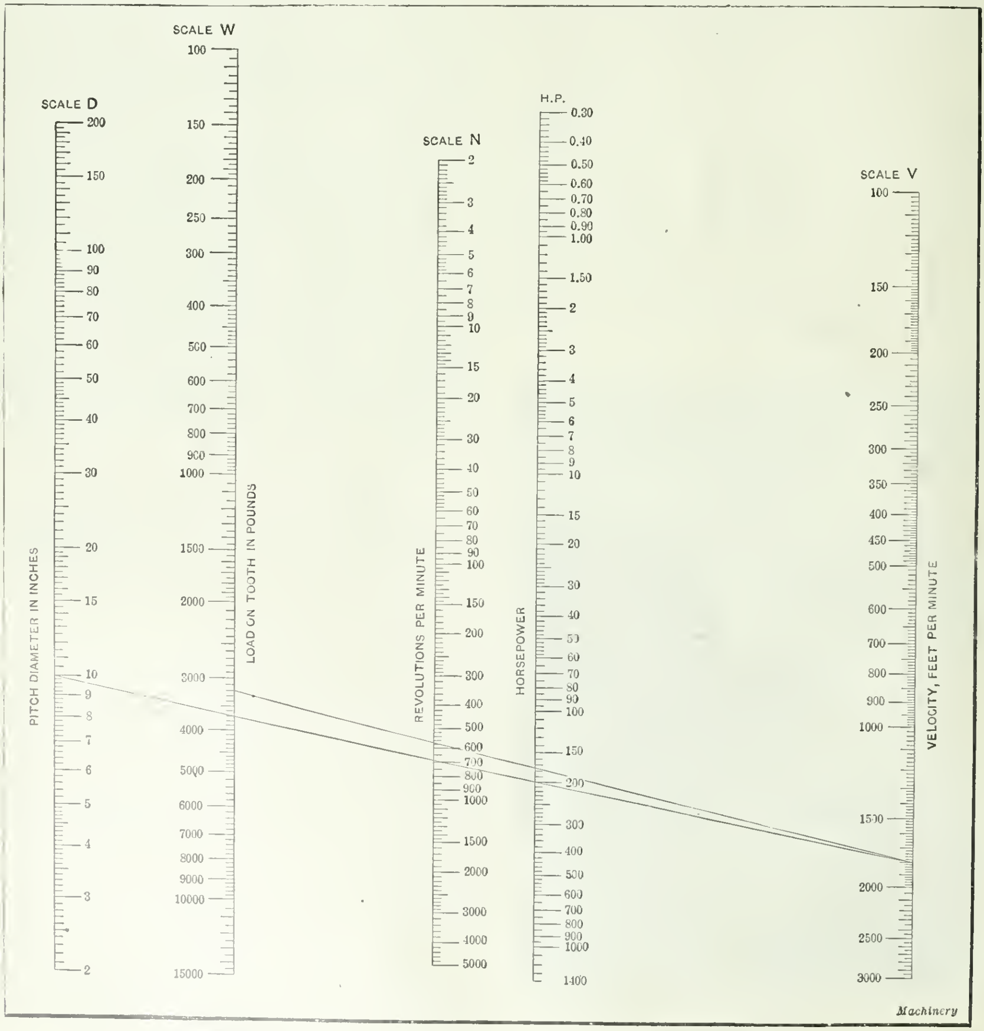


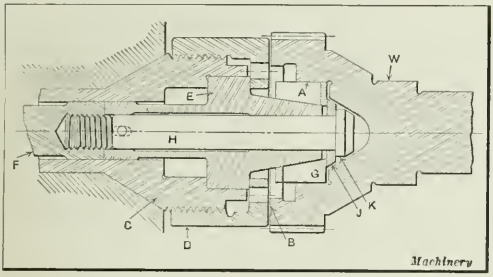
Chart from which Horsepower transmitted by a Gear can be read when Load is known scale *W*, it will pass through the horsepower scale at point 175, as shown in the accompanying illustration.

The chart can also be used to find the diameters of gears which will give any surface speed for any known number of revolutions per minute. Referring to the chart previously published, the writer has satisfactorily used a piece of tracing cloth with a fine line ruled on it which is laid on the chart and lined up with the required values on the S_v and *y* scales. The intersection of a line (which, if drawn, would pass through the given values on scales *f* and *p*) with the axis *m* is then marked with a sharp pencil. The intersection of a line connecting this latter point and the point where the ruled line crosses axis *n*, with scale *W*, enables the required result to be obtained without defacing the chart, and the method is quite accurate and satisfactory.

* * *

EXPANSION ARBOR

The special expansion arbor, of which this article is the subject, was designed to hold a clutch shaft, similar to the one indicated at *W* in the accompanying illustration, by gripping the work at surface *A*. The nature of the work is such that the operation of expanding the arbor must be accomplished from the end of the spindle opposite the work-holding end, the surface *B* of the work being abutted against the retaining ring *D* for the purpose of insuring endwise location for the machining operation. This retaining ring is screwed on the inner spindle of the lathe or grinding machine, shown at *C*, and when tightened it secures the expander *E* firmly in the machine spindle. The projecting end of the expander has a suitable taper which fits an expanding sleeve *G*, the diameter of which should be made to suit the internal diameter of the work. This expanding sleeve is split nearly through from each side, the saw cuts being located alternately with reference to the sides, as indicated. This arrangement provides for easy expansion. A threaded stud *H* fits the regular draw-back spindle *F* on the machine, and carries at the opposite end a collar-nut *K* and thrust washer *J* for the purpose of drawing the expanding sleeve on the tapered end of the expander. The operation of this arbor is simple, it being apparent that a partial turn of the draw-back handwheel first expands the sleeve within the work and then draws the face *B* against the ground surface of the retaining ring. By this means the work is firmly held and positively and accurately located, so that variations in machining operations on the work are reduced to a minimum.



Special Expansion Arbor operated by Handwheel on Draw-back Spindle

B. S.

* * *

It is stated in a recent commerce report that the number of ships built in the United States and officially numbered by the Bureau of Navigation, Department of Commerce, during the year ending June 30, 1920, totaled 2135, having a gross tonnage of 3,695,234. This figure did not include twenty-three vessels having a gross tonnage of 39,507, constructed for foreign owners, which would make a grand total of 2158 vessels of 3,734,741 gross tons.

ROLLER BEARINGS ON TRUCKS SUPPORTING DIRIGIBLE HANGAR DOORS

The huge structural steel doors of the hangar being erected at Lakehurst, N. J., to accommodate dirigibles belonging to the United States Government, are mounted on trucks provided with unusually large roller bearing journal boxes, which were manufactured by the Railway Roller Bearing Co., Syracuse, N. Y. Each journal box weighs 392 pounds when assembled. The principal dimensions of the roller bearings are as follows: Bore, 7 inches; outside diameter, 13½ inches; and width, 6½ inches. When the speed of the axles is one revolution per minute, the load capacity of each bearing is 45 tons. Fig. 1 shows one of the journal boxes disassembled.

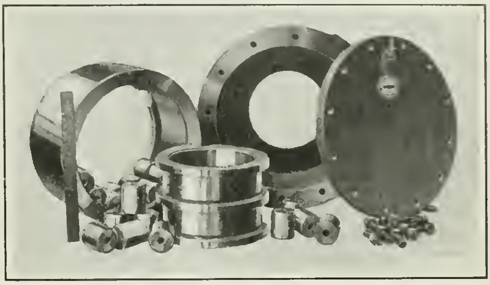


Fig. 1. Disassembled Roller Bearing Journal Box for Trucks supporting Dirigible Hangar Doors

An idea of the great size of the hangar doors will be obtained when it is stated that they are 135 feet high, 165 feet wide, 15 feet deep at the base, and weigh 3500 tons. Each door is mounted on four trucks which run on two standard-gage railroad tracks 165 feet apart. These trucks are driven by electric motors. Each truck is equipped with eight journal boxes so that thirty-two boxes are required per door. Fig. 2 shows a set of boxes for one of these doors, there being four doors to the hangar.

Fig. 2. Set of Thirty-two Journal Boxes which is required for Each of the Four Hangar Doors

* * *

Steel castings are preferable for use in cases where a forging is unsuitable or too expensive and where combined strength and toughness are required. Cast iron is suitable for service in which the stresses are mainly compressive or where the stresses can be overcome by increasing the size of the casting regardless of the resulting weight. In many parts great weight for a given strength is desirable. Where extra strength and toughness combined with fairly good resistance to wear and fatigue are essential, a malleable-iron casting will suffice.

Production Engineering

By JOHN S. WATTS

THE demand for men capable of successfully filling positions of production engineers is becoming greater from year to year. To the writer's knowledge there has not been any attempt made to train the younger men for this important branch of the mechanical industry, and very little literature is available to assist the engineer in becoming proficient in this work. This is partly due to the fact that this work has only recently been recognized as an important engineering function; those who have taken up production engineering have generally been forced by shop conditions to assume these duties.

Since, without doubt, the work will become still more important in the future, it would be helpful to have more discussion of the subject in the technical magazines in order that engineers may become familiar with the functions of a production engineer. In this article, the subject is dealt with in a general way, pointing out the need for production engineering and the economies that result from its use.

Placing the Responsibility for Shop Planning Under One Head

The production engineer is the man responsible for planning the routing of the work through the shop, the sequence of operations, and the maintenance of a regular flow of material to each machine, insuring that when the parts arrive at the erecting floor, all the necessary material will be on hand in correct quantities. Under the old methods the responsibility for laying out the progress of the work through the shop rested with the shop foreman. With very rare exceptions his method of scheduling the work was to wait until a man finished one job before deciding which of the jobs waiting to be done should be undertaken next. This involved consideration on the part of the foreman as to which of the available jobs was suited to the particular man's ability and which of the jobs should be given preference. Frequently the waiting workman would be kept idle until the foreman had decided these points. Even after some particular job had been decided upon, more time would be spent in a discussion as to how the job should be handled.

This is not a criticism of the foreman because of his lack of planning, as his duties under the old method were numerous and left him no opportunity for planning in advance. He was required to pass judgment on all kinds of questions as they arose, and upon his ability to give a snap judgment depended the success or failure of the whole matter. In the majority of cases, the output under the circumstances was very creditable. Under present conditions, however, it is impossible for even the smallest shop to run to the best advantage without more planning of the work than has been usual in the past. Therefore, in every shop it is necessary for someone to perform the duties of a production engineer. If the plant is small, this man will be able to perform additional duties, but it is essential that the problem of routing jobs through the shop be given consideration.

Production Engineering for the Small Shop

The scheduling of work through a small shop presents in some ways more difficult problems than it does in the large shop, owing to the relatively greater variety of work handled and to the fact that there is a smaller number of men and of machines to choose from. For these reasons, the ability of the available mechanics becomes the vital point for consideration in distributing the jobs. In such shops it is necessary that whoever handles the scheduling must have an intimate knowledge of the ability of the men who are to do the work. The conclusion is, then, that in the medium sized or small factory it is seldom that anyone except the foreman would have the knowledge necessary to schedule the work successfully, but when thus burdened with production work he should be relieved of enough of his other less important duties to enable him to devote the necessary time to planning the work.

In actual experience the output of a moderate-sized machine shop has been increased more than 50 per cent by merely having the various jobs carefully planned ahead, choosing that work for each man at which he was most proficient, and having the next job with all essential information waiting at his machine before he had finished the previous job. In larger plants where a production engineer is employed, the work is scheduled to go to the machine that is most efficient for the particular job, and the foreman is responsible for obtaining the most suitable operator for the machine.

General Outline of the Method of Routing and Scheduling the Work

The end toward which the production engineer should work is to have every operation on every piece of work that is passing through the shop scheduled definitely and clearly both in regard to the machine which is to be employed and the time that it is to be performed; at least, the order in which the jobs are to be executed should be specified. The most desirable sequence of operations will usually be decided upon, and then, after estimating the time requirement for each operation, it is possible to distribute the work to the best advantage among the available machines so as to avoid overtaxing any of them. The best plan is to have the work so arranged that all the machines will be kept busy all the time.

The division of the work among the various machines demands careful consideration, especially when dies or special tools are required for executing the work. The reason for this is that generally, after the tools are made, it is difficult and expensive to transfer the work to another machine if it is found that the one chosen has been assigned more work than it can do according to schedule. The jobs should be run through in as large lots as possible to avoid changing tools too often, although some leeway must be had here, because if the lots are too large some unforeseen delay may prevent delivery to the erecting gang of some essential part and thus stop the work on the erecting floor. At the same time, this trouble is less likely to occur even with poor scheduling than it is with none at all.

It is surprising how many supposedly up-to-date plants are running the work through the shop with practically no planning, the infallible result being that some of the machines are loaded with a quantity of work beyond any possible output that can be expected from them, while other machines stand idle, thus seriously impeding the possible output of the plant. This condition usually results in a continuous rush to get out some part necessary to complete a job which may have been overlooked, and as a result the whole shop is thrown into a turmoil, trying to catch up with the erecting crew. To attempt to run any machine shop today without some kind of schedule is about as foolish as it would be to try to run a railroad without a time table. Furthermore, to wait until a man finishes one job before deciding on the next is on a par with a railroad on which the train crew has to stop at each station to find out at what place they stop next, if such a foolish thing can be imagined.

Advantages of Operating a Shop According to Schedule

There are numerous reasons for employing engineering methods in directing the flow of production through the shop. While at first sight, the labor and expense involved in maintaining a schedule may seem formidable, this is really not the case, since the economies that will be effected both in reduced costs and in increased output will return a big dividend on the expenditure. It is not necessary that the work, in order to pay for scheduling, be repetition work, for it has been the experience of the writer that it pays as well to schedule the work through a repair shop as it does through a manufacturing plant. The schedule for a repair shop must naturally be more elastic than it is in the manufacturing plant in order to allow for the occasional breakdown job which must be handled at once, but even then the schedule has its advantages in that it gives a better idea of the situation and shows which work can be laid aside to take care of the emergency job. It may seem on first thought that the breakdown of a machine would throw the whole schedule out of order, but this is not true, as with the information that was used in making the schedule, it is possible to rearrange it by transferring the work to some other machine, or to find out just what it is possible to do at short notice more readily and surely than can be done without this information. The schedule also shows the amount of time that may be consumed in repairing the machine without holding up production.

Keeping Production to the Maximum by Properly Assigning Jobs

It is common knowledge to those who have worked in the shop that a man will finish a job more quickly when he knows that the next one is waiting for him than he will when he does not know what he is to do next. This fact is especially noticeable when there happens to be a disagreeable job waiting to be performed that no one wants and everyone trys to avoid until it has been assigned. Many machine operators make a habit of lagging in their work at the end of a job, thinking that it is entirely up to the foreman to keep them busy, and as long as they can make an appearance of being at work they will not tell the foreman that they are ready for another job. Some will entirely refuse to report when through with a job, but depend upon the foreman to know, and to assign the next job when he gets around to deciding what it is to be.

This leaves all the responsibility of knowing just when each job is completed to the foreman. If a number of men finish their jobs at the same time, which often happens, a serious loss of time is incurred until the foreman can decide upon the next job for each, one after the other, and give each his instructions. Under these circumstances an error in judgment on the part of the foreman in distributing the work or in issuing instructions is very likely to occur. On the other hand, if a schedule were arranged, the foreman could distribute the work among the men without waiting for the completion of the various jobs.

The importance of, and the knowledge required for production engineering cannot be over-emphasized. It demands a thorough knowledge of all machines, machining operations, and time required to perform the work, as well as good judgment regarding general shop practice. The successful production engineer will not stop at the scheduling of the work, but will be able to assist the designing engineer in developing designs which can be most economically manufactured with the available equipment, thus avoiding the buying of new machines that cannot be kept in operation.

* * *

The largest rolling mill in the world is said to be one recently put in service at Dorman & Long's Warrenby mills near Durham, England. This is an electrically driven 42-inch plate mill of the reversing type. Each roll is 3 feet 6 inches in diameter and 9 feet 6 inches long, plates 3/8 inch thick or over, with a width of 9 feet and a length of 100 feet, being rolled.

TESTS FOR TOOL DESIGNERS

By ALBERT A DOWD

The demand for draftsmen during the past year has been great, and some firms have been unable to secure enough men. Other firms have a full drafting-room force and yet are not able to produce the amount of work desired. The salaries of draftsmen have been very nearly doubled during the last three years, yet it is difficult to obtain capable men for certain kinds of work, notably tool designing. The colleges, trade schools, evening classes, and correspondence schools graduate a great number of men every year. These men have received a certain amount of training and have then been thrown on their own resources to make a living, with the expectation of receiving high salaries and easy work. The demand for men opens a door here and there until all the applicants have finally found positions. A certain number of these men possess some mechanical ability; others have very little, yet may develop into fair draftsmen in the course of time; the remainder will never become successful draftsmen. Quite a large percentage of these men branch out into other lines after a year or two.

The Importance of Actual Shop Experience

In the line of tool designing, however, many draftsmen lack practical shop knowledge, and consequently will never rise above mediocrity. At present all the courses in mechanical drafting or mechanical engineering include a certain amount of shop work. The men are taught how to run the various machine tools and are given several hours' actual practice in this line each week. To those men who have natural mechanical ability this practice gives a start in the right direction and a desire for this kind of work. It is not the purpose of the writer to belittle the efforts of colleges and trade schools in the matter of practical shop training. He believes that this is of the utmost importance to men intending to follow up mechanical engineering in any of its branches. There should be more of this shop training, and instructors should make it as practical as possible.

The weak points in the average tool designer's knowledge are largely due to lack of practical shop experience. A man may know how to turn a shaft or cut a thread using an engine lathe, yet he may do these things in a purely routine way, without the basic knowledge of the reasons why certain things are done. Very likely if he were asked to do the same piece of work on a turret lathe or screw machine, he would not know what kind of tools to use or how to use them. He might be able to operate a milling machine for plain work, but would not know when to use an end-mill, or when the use of plain milling cutters would be advisable. He may know what a jig or fixture is, but he may not thoroughly understand the principles underlying the design, and may never have used a drill jig or milling fixture. He probably does not know how to grind a drill or an ordinary forged tool. There are, of course, many good tool designers, but the problem which the employer is called upon to solve is whether or not an applicant has the necessary qualifications for the work required of him.

Usual Practice in Hiring Designers

The usual practice when hiring a designer is about as follows: The applicant is asked to fill out an application form or card, and is then hired or not, according to the more or less satisfactory record of his experience and references. The result is, in many cases, that after a trial he is found to be overpaid and his work generally unsatisfactory due possibly to a lack of shop experience or to insufficient mechanical training. However, this man is frequently kept at work because the employer is shorthanded and prefers to make the best of the situation rather than to take any chances with a new man.

The writer has hired several hundred draftsmen, detailers, and tool designers in the past five years, and realizes the difficulty of picking men from a number of applicants so as to obtain those who are really suitable for the available positions. Sometimes a man applies and states that he has had a number of years' shop experience and a number of years' experience in designing jigs and fixtures; he states that he has worked for several concerns a number of years and gives references to these firms. The references prove to be all right and the man is put to work, but often is found to be deficient. The following questionnaire has been used in a number of cases by the Service Engineering Co., Inc., New York City, in connection with applicants for positions, and as a result a considerable saving of unnecessary expense has been realized.

Application Form and Questionnaire

An application form should be prepared for the prospective draftsman to fill out. This form should have provision for the applicant's name, address, age, nationality, etc., together with a list of firms for whom he has worked, and a space for the record of his shop experience, class of work, salary desired, etc. In addition to this more or less general practice, a series of test questions should be prepared to determine how much the man really knows about the business. Each employer can make his own list according to his needs, although some of the following may be used in selecting a tool designer. The questions marked (A) should be answered readily by a detailer on jigs and fixtures; those marked (B) by a designer; and those marked (C) by a checker or other high-class man of broad experience.

(A) 1. What is a drill jig and how is it used?

(A) 2. What is a milling fixture, and how is it used?

(A) 3. What is a finish mark and how is it used?

(A) 4. Give a sample of your lettering such as you would put on a drawing, using the following notations: "Drill jig for front axle, part number XE 157-T-243."

(B) 5. What kind of milling cutter would you use for surfacing a cast-iron block 2 by 6 by 18 inches?

(C) 6. What limits would you put on: (a) a one-inch diameter hole for good commercial work; (b) a one-inch diameter shaft which is to be a good running fit in the one-inch hole?

(B) 7. If you were making a drawing of a drill jig having eight (8) holes equally spaced around a 4-inch diameter circle (a) what dimensions would you give to locate the holes? (b) Give the formula you would use in figuring the dimensions.

(B) 8. What are the following gages used for: (a) snap gage; (b) plug gage?

(B) 9. (a) From what material would you make a 2-inch slip bushing? (b) How would you harden it?

(B) 10. (a) Extract the square root of 31784. (b) Extract the cube root of 913496.

(B) 11. (a) Find the circumference of a circle having a diameter of 0.750 inch. (b) Find the area of this circle.

(B) 12. What machine would you use to broach a 1-inch square hole?

(C) 13. If a shaft is to be hardened and afterward ground to 1.000 inch diameter, to what diameter would you turn the shaft before hardening?

(B) 14. In making a jig or fixture for a rough casting, how many fixed points of support would you provide?

(C) 15. A piece of machine steel 4 inches in diameter is revolving at 52 revolutions per minute. What is the cutting speed in feet per minute? Does this speed conform to modern practice?

(B) 16. Can you read a micrometer? If so, what measurement would a one-inch instrument indicate if the figure "3" appeared on the stationary portion, and the mark on the revolving sleeve showed "21"?

(A) 17. How many cubic inches in one cubic foot?

(B) 18. What is the ordinary draft on a forging?

(B) 19. In cutting the teeth on spur gears, what kind of machines are commonly used? Mention at least two types.

(B) 20. What is the difference between a bevel gear and a miter gear?

(C) 21. What kind of steel would you use for (a) clamps in jig work; (b) small bushings; (c) V-blocks; (d) clamp screws? (e) Would you harden any of these, and if so how?

(B) 22. How much clearance would you provide on all sides of the work in making a drill jig for a rough casting

(B) 23 Have you had any experience in turret lathe or screw machine work? If so, answer the following questions: (a) If you were to machine a 2.000 ± 0.001 inch diameter hole in a cast-iron flywheel, on a turret lathe, and the hole were cored to 1¾ inches in diameter, what tools would you use? (b) What tools would you use in reducing a 2-inch shaft to 1 inch diameter on a turret lathe?

(B) 24. Make a sketch to illustrate a method by which you could clamp four (4) round bars 1 inch in diameter at one time, using but one screw or lever.

(B) 25. What is an interlocking milling cutter and how is it made?

(B) 26. Did you ever make a punch and die? If so, what is the stripper plate used for?

(B) 27. What kind of machines are used for punch and die work?

(B) 28. Can you use a slide-rule?

(B) 29. Have you ever designed automatic machinery? If so, what type of machines and for what purpose?

(B) 30. What machine would you use in cutting a shaft to receive a Woodruff key?

(C) 31. In making a dovetail slide like the cross-slide of an engine lathe, would the final fitting be done by machinery or by hand?

(B) 32. Of what use is a taper gib in a movable slide?

(B) 33. Do you know much about automobile tools? If so, state the common practice for final finishing the inside of motor cylinders.

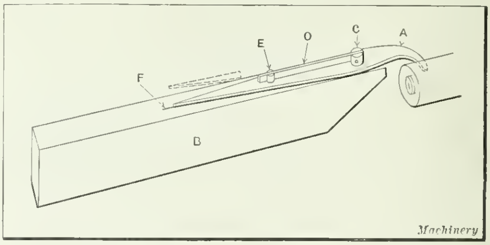
The above list is only a suggestion which may be used as a basis, and adapted to suit the judgment of the user. It has been found, in hiring men with the aid of a questionnaire, that with a little judgment it is possible to classify a man and readily determine whether he has had the experience which he claims. In using a series of test questions of this kind, it is suggested that they be put to the applicant verbally, selecting such questions as may be considered advisable.

* * *

INDICATOR FOR CENTERING WORK

By ADOLPH GRIMM

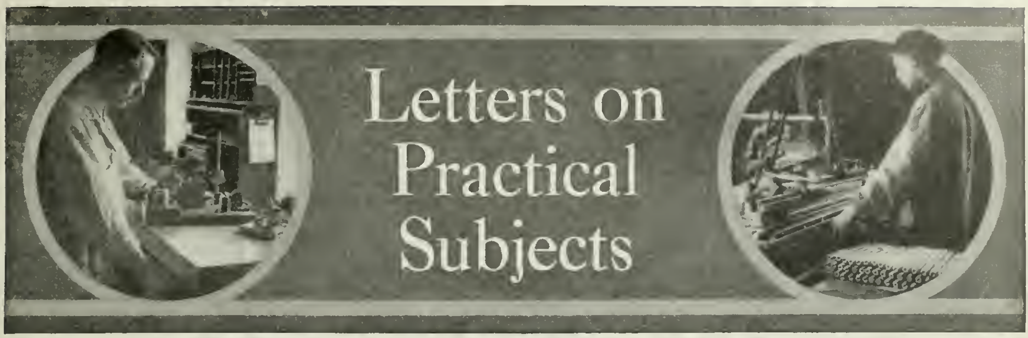
The accompanying illustration shows an indicator that will be found useful for centering work in the lathe. This tool can be easily made by the machinist, and if carefully constructed will produce sufficiently accurate results. The indicator is designed to be held in the toolpost of the lathe, and used in the usual manner. The indicating lever *A* is pivoted on shank *B* by means of a shoulder screw or pin *C*. Spring *D* may be made either of flat stock or of music wire, and is fastened to the pivot screw *C* so that its opposite end will act upon pin *E*, carried on the indicating lever. The tension of this spring is such that when the tool is not in use the indicating arm will occupy the position shown by the dotted lines. The leverage ratio may be increased or decreased as desired, according to the quality of the work being handled.



Indicator for Use in centering Work in the Lathe

* * *

An alloy consisting of 95 per cent aluminum and 5 per cent magnesium is used by the Westinghouse Electric & Mfg. Co. for starting-motor frames and other automobile work where extreme lightness and good machining qualities are necessary. The specific gravity of this alloy is 2.47, the average tensile strength approximately 27,000 pounds per square inch, and the elongation about 3 per cent in two inches.



Letters on Practical Subjects

RECORDS OF MACHINE TOOL EQUIPMENT

The maintenance of records giving the specifications and important dimensions of machine tool equipment in the shop will be of value to the concern, although this fact is not appreciated by all. Such a record is of help in connection with the designing of jigs and fixtures, and as a means of determining at a glance whether or not newly designed parts can be machined on the equipment available in the shop. To be able to refer to a record and obtain immediately such valuable information as, for example, the size of the slots in a machine table or the diameter of a boring mill table, is a great deal easier and requires less time than the old method of making a trip to the shop as the occasion arises for the purpose of taking the required measurements.

The writer has prepared machine tool equipment records by making tracings such as shown in the accompanying illustration, from which blueprints were made and fastened together in a loose-leaf binder. The illustration shows the idea that would be followed for each machine in the shop. In so far as possible these data sheets were made by tracing the outline of the machines from a catalogue, and incorporating drawings of machine tables, dimensions of slots in the table, and other similar sketches, together with tabulated items such as shown in the illustration. These sheets are arranged numerically in the loose-leaf binder to agree with the number of the machine. As this record shows the weight of the machine, size of motor, width of belts, countershaft specifications, and other similar information, it is evident that the reference sheets will be of value to other departments than the designing department.

Cincinnati, Ohio **Howard E. Darby**

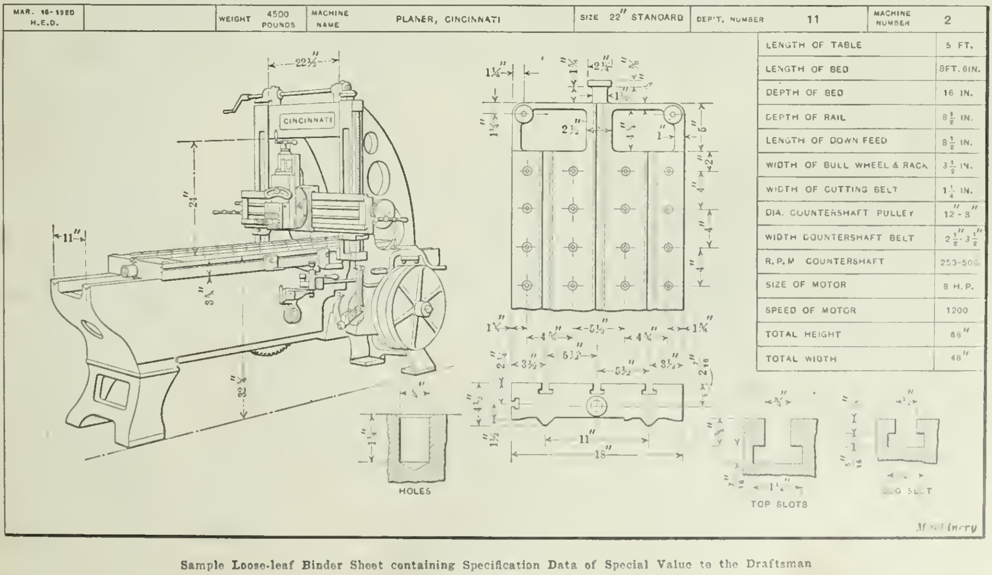
APPROXIMATE MILLIMETER EQUIVALENTS FOR FRACTIONS OF AN INCH

The number of millimeters equal to fractions of an inch is given to four decimal places in Machinery's Handbook. For many purposes, however, an approximate equivalent given to one decimal place is sufficient. If it is assumed that 25.6 millimeters are equal to one inch, rather than the actual 25.3995 millimeters, a number is obtained which permits ready subdivision for determining the number of millimeters, and decimal parts thereof, equal to fractions of an inch. On this basis:

25.6 millimeters = 1 inch 1.6 millimeter = 1/16 inch
12.8 millimeters = ½ inch 0.8 millimeter = 1/32 inch
6.4 millimeters = ¼ inch 0.4 millimeter = 1/64 inch
3.2 millimeters = ⅛ inch 0.2 millimeter = 1/128 inch

These metric equivalents can be easily remembered, especially the number of millimeters corresponding to 1/16 inch, and the values given are sufficiently accurate for many ordinary uses.

Auckland, New Zealand **Fred H. Hadfield**



MAR. 16-1920 H.E.D.		WEIGHT	4500 POUNDS	MACHINE NAME	PLANER, CINCINNATI	SIZE	22" STANDARD	DEP'T. NUMBER	11	MACHINE NUMBER	2

LENGTH OF TABLE	5 FT.
LENGTH OF BED	8FT. 6IN.
DEPTH OF BED	16 IN.
DEPTH OF RAIL	8½ IN.
LENGTH OF DOWN FEED	8½ IN.
WIDTH OF BULL WHEEL & RACK	3½ IN.
WIDTH OF CUTTING BELT	1¼ IN.
DIA. COUNTERSHAFT PULLEY	12"-8"
WIDTH COUNTERSHAFT BELT	2½"-3½"
R.P.M. COUNTERSHAFT	250-500
SIZE OF MOTOR	8 H.P.
SPEED OF MOTOR	1200
TOTAL HEIGHT	68"
TOTAL WIDTH	48"

Sample Loose-leaf Binder Sheet containing Specification Data of Special Value to the Draftsman

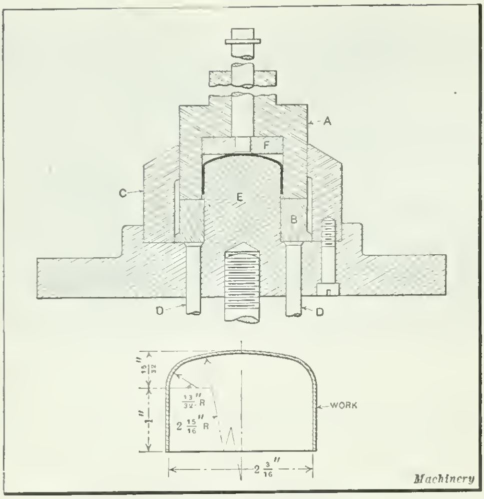


Fig. 1. Combination Blanking and Drawing Die used in First Operation on Door Knob Shell

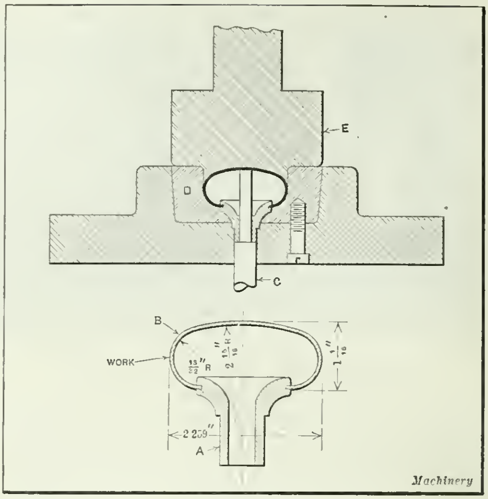


Fig. 2. Die employed to complete the Shaping of the Shell and to force it on the Shank

DIES USED IN THE MANUFACTURE OF DOOR KNOBS

The dies described in the following article are employed in the production of door knobs of the type shown beneath the die in Fig. 2. This door knob consists of a cast-iron shank *A*, which is finished on various machines, and shell *B*. which is formed to the desired shape and forced on the shank by means of two dies which are illustrated in Figs. 1 and 2. Shell *B* is produced from sheet brass, 0.036 inch thick, the diameter of the blank being 3¾ inches.

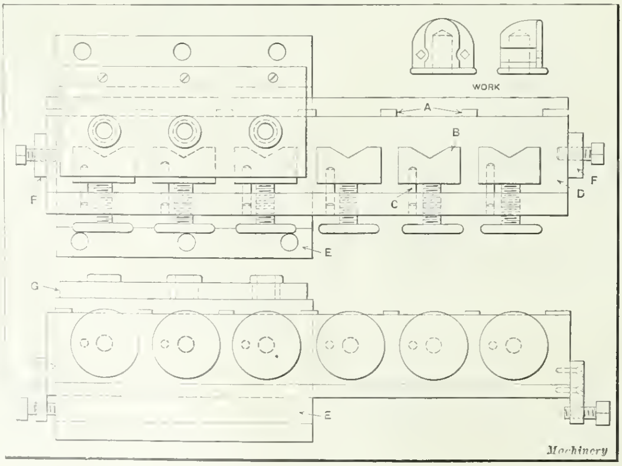
The first operation on the shell is performed by the combination blanking and drawing die shown in Fig. 1; this illustration shows the positions of the various moving parts at the completion of the downward stroke of the punch press ram. Prior to the downward stroke, punch *A* is in a position above the die, and drawing ring *B* is also in a raised position, its upper surface being in the same plane as the upper surface of die ring *C*. This is accomplished by means of pins *D*, which are actuated by a rubber buffer of standard design. The brass strip from which the blank is cut is placed on the upper surface of the die ring *C*. and is blanked to the proper size by punch *A* as it passes the cutting edge of the die ring on the downward stroke. The shell is then drawn to the proper shape by the forming die *E* as the punch continues to descend, forcing drawing ring *B* downward at the same time. The pressure between the punch and the drawing ring is sufficient to prevent wrinkles from being formed on the shell in this operation. A knockout device *F* is provided to force the shell from the punch when the punch is raised from the die. The removal of the shell from the die is easily effected by drawing ring *B* when it is raised to its normal position by pins *D*.

The second and final operation on the door knob is performed by the die illustrated in Fig. 2. At the beginning of this operation, rod *C* is in a raised position, and shank *A* and the shell produced in the first operation are placed on it. The position of rod *C* is such that when the shell is placed on it, the lower portion of the shell extends into the die ring *D*. It is evident that as punch *E* descends on the downward stroke, the work and rod *C* are forced into the die. This movement causes the lower portion of the shell to be rounded to the same shape as die ring *D*, and forces the edge of the shell into a corresponding groove on the periphery of the largest portion of the shank. The removal of the completed door knob from the die is an easy matter, because it is raised with rod *C* when the rod is returned to its original position.

Toledo, Ohio J. BINGHAM

MULTIPLE DRILL JIG

The drill jig described in this article was used on an old-style three-spindle drilling machine, being designed especially to agree with the center distances of the drill spindles. This machine was worm-driven and equipped with a power feed for raising the table to the drills. The work for which the jig was designed is shown in the upper right-hand corner of the accompanying illustration, and is a cast-iron caster bracket which has no machining operations performed on it except the drilling of one 37/64-inch hole, 1⅜ inches deep. This casting has a flange by means of which it hangs on



Drill Jig with Sliding Carriage for Use on Multiple-spindle Drilling Machine

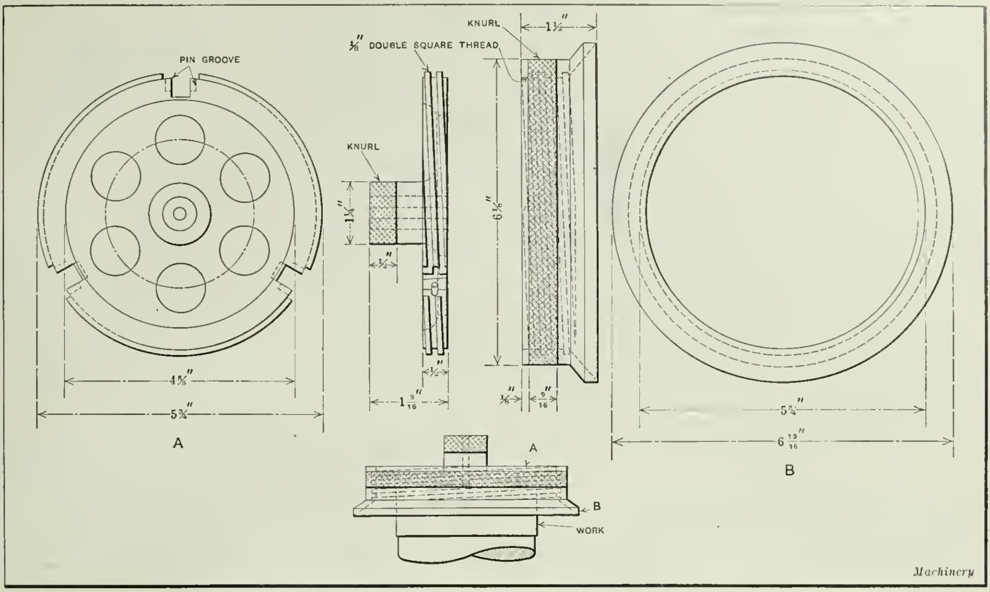


Fig. 1. Principal Details of Centering Jig and Method of Application to the End of the Work

the rear upright part of carriage *D*, being located between locating blocks, such as shown at *A*. The carriage is fitted to the base *E* by means of a tongue and groove slide, so that after the jig has been clamped to the machine table with the drill bushings in line with the spindles, the carriage may be slid from end to end, so as to bring the right-hand end under the bushing plate *G*. The front upright portion of the carriage is tapped for hand-screws, to the end of each of which a V-block *B* is fitted. Guide pins *C*, which are a press fit in the V-blocks and a loose fit in the carriage *D*, are employed to guide the blocks as they are being operated by the hand-screws, when clamping and releasing the work. The end-stops *F* are provided for the purpose of limiting the travel of the carriage.

In operation, it is apparent that the workman first clamps and drills three parts in the first half of the jig. While these castings are being drilled, the operator inserts three more in the empty sections of the jig, following which, as soon as the feed is cut off after drilling the first three, the jig is indexed by sliding the carriage along the base until the three newly loaded parts are brought into position under the drill bushings in bushing plate *G*. The finished work may then be readily removed and the jig reloaded while the table is again being fed up to the drills. Although this jig does not employ any mechanical means for holding the carriage or for preventing it from moving during the drilling operation, some form of indexing pin or locking device could be used to accurately locate and secure the carriage. Obviously the capacity of the jig may be increased so as to be used on multiple-spindle drilling machines of six spindles or more.

Cicero, Ill. JOHN J. BORKENHAGEN

CENTERING JIG FOR CROSS-HEAD AND KNUCKLE-JOINT PINS

Cross-head and knuckle-joint pins are usually made from bar stock and are not provided with centers. On locomotive repair work it is essential that some means be provided for centering these pins; consequently the jig here described was designed for the purpose of drilling the centers in the large ends. The principal details of the jig are shown in Fig. 1, as well as its application; while in Fig. 2 the general arrangement may be seen by referring to the sectional view at the right.

The tool consists of a flanged steel ring *B* provided with double square threads on the inside and knurled on the outside to facilitate handling. The hole on the flanged side of the ring is tapered, the purpose of which will presently be explained. Disk *A* is provided with a casehardened steel bushing to accommodate the drill used in centering the work. This bushing may be seen at *E*, Fig. 2, from which it will be apparent that it fits in the knurled hub of the disk. Three slots, spaced equally around the periphery of the disk, are provided to receive three centering dogs, such as shown

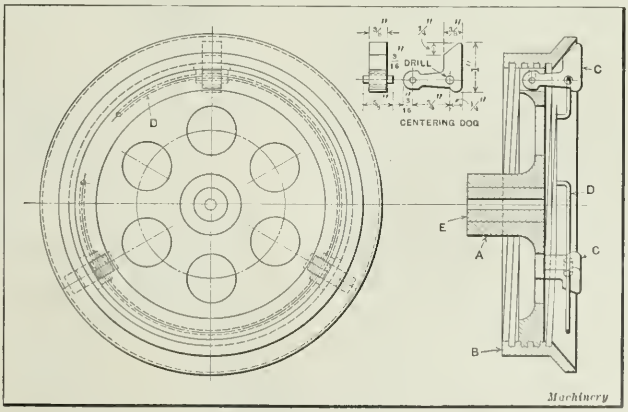


Fig. 2. Assembly of the Jig showing Relative Position of Parts, also Detail of Centering Dog

in detail in Fig. 2 and indicated in the assembly at *C*. The slots in the disk are machined with a pin groove on each side to accommodate the trunnions on the dogs. Before these dogs are assembled in the disk, they are strung on a brass wire spring *D*, which forms a three-quarter circle, the diameter of which for this size of tool is about 6¼ inches. When disk *A*, carrying the three dogs supported at the heel by this special spring, is screwed into the steel ring *B*, the dogs will bear against the previously mentioned tapered hole in the ring so that they are swung radially toward the center. The further the disk is screwed in, the greater the compression of the spring becomes, until at its greatest contraction the ends nearly meet. The relative position of the dogs and the spring when the disk is screwed about half way in, may be seen in Fig. 2. From the foregoing discussion, it will be apparent that in using the jig it is only necessary to place it over the end of the pin, the dogs adjusting themselves to the circumference of the work and centralizing the jig automatically as the disk is tightened. This brings the drill bushing to the center of the pin as determined by the three points of contact at the circumference.

Norman McCleod

DETERMINING PROPER EXPOSURE FOR BLUEPRINTS

The variety of shades of blue that prints made from tracings and bond drawing paper may have is very great. Discussion often occurs in the drafting-room as to the proper color and the best way to obtain it. By noting the color on the margin of the print that projects beyond the edge of the tracing, the question as to the amount of time allowance for making the print can be determined. If this margin is lighter than the body of the print, approximately the correct amount of exposure has been given the print; if it is darker than the body of the print it shows under-exposure; and when the margin has a greenish yellow appearance, the body will be mottled and the lines narrow and faint—an indication of over-exposure. Bond paper requires a longer exposure than tracing cloth.

Baltimore, Md. Henry R. Bowman

INDEXING MILLING FIXTURE

For the purpose of squaring and slotting the automobile drag-link adjusting screw shown at *A*, Fig. 1, a special indexing fixture was designed by means of which the work was performed in one operation. This indexing fixture has proved efficient, and its design is such as to be applicable to a wide range of work. The fixture is illustrated in Fig. 2, from which it will be seen that two sets of cutters are employed. The turret of the fixture, which indexes on the base, carries four work-holding stations, located equally from the center of rotation and 90 degrees apart. In operation, the work is loaded at station *A*; then the fixture is indexed 90 degrees to station *B* where two sides of the square are milled. The fixture is then indexed another 90 degrees to station *C* where the two remaining sides are milled and the slot cut, simultaneously. While the work at station *C* is being completed, another part is being machined at station *B*. On the next indexing movement of the fixture the completed part arrives at station *D* and is removed by the operator. From then on the operation of the fixture is simply a repetition of loading and unloading one piece at stations *A* and *D*, respectively, while the two pairs of cutters are simultaneously at work on two other pieces.

In connection with the application of this general type of fixture for machining other similar work, attention is directed to the two parts shown in the lower part of Fig. 1, both of which have recently been produced in large quantities. A fixture operating on the principle described could have handled these parts with better results than were attained with the tools used. The parts are shown as an aid to the reader in adapting a fixture of this kind to his requirements, the surfaces shown by heavy lines being those which can be machined in one operation. The radius *R*, Fig. 2, should be large enough so that the operator can load and unload safely.

E. C. Cooley
Syracuse, N. Y.

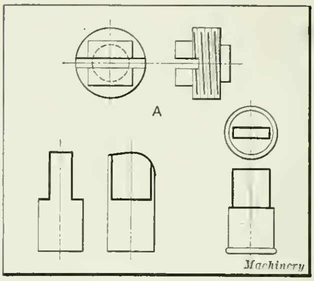


Fig. 1. Types of Work which may be advantageously machined on a Fixture of the Type shown in Fig. 2

BORING TOOL OR DRILL FOR FLAT-BOTTOMED RECESSES

A tool designed by the writer for rough-boring a recess in the base of a high-explosive shell is shown in the illustration accompanying this description. This cutter can also be employed in performing similar operations on a large variety of work. The shell was mounted in a turret lathe for the operation, the blunt end of the cutter being held in a simple holder (attached to the turret) having a slot extending across the front end, and two set-screws. Best results were obtained by having the turret slightly loose, thus permitting the cutter to float, and by using a hand feed.

In making the cutter, a piece of high-speed steel, 2½ inches wide by ½ inch thick and 2 inches long, was milled on the narrow sides until the distance across the corners was 2⅛ inches—the diameter of the recess to be bored in the shell. A line was then scribed across the top of the blank between two opposite corners, after which the cutter was set up on an angle in a milling machine vise and the front faces or "lips" were milled out as shown, by using a round-cornered milling cutter. Sufficient metal was then removed from the narrow sides to afford a generous clearance, there

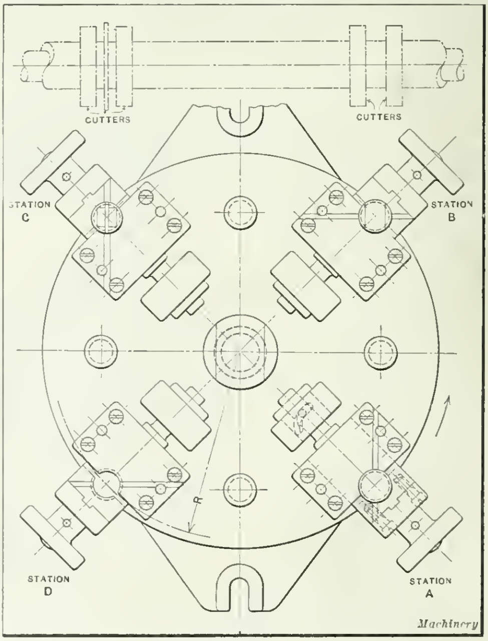
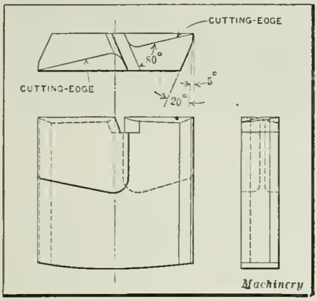


Fig. 2. Indexing Fixture designed for Use in milling and slotting Drag-link Adjusting Screws for Automobiles



Cutter for boring Square-bottom Holes

being a land ⅛ inch wide left. This land was also machined at an angle of 5 degrees for clearance purposes. The metal backing the cutting edges was machined at an angle of 7 degrees from the horizontal plane of the cutting edges. The cutter was next hardened, and the gash on the cutting edge ground.

The cutter was held in the vise on a grinding machine for the operation, the center line of the vise being set to an angle of 10 degrees with the grinding wheel so that the gash was ground at an angle of 80 degrees with the cutting edges. A saucer wheel was used, the angular side of the wheel being placed toward the longer. of the two cutting edges. In this manner it was possible to grind the gash to such a depth that the right-hand end of the longer cutting edge terminated at the exact center of the cutter. This is an important requisite in a tool of this type in order to insure proper cutting action.

It will be noted that the end of the cutter held in the holder is slightly rounded, this condition permitting the cutting edges to square themselves with the surface of the work. A coolant should be used in connection with this cutter. The cutting edges can be readily reground by hand on a fine-grained emery wheel, but care should be taken to grind them in a straight line across the center of the tool.

Allentown, Pa. Joe V. Romig

FORMULA FOR SOLVING AN INSPECTOR'S PROBLEM

Some time ago the writer had occasion to inspect a number of pieces having the outline shown in the accompanying diagram. It was a comparatively simple matter to check the dimensions D and L and angles A and B, but the checking of the dimension X from the top of the part to the intersection of the two surfaces which constitute each side of the part could not be readily accomplished on account of these surfaces being joined together by an arc of which R was the radius. Tolerances were allowed on angles A and B and, of course, dimension X varied as these angles varied. Subsequently, a formula was evolved for determining this dimension after dimensions D and L and angles A and B were known.

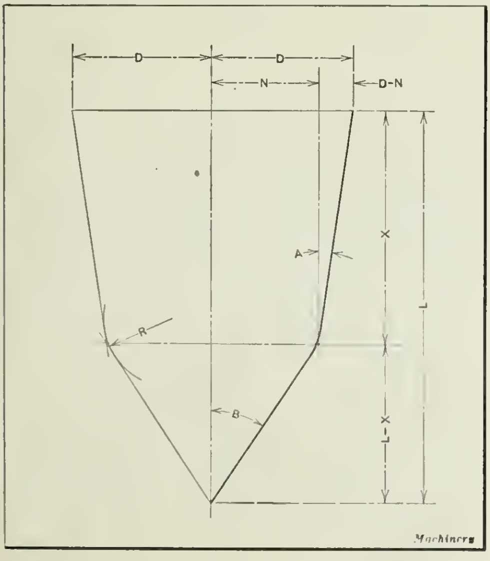


Diagram used in evolving Formula for checking Dimension X

Referring to the illustration,

$$\frac{D - X}{X} = \tan A$$

and

$$X = D - X \tan A$$

Also

$$\frac{X}{L - X} = \tan B$$

and

$$X = \tan B\ (L - X)$$

Therefore

$$D - X \tan A = L \tan B - X \tan B$$

Solving,

$$X\ (\tan B - \tan A) = L \tan B - D$$

$$X = \frac{L \tan B - D}{\tan B - \tan A}$$

It will be seen that this formula can be applied to a large variety of work where similar conditions are met with.

Philadelphia, Pa. Frederick J. Naab

* * *

FEDERAL FUNDS FOR RE-EDUCATION OF THE INJURED

According to an act recently passed by Congress, federal funds will be expended in the various states for the rehabilitation of persons injured in industrial work. The amount allowed by Congress to each state must be equalled by state funds. An appropriation of $750,000 has been made by Congress for the present fiscal year, and $1,000,000 has been pledged for each of the next three years. The funds will be apportioned in proportion to the population of the states. Up to this time six states have accepted the federal cooperation, three through the action of the legislatures and three by the act of governors. The states that have acted through their legislatures are Minnesota, Nevada, and New York, and those in which the act has been accepted by the governors are Tennessee, Arizona, and Indiana. It is expected that other states will take similar steps to accept federal aid as soon as their legislatures meet. Those permanently disabled in industrial occupations from amputations of the hand, arm, leg, feet, or a total loss of sight of one or both eyes have been estimated to total more than 14,000 a year. Although accurate figures are not available upon which to base calculations, a rough estimate places the figure for the number of persons who will be re-educated each year under the act at from 100,000 to 200,000. The federal board of vocational education will help the states to formulate the best rehabilitation methods.

* * *

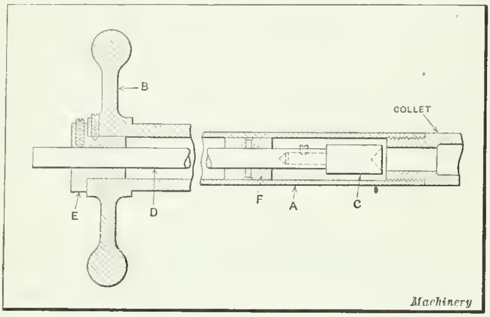
RECOVERY OF BELGIAN IRON AND STEEL INDUSTRIES

Belgium is gradually rehabilitating her industries, although the progress naturally is slow. In the early part of this year, the pig iron production of Belgium amounted to about 20 per cent of the pre-war production, and the steel production to about 27 per cent of the production in 1913. The wrought-iron production in January, 1920, was over 26,000 tons, which was slightly greater then the average monthly production in 1913, indicating that in this field Belgian mills have entirely recovered their pre-war production capacity. The coal production has also regained the average total previous to the war and in certain districts is now exceeding the output in 1913. In some districts, where the damage to mines was the greatest, the production is still below the pre-war figures, but not more than an average of about 15 per cent.

SHOP AND DRAFTING-ROOM KINKS

STOP FOR DRAW-IN COLLET CHUCK

A device for regulating the depth to which work is to be inserted in a draw-in collet chuck is shown in the illustration. The stopping attachment is contained in tube *A*, which connects handwheel *B* with the shank of the collet, and by means of which the collet is operated in or out when the handwheel is revolved. On a machine equipped with this attachment, the work is inserted in the collet until it comes in contact with the front end of stop *C*. The stop-bar *D*, to which the shank of stop *C* is secured by means of a headless set-screw, is a sliding fit in bushing *E*. This permits the bar to be readily adjusted to the proper longitudinal position to suit the desired length of the work. The bar is secured in position by means of a set-screw provided in the bushing for the purpose. The collar *F*, which is pinned to bar *D* and is a sliding fit in tube *A*, supports the forward end of the bar.



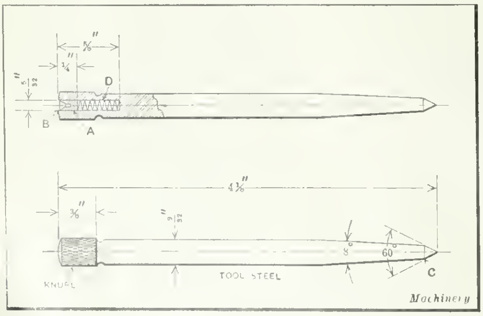
Attachment for regulating the Distance the Work should extend into the Collet

When it is desired to use this stop for gaging the length of short work, stop *C* should be designed to project sufficiently into the shank of the collet. Machining the front end of the stop to suit, when the end of the work is not flat, often gives better results than are obtained otherwise.

Paterson, N. J. Stephen Courter

LATHE CENTER WIGGLER

The accompanying illustration shows the construction of a center wiggler which has been used satisfactorily for truing up work in a lathe. After the work has been properly spotted, either by means of a milling machine or some other accurate method, it is set up on the lathe and the wiggler set with the pointed end in the spot on the work. The tail-center of the lathe is located in the opposite end of the wiggler. The spring arrangement for the female center will keep the pointer from distorting the spot in the work before it is properly trued up. By using an indicator at the pointer end of the wiggler and tapping the work until no deflection in the indicator pointer is noted, the work will be accurately located.



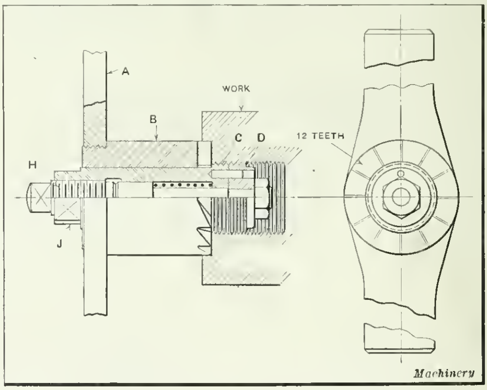
Wiggler used to true up Work held in Lathe Chuck or on Faceplate

The tool consists of a tool-steel spindle with a knurled head and a 60-degree point *C*, which is hardened on one end and ground. The knurled end of the tool is drilled out as shown and carries a coil spring *D* and a hardened steel center *A*. The edges of the hole in which center *A* is fitted are rolled as shown at *B* in order to hold the parts together. All necessary dimensions for making this tool are given on the illustration.

Bridgeport, Conn. Gustave Bahr

HAND FACING TOOL

The accompanying illustration shows a hand facing tool that was designed to finish the surface surrounding a tapped hole. Many counterbored holes are encountered on airplane and automobile engine work, and on the Hispano-Suiza airplane engine, in particular, considerable trouble was experienced in making the counterbored surface square with the center of the tapped hole. The tool here shown is screwed into the work to the required depth by means of the hexagonal head *J* on the center plug *C*. Then by turning the screw plug *H*, a tension is produced between the two screw plugs *C* and *D*, which causes them to bind against the opposed flanks of the threads in the hole so that they become locked in place. By this means the tool is held firmly and the face of the high-speed steel mill *B* is held perpendicular to the center line of the hole. By manually turning the handle *A*, the facing mill, which is independent of the rest of the tool, will face or counterbore the hole to the required depth as determined by the depth to which the plugs were originally screwed in. This provides a stop for the counterbore and assures accurate results. This tool has been extensively used on this type of work.



Hand Tool for counterboring Tapped Holes

Irvington, N. J. C. H. Dengler

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

FORCE REQUIRED FOR BENDING BARS AND PLATES

P. M.—It is sometimes necessary to know approximately, at least, how much pressure will be required to bend a bar or plate. Is there any simple way of determining the required pressure?

A.—In the design of most machines and structures, bending stresses are to be resisted, but occasionally it is necessary to determine approximately the force that will actually bend a bar or beam. Ordinary beam formulas may be used, whether the beam is to bend or to resist bending. When it must resist bending, the stress on the extreme or outer fibers of the beam (where the stress is greatest) must be less than the elastic limit of the material. In fact, the fiber stress should be considerably less than the elastic limit in order to avoid excessive deflection of the beam and to make it safe. On the contrary, when a bar or plate is to be bent, the applied force must be great enough to overcome the elastic limit of the material. Hence, in the following rules and formulas for determining the force required for bending, a value is employed which is assumed to be equal to, or slightly greater than, the elastic limit of the material. The elastic limit of steel is generally assumed to be one-half the ultimate tensile strength, although it might be two-thirds of the ultimate strength in the case of nickel steel and heat-treated forgings. It is evident, then, that the force required for bending, as determined by calculations is only approximate.

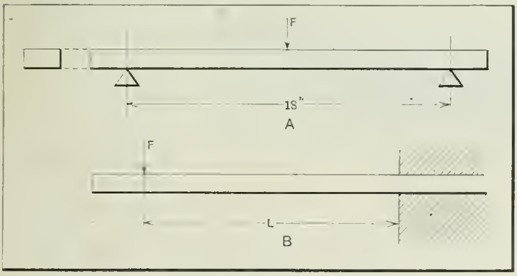


Diagram illustrating Calculation of Force required to bend Bars and Plates

The method of calculating force required for bending depends upon the way the bar or plate to be bent is supported, and how the force is applied. Ordinarily, the parts to be bent are either supported at both ends and the force is applied in the center, or the work is held rigidly at one end and the force or pressure is applied at the other. To illustrate the first case mentioned, suppose a structural steel bar ¾ inch thick and 1½ inches wide is supported at points 18 inches apart as shown at *A* in the illustration. If the force *F* is applied at a point midway between the supports, how many pounds pressure will be required for bending the bar?

The tensile strength of structural steel is about 60,000 pounds per square inch, and if the elastic limit is assumed to be 35,000 pounds per square inch, this will doubtless be somewhat greater than the actual elastic limit. The load in pounds required for bending may be determined as follows:

Rule—Multiply the square of the thickness of the bar (vertical dimension) by twice its width in inches, and multiply the product by the value assumed for the elastic limit. Then divide this product by three times the distance in inches between the supports.

Applying this rule to the example given, the square of the thickness, or 0.75, equals 0.5625, and $0.5625 \times 1.5 \times 2 = 1.6875$. The assumed value for the elastic limit, or $35{,}000 \times 1.6875 = 59{,}062$. Dividing by three times the distance between the supports we have $59{,}062 \div 3 \times 18 = 1093$ pounds. This is, of course, only approximate. The actual load required for bending would probably be a little less than the calculated load, especially if the value assumed for the elastic limit were somewhat greater than the actual elastic limit. If the foregoing rule is expressed as a formula in which

F = force in pounds required for bending;

S = stress in pounds per square inch, which exceeds somewhat the elastic limit of the material;

B = width of bar in inches;

T = thickness of bar in inches, or its vertical dimension;

L = distance between supports in inches.

Then

$$F = \frac{S \times 2 \times B \times T^2}{3L}$$

When the bar or plate to be bent is held at one end and the force is applied at the other, the pressure in pounds required for bending may be found as follows:

Rule—Multiply the square of the thickness of the material (vertical dimension) by its width in inches, and the product by the value assumed for the elastic limit. Divide the product thus obtained by six times the distance in inches from the point where the pressure is applied to the point where the bend will occur. (Equals distance *L* of diagram *B*.) The result will equal the required force in pounds.

Example—A steel plate ½ inch thick and 6 inches wide is to be bent, and the force is to be applied 13½ inches from the clamping jaws or from the center of the bend. It is assumed that the elastic limit is 35,000 pounds per square inch and that the plate to be bent is held rigidly on each side of the place where the bend is required, as shown at *B*.

The square of the thickness equals 0.5^2 or 0.25. Multiplying by the width of the plate, $0.25 \times 6 = 1.5$ and $1.5 \times 35{,}000 = 52{,}500$. Dividing by six times the distance *L*, we have $52{,}500 \div 81 = 650$ pounds nearly. If

F = force in pounds required for bending;

T = thickness of plate in inches, or its vertical dimension;

B = width of plate in inches;

L = distance between point where pressure is applied and center of bend;

S = stress in pounds per square inch, which slightly exceeds elastic limit of material;

$$F = \frac{S \times B \times T^2}{6L}$$

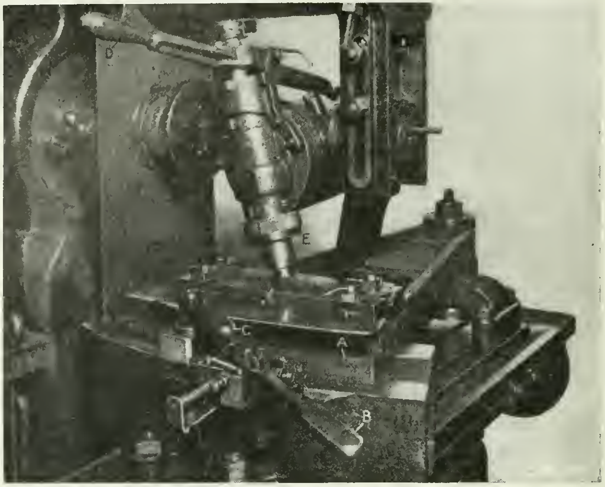
The values of S will vary considerably for different grades of steel, and also with the condition of the steel. For instance, unannealed steel will have a higher elastic limit than annealed steel. Consequently, the force required for bending can be calculated only approximately.

* * *

The Wisconsin Circuit Court has handed down a decision overruling a former decision of the State Industrial Commission. The Circuit Court's decision declares that the stockholders and officers of a company when performing duties as employes are not debarred from compensation for injuries received during such employment, but are entitled to it under the Workmen's Compensation Act. It is specifically stated that "no one can be denied compensation merely because he is an officer of an employing corporation, if in fact he performs duties of an employe as distinguished from those of an officer."

Cutting Teeth of Special Rack for Sight Mechanism

By CHARLES HARDY
General Manager
Blair Tool & Machine Works, New York City



WHEN the United States entered the world war, it was necessary to solve many mechanical problems in connection with the manufacture of guns, airplanes, and munitions of various kinds. The War Department decided to make about 1000 of the popular 75-millimeter "American" gun carriages. As government arsenals were able to produce but a small part of the tremendous output of munitions required, the Government turned to private manufacturers. The order for gun carriages was divided among several manufacturers, and many of the intricate parts were handled as separate items and given to different concerns in order to insure deliveries being made as soon as possible.

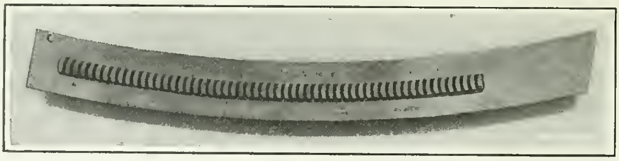


Fig. 1. Rocker-arm Rack of Sight Mechanism

One of the parts of the sight mechanism which is interesting as a manufacturing problem is known as the rocker-arm rack. This part is shown in Fig. 1. When the sight mechanism is assembled, a spiral scroll gear meshes with this rack, and the adjustment for sighting the gun is obtained as the scroll gear is revolved. The axis of the scroll gear is inclined at an angle of 14½ degrees, so that the rack is in mesh with one side of the scroll.

An enlarged detail view of the rack and teeth is shown in Fig. 3. The teeth are inclined at an angle of 14½ degrees, and the upper sides have a smaller radius than the lower sides, as the illustration shows. These two radii are necessary in order to avoid interference, because the teeth come into mesh with varying curvatures as the spiral scroll is revolved. It will also be noted that the centers of the tooth arcs are offset relative to the center line of the arc, which is necessary in order to secure a free movement without interference. As backlash or lost motion was limited to 0.0005 inch, it was necessary to provide accurate means for doing the work.

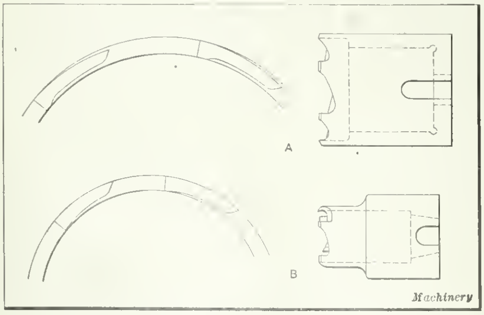


Fig. 2. Special Cutters used for Rocker-arm Racks—Enlarged Views of Cutter Teeth at Left

The special work-holding and milling fixture used is shown in the heading illustration. The radius to the center line of the rack is 21 inches, and the work-holder is provided with a slot conforming to its radius, the rack being clamped in the slot. The work-holder is pivoted at one end, the distance from the axis of the pivot to the center line of the rack being equal to the required radius of 21 inches. Another rack *A* forming part of the fixture is attached to the work-holder and serves to space the teeth on the work the required distance apart. The lever *B* is used for indexing from one tooth or division to the next. When a tooth is being milled, the work-holder is rigidly clamped to its base by lever *C*.

The special cutters used for this work are shown in Fig. 2. That side of the tooth having the larger radius is formed by the outside of cutter *A*, whereas the other side is formed by the inside of the smaller cutter *B*. As the teeth of the rack are inclined at an angle of 14½ degrees, the elevating screw of the milling machine could not be used for vertical feeding, it being necessary to feed the cutter-spindle in line with its axis when set at the required angle. For this reason the milling attachment was provided with a sliding spindle which is operated by hand-lever *D*, shown in the heading illustration.

After milling the side of the tooth having the larger radius, the smaller cutter was inserted in the special holder provided and the entire table of the machine was moved 0.026 inch (see Fig. 3) as this is the distance between the center lines on which the centers of the large and small tooth arcs are located. The shell-shaped cutters are held in the socket of a special holder *E* (see the heading illustration) which enables them to be removed easily when one cutter is replaced by the other.

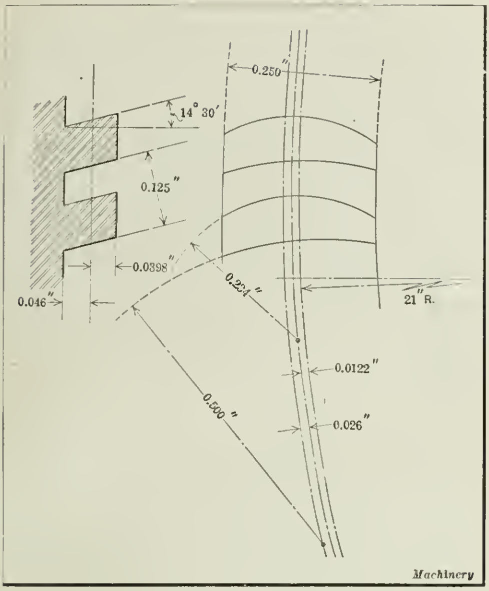


Fig. 3. Enlarged View of Rack Teeth

COMMERCIAL AERIAL TRANSPORTATION

Few people realize that regular aerial passenger service is an established fact. We know that mails are being carried regularly between various points in this country, and the newspapers have frequently referred to the airplane service between various cities in Europe, but that regular passenger service is maintained between London and Paris is not so generally known. Beginning August 25, 1919, one French and one British company inaugurated daily trips by airplane between the two capitals. Since that time, two additional French companies and one other English concern have established similar services. The distance is about 250 miles, and the trip takes from two to three hours. The best time that has been made is slightly less than two hours. The trips are taken in the early afternoon. At the present rate of exchange, from $40 to $50 is charged for a trip, and excess baggage costs about 30 cents a pound. In the first nine months of the service, 1074 trips were made and 1641 passengers carried, in addition to about 80,000 pounds of merchandise and over 1000 sacks of mail. The airplane method of crossing the channel appears to be growing in favor, as five times as many passengers were carried in May, 1920, as in the earlier months of the service. Most of the airplanes in service have accommodations for from two to four passengers, but some have large cabins with room for as many as a dozen people.

* * *

ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies' Building, 29 W. 39th St., New York City, December 7 to 10. Among the sessions, one will be included on the subject of Appraisal and Valuation, and another on the Application of Engineering to Woodworking. The newly founded professional sections on Management, Power, Fuels, Machine Shop Practice, Railroads, and Textiles will have separate sessions to consider the vital problems in their respective fields. In addition, there will be a number of papers of value and interest to engineers presented at the general sessions. A memorial session for Dr. Brashear is planned as a fitting tribute to the life and work of a great engineer.

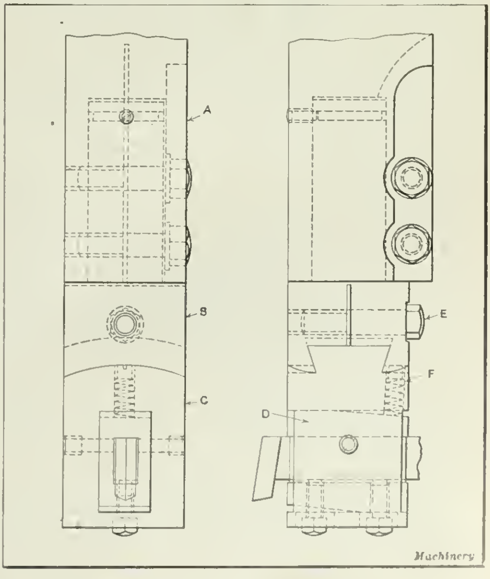
SLOTTING MACHINE TOOL-HOLDER

By HENRY DAUT

The accompanying illustration shows a tool-holder for a slotting machine, which is of such construction that the tool can be set in any angular position in a horizontal plane and can also be tilted with respect to a vertical plane. A click-box feature is incorporated to prevent the tool from scraping heavily against the work on the return stroke of the ram of the machine. The cast-iron holder *A* is attached to the lower end of the ram and can be made of any desired length. Part *B* is provided with a cylindrical shank, which is clamped in holder *A* by means of two machine screws. The setting of the tool in any position in a horizontal plane is accomplished by turning part *B* to the desired position, and then clamping it in place. This feature eliminates the necessity of changing the position of work on the machine table. A small headless set-screw in holder *A* engages a groove around the upper end of the shank of part *B* and prevents the shank from falling out of the holder when the clamping screws are loosened.

Part *C*, which contains the click-box, is provided with a circular dovetail tongue, by means of which the part is held in a corresponding groove in part *B*. As the tongue and groove are circular, part *C* and the tool can be tilted in various positions with respect to the vertical axis. A slot is cut across part *B* so that this part can be drawn slightly together by screw *E*, in order to clamp part *C* in position. Parts *B* and *C* are both round and made of machine steel. The click-box *D* is made of tool steel, and is spring tempered. It is machined on the top at the rear and on the bottom at the front to permit the tool to be tilted away from the work on the return stroke of the ram. It is important that the opposite sides of the surfaces mentioned are a close fit against the top and bottom of the slot in part *C* when a cut is being taken on the work. The pins on which the click-box is pivoted must also be located true to obtain a smooth working action.

The coil spring *F* is placed in a hole in part *C* and exerts a sufficient pressure against the click-box to place the tool in the cutting position before it reaches the work on the downward stroke. The pressure of this spring, however, is overcome as the tool bears against the work on the return stroke, so that the tool is tilted away from the work.



Tool-holder which permits Tool to be set in Any Horizontal Position and tilted from the Perpendicular

MILLING A SPLINED SHAFT

By J. B. GRAY

Frequently when there is a lack of proper shop equipment for the performance of a certain operation, the ingenuity of the foreman or machine operator is relied upon for finding some means by which the work can be satisfactorily accomplished with the use of existing equipment. Such was the case when the writer was called upon to mill ten spline grooves on the end of shafts 42 inches in length on a milling machine having a table so short that the work could not be held between index centers. The tolerances allowed on the spline dimensions were very small, as will be seen by referring to Fig. 1, which gives a sectional view of the splined portion of the shaft and the corresponding dimensions. The splines were to be finished by grinding in a later operation, and while the tops of splines in a job like this can be readily ground to the proper size, the grinding of the sides is always a slow and expensive operation. For this reason the grinding allowance on these surfaces was only 0.002 inch, and thus accurate spacing of the grooves was required.

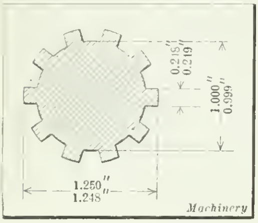


Fig. 1. Sectional View of Splined Portion of Shaft

The set-up that was finally employed on the milling machine for the operation is shown diagrammatically in Fig. 2. From this illustration it will be seen that the end of the shaft on which the grooves were to be machined was supported in an indexing head *A* and that the remainder of the shaft was supported near the middle by means of a lathe steadyrest *B*. This steadyrest also furnished a means of clamping the work in position after it had been properly indexed by the use of the indexing head. It was necessary to block up the indexing head several inches to place the center in proper alignment with the jaws of the steadyrest.

After the indexing head had been mounted on the machine table, the jaws of the steadyrest were adjusted radially to the proper position through the use of an aligning bar and an indicator attached to the end of a surface gage. The aligning bar was placed on the center of the indexing head and extended through the jaws of the steadyrest, being of the same diameter as the section of the shaft which was to be supported between the jaws. The amount of adjustment which the jaws required was readily observed by means of the indicator. After the aligning bar had been removed, the screw which operates jaw *C* was advanced one or two turns, the position of the two remaining jaws being undisturbed, so that when work was later placed in the steadyrest it was tightly clamped on account of the advanced position of jaw *C*. The upper part of the steadyrest was then swung back to permit the work to be placed in position.

After a dog had been attached to the front end of the shaft so that the work would be revolved with the center of the indexing head, the work was placed on the center and the steadyrest. The hinged part of the steadyrest was then placed in a closed position but was not clamped to the lower member. The index crank was next turned sufficiently to take up all backlash and to bring the plunger to a convenient position, after which jaw *C* was clamped on the work by tightening nut *D*, which is used to hold the upper member of the steadyrest in a closed position on the lower member. The dog was then loosened and removed to the position indicated at *E*, and the first groove was cut on the work by means of a slitting saw, 1/8 inch wide.

After the first cut had been taken across the work, the table was returned to its starting position, the dog carefully replaced, nut *D* loosened, and the work indexed the proper amount. Nut *D* was then retightened, the dog removed as previously described, and a cut taken on the next groove. The same procedure was followed in indexing the work for milling the remaining eight grooves. After each groove had been machined by the slitting saw, the splines were finished by straddle-milling, the proper spacing being again obtained by the method outlined in the foregoing.

* * *

NINTH SAFETY CONGRESS

The ninth annual congress of the National Safety Council will be held in Milwaukee September 27 to October 1. There will be four general sessions and sixty-two sectional meetings of which sixteen will be industrial sections on health service, education, and safety in the engineering trades. There will be a great many addresses by men prominent in the industrial and transportation fields in managing and executive capacities, as well as papers read by men who have made safety engineering their life work. A program especially fitted to the needs of men who are beginning work in the accident prevention field has been planned for the general session beginning at 10 o'clock Tuesday morning, September 28. In conjunction with the convention, there will be an exhibition of safety appliances at the Milwaukee auditorium. This safety exhibit promises to be the biggest yet held by the National Safety Council. Applications for space should be addressed to W. H. Frater, business manager, 168 N. Michigan Ave., Chicago, Ill.

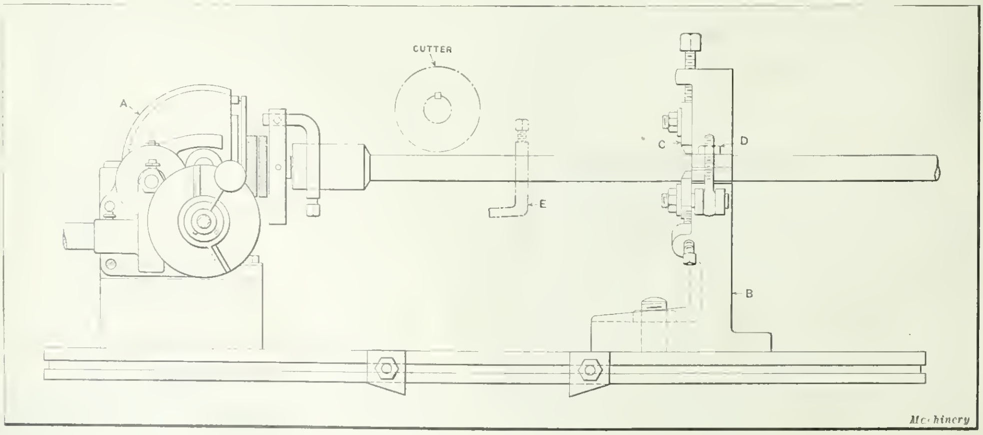


Fig. 2. Set-up employed for milling Spline Grooves on Shafts of a Length that prevented the Use of Index Centers

True Stresses in Rectangular Steel Bars

By N. BARNES HUNT, Engineer, United States Reclamation Service, St. Ignatius, Montana

THE following presentation of combined stresses is supplementary to the article entitled "Practical Applications of the Combined Stress Theory," which was published in the August, 1919, number of MACHINERY, and is subject throughout to the same general conditions and limitations. It may be of interest in comparison with the formulas for combined stresses deduced by Victor M. Summa in an article entitled "Combined Stresses" published in the July number of the same year. In that discussion Mr. Summa used the apparent stress theory, or a combination of stresses by the methods of statics, while the theory here employed is known as the true stress theory, in which stress is assumed to be a function of deformation.

A single force will cause deformation in two perpendicular directions, the amount of deformation occurring laterally with respect to the direction of the load being given by Poisson's ratio. The stresses resulting from the application of this theory are called true stresses. Further complications are introduced by a consideration of two forces applied at right angles to each other. This discussion is limited to such a condition, in which the applied forces produce flexural and torsional stresses. For the purpose of enabling the discussion to be more clearly followed, the general formulas for true stresses as deduced by Merriman, which apply when the axial force is tension, will be repeated here:

$$S_t = \tfrac{1}{2}(1 - R)\, S_{ts} + (1 + R)\sqrt{S_{ss}^2 + (\tfrac{1}{2} S_{ts})^2} \qquad (1)$$

$$S_s = (1 + R)\sqrt{S_{ss}^2 + (\tfrac{1}{2} S_{ts})^2} \qquad (2)$$

in which

S_t = true unit tensile stress;
S_s = true unit shearing stress;
S_{ts} = simple unit tensile stress;
S_{ss} = simple unit shearing stress;
R = Poisson's ratio.

Formulas for tension and shear may be developed from Formulas (1) and (2) by substituting in them the values of S_{ts} and S_{ss} found from the flexure and torsion formulas, respectively, and using a suitable factor of lateral contraction, which is usually taken as one-third for steel. Assuming that the load causing flexure acts in the same direction at all times, the neutral axis will occupy an infinite number of positions with respect to a rotating shaft, and the value of the rectangular section modulus will be variable, from which it is evident that S_{ts} will also vary. In the following equations,

M_b = bending moment in inch-pounds;
d = breadth of cross-section in inches;
l = length of cross-section in inches.

When the neutral axis is parallel to d:

$$S_{ts} = \frac{6M_b}{dl^2} \qquad (3)$$

When the neutral axis is parallel to l:

$$S_{ts} = \frac{6M_b}{d^2l} \qquad (4)$$

When the neutral axis coincides with a diagonal:

$$S_{ts} = \frac{6M_b\sqrt{d^2 + l^2}}{d^2l^2} \qquad (5)$$

In the last case, the maximum stress is attained, but since this stress occurs at a corner of the bar and since the torsional stress is zero at the corners, no combined effect need be considered. The bar occupies its most critical position when the flexural load acts in a direction perpendicular to the length of the cross-section; consequently Formula (4) should be used for revolving shafts or bars. The appropriate formula for use when bars are in static equilibrium depends upon the direction in which the load is applied.

The formula for finding the torsional stress at the middle of the short side d, is

$$S_{ss} = \frac{9M_t}{2dl^2} \qquad (6)$$

and at the middle of the long side l,

$$S_{ss} = \frac{9M_t}{2d^2l} \qquad (7)$$

in which M_t = the torsional moment in inch-pounds.

Formula (7) gives the maximum torsional stress in the bar. Assuming $R = 1/3$ and substituting values from Equations (3) and (6), Formulas (1) and (2) may be written

$$dl^2 = \frac{2M_b + 2\sqrt{9M_t^2 + 4M_b^2}}{S_t} \qquad (8)$$

$$dl^2 = \frac{2}{S_s}\sqrt{9M_t^2 + 4M_b^2} \qquad (9)$$

when the flexural load acts in a direction perpendicular to the breadth d of the bar section. In like manner, using values taken from Equations (4) and (7), Formulas (1) and (2) may be written

$$d^2l = \frac{2M_b + 2\sqrt{9M_t^2 + 4M_b^2}}{S_t} \qquad (10)$$

$$d^2l = \frac{2}{S_s}\sqrt{9M_t^2 + 4M_b^2} \qquad (11)$$

when the flexural load acts in a direction perpendicular to the length l of the section.

When the bar is of square section, $d = l$, and these formulas may then be written

$$d^3 = \frac{2M_b + 2\sqrt{9M_t^2 + 4M_b^2}}{S_t} \qquad (12)$$

$$d^3 = \frac{2}{S_s}\sqrt{9M_t^2 + 4M_b^2} \qquad (13)$$

for a flexural load acting in a direction perpendicular to any side.

In each of the preceding groups of two formulas, the size of the bar is governed by the greater value of dl^2, d^2l, or d^3.

The flexural compressive stress has been ignored in these deductions, but it may be used instead of the tensile stress when the strength of the material is approximately the same in tension and compression, by substituting the simple unit compressive and shearing stress values in the basic formulas (1) and (2). Since the simple tensile and compressive stresses are equal, when both are flexural stresses, the only change in the formulas will be the substitution of the true unit compressive stress values for the true unit tensile stress values.

Example—The first example used in Mr. Summa's article published in MACHINERY for July, 1919, which has previously been referred to as exemplifying the apparent stress theory, may also be employed in this case. The problem is to find the size of a square-sectioned bar, subjected to a bending moment of 100,000 inch-pounds, and a torsional moment of 80,000 inch-pounds, allowing a working stress of 12,000 pounds per square inch in tension and 9600 pounds per square inch in shear. It is assumed in the following solution that the material is steel.

From Formula (12) for bars of square section,

$$d^3 = \frac{2 \times 100{,}000 + 2\sqrt{9\,(80{,}000)^2 + 4\,(100{,}000)^2}}{12{,}000} = 68.73$$

$d = 4.10$ inches

and from Formula (13)

$$d^3 = \frac{2}{9600}\sqrt{9\,(80{,}000)^2 + 4\,(100{,}000)^2} = 65.09$$

$d = 4.02$ inches

The corresponding values obtained in the article referred to were 4 inches, and 3.66 inches respectively, from which it is seen that only in the value obtained by using the shearing stress S_s, is there an appreciable difference. It does not follow, however, that the two theories will always agree so closely. In general, the use of the true stress theory will result in larger sections than found by the apparent stress theory. There is some difference of opinion as to whether this increase in the size is justified, and the difference may, of course, be neutralized within certain limits by using a different factor of safety. The designer may form his own opinions after consulting the leading authorities.

* * *

NOTES FROM THE AMERICAN INSTITUTE OF WEIGHTS AND MEASURES

The American Institute of Weights and Measures, 115 Broadway, New York City, in a recent statement, points to the practically universal use of the English system of measurements in the lumber trade, even in countries that otherwise use the metric system. Quoting from the U. S. Commerce reports of February 11, 1920, it is stated that, according to trade commissioner A. X. Oxholm, lumber exported by one of the saw-mill companies in northern Sweden is cut as follows: 69 per cent to English measurements; 7 per cent to Danish feet; 7 per cent to Spanish feet; 4 per cent to Dutch feet; 4 per cent to German feet; and 9 per cent to the metric system. Of the 9 per cent, however, 8 per cent is cut to what is known as "metric feet," the metric foot being one-third of a meter, a sub-division of the meter that equals about 9 per cent more than an English foot.

It is further pointed out that the overwhelming proportions of British and American foreign and domestic trade has secured for the English system of measurements a universality in the engineering trade, due to natural processes, which no amount of compulsory legislation could have made possible. Thus, 70 per cent of the world's output in steel is manufactured in the United States and Great Britain to the English system of measurements, and these two countries are also responsible for approximately two-thirds of the world's production of machine tools and 80 per cent of the world's production of screw products. The United States alone manufactures 90 per cent of the world's motor vehicles. Generally speaking, two-thirds of the commerce of the world is in manufactured products produced on the basis of the English system of weights and measures.

* * *

MATERIALS HANDLING SECTION OF A. S. M. E.

The Materials Handling Section of the American Society of Mechanical Engineers met at the Engineering Societies' Building, 29 W. 39th St., August 13, to consider ways and means for promoting the art of the mechanical handling of materials. Robert M. Gates of the Lakewood Engineering Co. presided and addresses were made by a number of other engineers well known in the material-handling field. It is intended that the section, which has recently been formed, shall be a channel of intercourse between technical and industrial organizations on the subject of mechanical handling of materials. The section shows great activity, and 381 members signed the petition to the council of the American Society of Mechanical Engineers, requesting the formation of such a section.

USE OF TITANIUM IN STEEL

In view of the constant investigations as to the value of various metals in alloy steels, the following review of the present status of titanium as an alloying metal, published in a recent number of *Reactions*, is of interest. It is stated that while vanadium is comparatively scarce, there are large quantities of high-grade titanium ores in the United States, sufficient to last over one hundred years. A great amount of research work is now being applied to titanium, the use of which as a content in steel has hitherto been comparatively unknown. Until recently ferro-titanium was known simply as a deoxidizer.

During the war, France used a great deal of titanium, not only as a deoxidizer, but also in the production of steel having a certain content of titanium. It has also been learned that some of the other European countries, particularly Germany and Sweden, are using titanium as a content in the production of automobile and other steels which are subjected to most severe service. Such steel has been a successful competitor of American steels of about the same composition but without titanium. American steel makers, however, have since experimented along the same lines, with the result that they are now producing a steel which is at least equal to that of their European competitors.

Research work has not stopped here, but has been extended into the tool steel industry, and the results of experiments indicate that titanium can be used to advantage in place of all or part of some other alloy materials. This is of particular interest to American manufacturers of high-grade steels, who have been unable always to obtain ferro-vanadium in sufficient quantities and have been forced to look for substitutes. Alloy steel makers who have been experimenting with titanium as a substitute report satisfactory results, and think it is only a question of time until the public is educated to the merits of such steel. An argument for the close study of the possibilities of titanium is the fact that there are unlimited supplies of high-grade titanium in this country. Also, the price of titanium ores is very low in comparison with that of ores of the other well-known alloying metals.

* * *

ORGANIZATION PROGRESS OF THE FEDERATED AMERICAN ENGINEERING SOCIETIES

The Joint Conference Committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, acting as a committee in accordance with the authorization of the Organizing Conference held in Washington, D. C., June 3 and 4, 1920, has extended an invitation to the engineering and allied technical organizations in the country, to become charter members of the American Federated Engineering Societies, and to appoint delegates to the first meeting of the American Engineering Council to be held in November. At the meeting in Washington, 140 delegates were present, representing 71 engineering and allied technical organizations. It was the unanimous opinion of the conference that there should be created an organization "to further the public welfare wherever technical knowledge and engineering experience are involved, and to consider and act upon matters of common concern in the engineering and allied technical professions," and that this organization should consist of societies or affiliations, and not of individual members. On the basis of these fundamentals, a constitution and by-laws were adopted.

The Joint Conference Committee has asked each organization invited to take favorable action in the matter of membership in the organization at the earliest possible moment and to advise the committee promptly of the names of the delegates who will attend the first meeting of the American Engineering Council in November of this year. The address of the committee is 29 W. 39th St., New York City.

Machine for Testing Efficiency of Spur Gears

A MACHINE for testing the efficiency of spur gear drives has recently been developed by the National Physical Laboratory of Great Britain. In this machine, as described by T. E. Stanton in *Engineering*, the two gears being tested are mounted on shafts, and the machine measures the torque of the driving shaft and the difference between the torques of the driving and driven shafts. After the torques on both gear shafts are known, the efficiency of the gears can readily be determined by dividing the torque of the driving shaft by that of the driven shaft. The machine is of one-horsepower capacity, it having been thought preferable to build a small machine for experimental purposes before attempting to build a larger one for practical use. By referring to the accompanying illustrations an idea of the construction of the machine may be obtained.

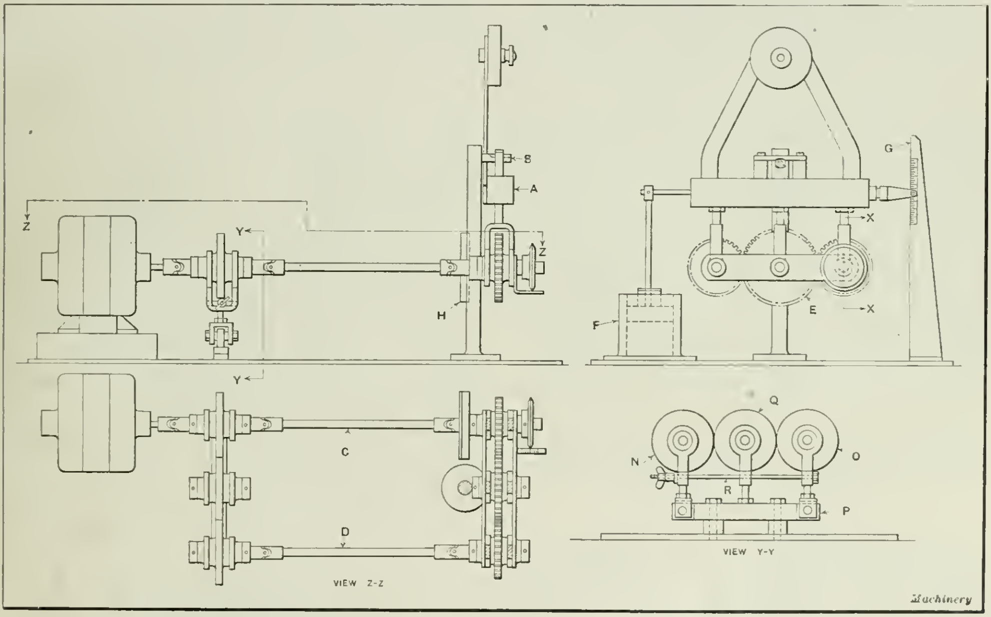


Fig. 1. Machine developed by the National Physical Laboratory of Great Britain for determining the Torques of the Shafts on which the Gears under Test are mounted

The frame *A*, Fig. 1, on which the gears being tested are mounted, is entirely supported by a horizontal knife-edge *B*. It will be noticed that driving shaft *C* and driven shaft *D* are provided with universal joints on each end. By this arrangement it is possible for frame *A* to oscillate somewhat in a vertical plane about its neutral position. An intermediate wheel *E* is placed between the gears being tested, because it is necessary for both shafts to rotate in the same direction in order for the reaction on the frame to be equal to the difference between the torques on the driving and driven shafts. If they should revolve in opposite directions the reaction would be equal to the sum of the torques. An oil dashpot *F* is provided for damping the oscillations of frame *A*, and a scale pan in the dashpot and scale *G* are furnished for measuring the difference between the torques of the two shafts.

There is an indicator on the driving shaft for determining the torque of this shaft. The construction of this indicator may be observed by referring to Fig. 2. Motion is transmitted from driving shaft *C* to one of the gears being tested, by means of two spiral coil springs *I* and *J*, which rotate box *H*. These springs are of equal dimensions, one of them being left-hand while the other is right-hand. Box *H* has a long sleeve on which the gear is mounted and through which shaft *C* extends. The shaft has a double spiral groove of 2 inches pitch on its right-hand end, this end being a sliding fit in the sleeve of box *H* on which the torque indicator *K* is also mounted. The sleeve has two longitudinal slots in it in which two studs *L*, which are attached to the torque indicator, slide. The inner ends of these studs are provided with hardened steel rollers which project into the spiral grooves. It is obvious that the relative motion of the spiral groove on the driving shaft and the sleeve on which the gear is mounted will cause an axial movement of the torque indicator, and that if a calibrated scale is provided, the value of the torque can be read on this scale. Scale *M* is provided for this purpose.

By referring to the view *Y–Y* in Fig. 1, it will be apparent that the power from the driven shaft is returned to the driving shaft by means of a friction drive. The two outer wheels *N* and *O* are made of cast iron and have a velocity ratio about 5 per cent greater than that of the gears under test. These wheels are supported by rocking arms which permit a freedom of movement in a vertical plane about pin connections in the supporting bracket *P*. The intermediate wheel *Q* is made of red fiber and is supported by a bearing which is fixed to bracket *P*. The hinged bearings are connected by a steel rod *R* which passes through their forks. The tension in this rod can be adjusted by means of the wing-nut at the left end, the elasticity of the connection being supplied by means of a beam spring across the forks of the bearing at the right end. By varying the tension in this rod, the power passing through the gearing can be

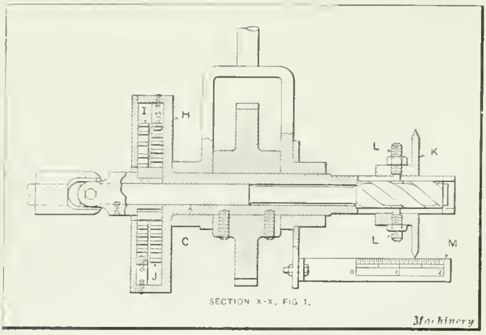


Fig. 2. Sectional View showing Torque Indicating Device on Driving Shaft

varied over a fairly wide range, the upper limit of which depends upon the frictional resistance of the fiber wheel.

In making a test, the most convenient method is to place weights in the scale pan corresponding to a given torque difference and then regulate the tension in rod *R* by means of the wing-nut until the frame is balanced with the pointer indicating the zero graduation on the torque difference scale *G*. A reading of the torque indicator *K*, Fig. 2, will then give all the data necessary for the determination of the gearing efficiency. In an experiment on two gears having 60 teeth of 14 diametral pitch revolving at 1230 revolutions per minute, with which an intermediate gear having 75 teeth was used, the measured torque of the driving shaft was 4.28 foot-pounds and the difference between the torques of the driving and driven shafts was 0.88 foot-pound. The torque of the driven shaft was therefore equal to 4.28 — 0.88 or 3.40 foot-pounds. Therefore the combined efficiency of the three gears was equal to 3.40 ÷ 4.28 or about 79 per cent. And the efficiency of transmission of each pair of gears was approximately 89 per cent. A modification of the machine described in the foregoing is now being developed for use in testing bevel gears and chain drives.

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TAPPING ATTACHMENT WITH AUTOMATIC REVERSAL

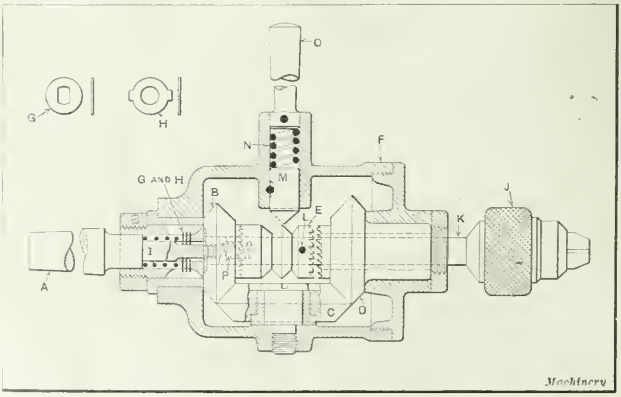
By CHARLES RUIZ

Reversal of the direction in which the tap rotates is automatically obtained when the tapping of a hole is completed, through the use of the attachment illustrated, without necessitating a change in the direction in which the driving spindle of the machine rotates. This device was designed for use on a special chucking machine, but it is also applicable to lathes, drilling machines, and other machines built along the same lines. The fact that the attachment reverses itself makes it especially convenient for use in tapping deep holes. In such cases, the operator can tend to several machines, because after the tapping of a hole has commenced, no attention is required until the operation has been completed and the tap withdrawn.

The attachment is driven by means of shank *A*, which is inserted in the socket in the end of the machine spindle. The rotation of the spindle in the two directions necessary to feed the tap into the hole and effect its withdrawal is secured through the three bevel gears *B*, *C*, and *D* and clutch *E*, these parts being contained in the cylindrical housing *F*. Gear *B* is driven by means of the friction disks *G* and *H*, which are assembled alternately and pressed together by the compression coil spring *I*. Disks *G* are fastened on the end of shank *A* and drive disks *H* which are provided with tongues that extend into grooves in the bevel gear *B*. The detail views of these disks should be of assistance in understanding the manner in which they cause the gear to revolve. When it is desired to produce threads in a hole, the tap is first placed in the drill chuck *J*, then the teeth on the rear end of clutch *E* are brought in mesh with the saw teeth on gear *B*, and the machine spindle advanced until the tap comes in contact with the work. When power is applied, the clutch drives the tapping spindle *K* by means of pin *L*, which passes through a slot in the spindle. The tap draws itself into the hole being tapped, and the entire attachment and the machine spindle are pulled forward as this occurs. The clutch *E* is held in engagement with the gear *B* by the plunger *M*, which is actuated by means of the compression coil spring *N*.

A stop, properly located on the machine, prevents the machine spindle from advancing farther when the tapping operation is completed. However, the tap continues to be drawn into the hole due to the continued rotation of the machine spindle, pulling spindle *K* and clutch *E* with it. This pulling force is sufficient to overcome the pressure exerted by spring *N*, and engagement of the clutch with gear *B* is broken as the high point between the two grooves on the clutch passes the point of the plunger. As soon as this happens, the plunger, being again actuated by spring *N*, is pushed into the next groove on the clutch and forces the teeth on the front end of the clutch to be brought in mesh with the saw teeth of gear *D*. This gear, of course, revolves in an opposite direction to gear *B* on account of being driven from the latter through the intermediate gear *C*. Thus, when the clutch is brought in mesh with gear *D*, the rotating direction of the tap is immediately reversed, causing it to withdraw itself from the hole. The pressure of spring *N* is great enough to hold the clutch in mesh with gear *D* during this movement, so that the entire unit and the machine spindle are returned to their starting positions.

The clutch is again brought in mesh with gear *B* preparatory to another tapping operation by exerting sufficient pressure on spindle *K* to overcome the force of spring *N*, at the same time holding the housing *F* in an immovable position. Handle *O* is provided so the housing can be held from rotating with the shank. It is obvious that by increasing or decreasing the number of driving disks *G* and *H*, the power of the attachment can be altered to suit various sizes of taps. The front end of shank *A* is held in gear *B* by means of a small round nut placed in a counterbored hole in the gear. The spring *P*, which is placed in the same hole, extends into another counterbored hole in the end of spindle *K* and takes up any backlash of the latter that might be produced by the slot in which pin *L* operates.



Tapping Attachment which reverses Rotation of Tap when Operation is completed

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application

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Electrical Speed Control for Cleveland Automatics

In performing a sequence of machining operations on an automatic screw machine, it is often desirable to rotate the work at different speeds while it is in contact with successive tools of the series, if each tool is to operate under ideal conditions. On the Cleveland Type A machines, this result is accomplished automatically by a mechanism that regulates the amount of resistance in series with the shunt field windings of an adjustable-speed driving motor. Maintenance of the correct cutting speed for each tool assures efficient cutting, satisfactory rates of production, and a good finish on the machined surfaces.

A WIDE range of feed variations are provided on automatic screw machines built by the Cleveland Automatic Machine Co., Cleveland, Ohio. Several years ago it became apparent that if this provision for feeding the tools to the work at suitable rates could be supplemented by an automatically controlled spindle speed changing mechanism which would enable the number of revolutions per minute of the work to be varied to maintain the correct peripheral cutting speed for different tools that are used successively, the machine with such an equipment would be able to obtain a more satisfactory productive efficiency. Over two years were spent on this problem of machine design before a satisfactory solution was evolved, and during this period of development various forms of electrical speed controllers were employed, with provision for their operation either automatically or by hand.

Quite obviously an automatic controller would possess many important advantages over a hand-operated equipment for use on an automatic screw machine. Chief among these is the fact that with automatic control there would be no interference with the quite general practice of having a single attendant look after a number of machines of this type. With a hand-operated controller it would be necessary to have the operator always near the machine in order that he might effect the speed changes at exactly the proper time. The means finally adopted consists of an automatically operated controller that increases or decreases the resistance in series with the shunt field windings of an adjustable-speed motor, thus varying the peripheral speed of the work to suit the different tools.

General Description of the Machine

Cleveland automatic screw machines equipped with this automatically operated adjustable-speed mechanism are

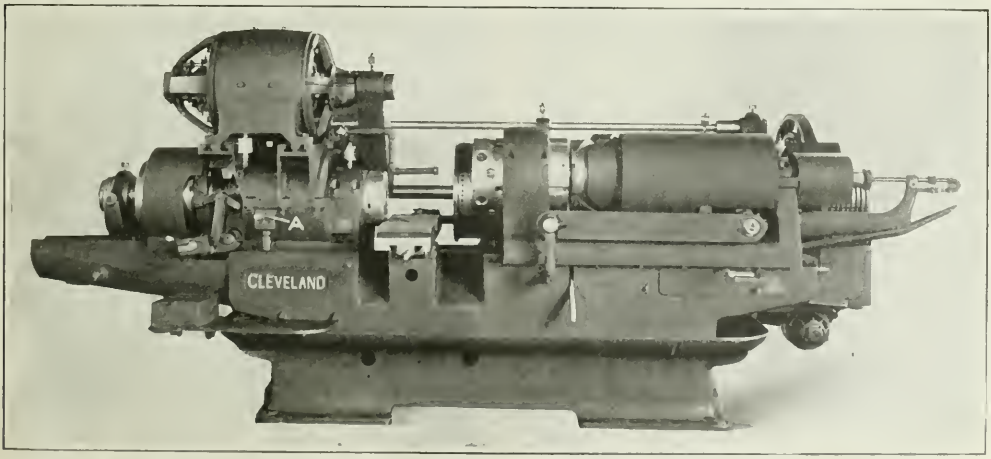


Fig. 1. Front View of Large Cleveland Automatic equipped with Automatically Controlled Adjustable-speed Driving Motor

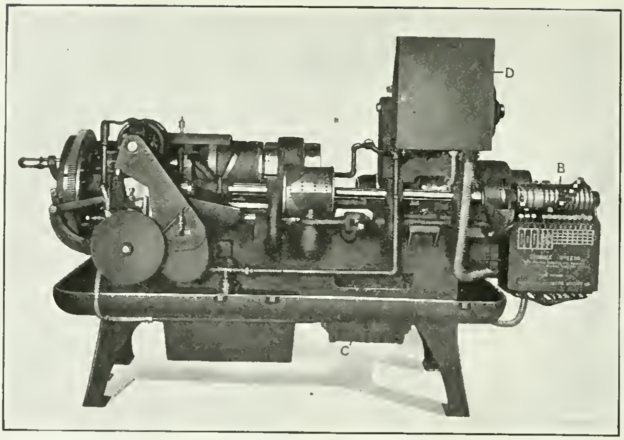


Fig. 2. Rear View of a Smaller Cleveland Automatic equipped with Automatically Controlled Adjustable-speed Spindle Driving Motor, and Constant-speed Motor for driving Other Parts of the Mechanism

known as Type A automatics and in the 1½-, 2-, 2½-, 3-, and 3½-inch sizes they are equipped with two electric motors. One of these is an adjustable-speed reversible or so-called planer type of motor which is used for driving the spindle only. The other is a small constant-speed motor that is utilized to drive all other parts of the machine including the patented automatic spindle speed controller. On the larger sizes of Cleveland automatics only one electric motor is employed, this being the standard equipment for the Type A machines of 4½, 5½, 6¾ and 7¾ inches capacity.

On the small sized machines provision is made for automatically obtaining eight changes of spindle speed through the electrical controller, and by means of a cam-operated solenoid it is possible to actuate a clutch that engages either the high- or low-speed gears, so that a total of sixteen spindle speeds is available, giving a range of ten to one in either direction at any point in the cycle. This applies to Cleveland Type A automatics in sizes up to 3½ inches, inclusive.

The four larger sized machines are not furnished with back-gears, so that only eight changes of spindle speed are available, and as it is not required to perform threading operations on work handled on the larger sizes of machines, no provision is made for reversing the direction of spindle rotation. As only one motor is used on the large automatics, in addition to driving the spindle, the power is transmitted from this motor to a shaft running along the back of the machine to carry movement to all other members of the machine. Aside from the provision for adjusting the spindle speed, the design of these Type A automatics is essentially the same as that of other machines built by this company.

How the Automatic Control of the Spindle Speed is Obtained

Having made a general statement as to the arrangement of the controller mechanism of the Cleveland Type A automatics, we are in a position to give a detailed description of the arrangement of the special equipment provided for this purpose and of the manner in which it functions. It will be desirable to obtain an idea of the relationship of the spindle speed control and reversing mechanism to the other parts of the machine, and this can best be done by referring to Figs. 1 and 2 which show front and rear views of two different sizes. Referring to Fig. 1 it will be seen that there is a push-button at *A* that operates the main switch and provides for starting and stopping both motors. Next turning attention to Fig. 2, it will be noticed that there is a drum *B* mounted at the end of the main camshaft; this camshaft also carries other cams which time or synchronize all of the automatic movements of the machine. The number of cams mounted on drum *B* will vary according to the size of the machine, that is to say, upon whether or not provision is made for doubling the number of spindle speeds obtained through the controller by the engagement of high- or low-speed gears, and for reversing the direction of rotation of the spindle.

For the purpose of this description it will be best to consider the equipment used on machines of sizes up to 3½ inches, inclusive, and in these cases the cam-drum *B* carries three cams that provide for starting, stopping, and reversing the spindle driving motor, respectively; there are also two cams for engaging the high- and the low-speed gears, and eight cams operate the controller to obtain any of the available speeds which it provides. A clearer idea of the arrangement of this part of the mechanism, and of the way in which it functions will be gathered by referring to Figs. 3 and 4, which show close-up views of the controller cam-drum and of the auxiliary mechanism. In Fig. 3 it will be seen that on the cover plate over the box is marked, opposite each lever, the functions performed by the several cams carried

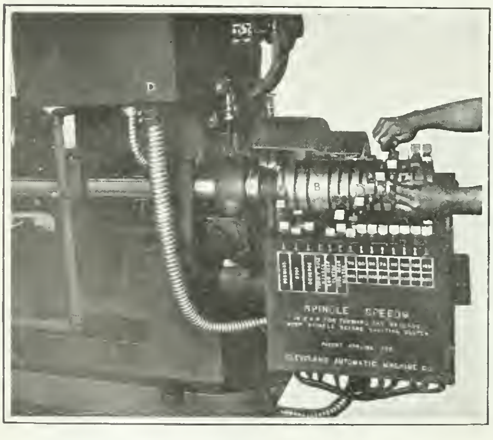


Fig. 3. Close-up View of Mechanism for automatically starting, stopping, and reversing the Spindle, engaging High- and Low-speed Gears and changing the Speed of Rotation

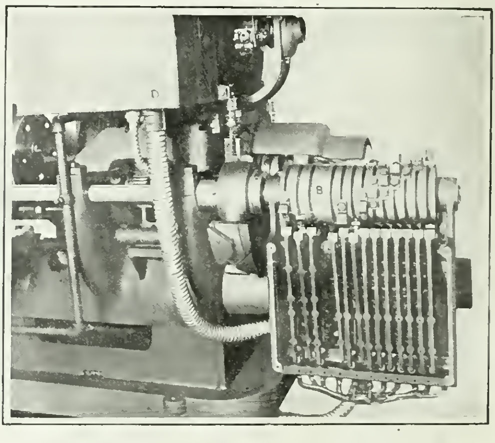


Fig. 4. Close-up View of Patented Automatic Controller for Adjustable-speed Spindle Driving Motor, with the Cover Plate removed to show the Arrangement of the Operating Mechanism

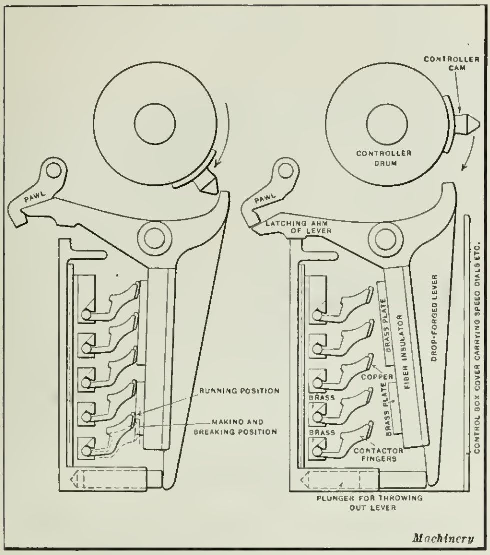


Fig. 5. Arrangement of Control Box Mechanism, showing Contactor Fingers in Disengaged and Running Positions

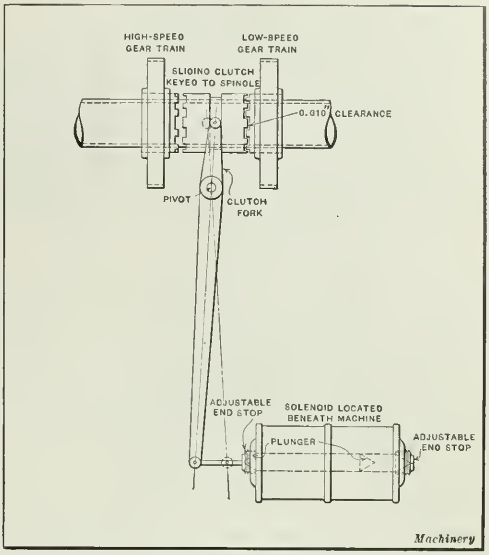


Fig. 6. Arrangement of Solenoid-operated Clutch for automatically engaging the High- and Low-speed Gears

on drum *B*, and in the case of the eight cams that effect changes of speed, information is given concerning the speeds that are secured with each cam when the spindle is driven through the high-speed and through the low-speed gears.

In Fig. 4 the cover plate has been removed from the box to show the interior, and this illustration, in conjunction with Figs. 5 and 6, will give the reader a good idea of how the mechanism operates. Each of the cams carried by the drum *B* comes into engagement with its respective controller lever at some point in the revolution of the camshaft. In the case of speed changes, the desired result is accomplished by eight cams which come successively into engagement with their respective controller levers and throw over contact levers that bring contactors carried by the levers into engagement with corresponding contacts in the controller box. In this way, the amount of resistance that is in series with the shunt field windings of the adjustable-speed driving motor may be changed, in order to rotate the work at a suitable speed for the tool in the operating position. Particular attention is called to the manner in which this engagement is effected through a combination rubbing and rolling action that tends to keep the surfaces of the contacts clean so that a satisfactory electrical connection will always be secured. Engagement of either the high- or low-speed gears is secured through two cams and control levers that operate a solenoid carried in a case shown at *C* in Fig. 2. This mechanism is also illustrated diagrammatically in Fig. 6, where it will be seen that when the solenoid is energized in one direction it throws the high-speed gear into engagement; and energizing the solenoid in the opposite direction results in engagement of the low-speed gear. Similarly, the three remaining cams on drum *B*, Fig. 2, actuate control levers that engage contacts for driving the motor in the forward or reverse direction, or for stopping its rotation.

Only one lever in the row can have contact at a time, because as the next lever is brought into engagement with the contactor fingers, the latching arm of the incoming lever raises the pawl, thus letting the other arm which is in

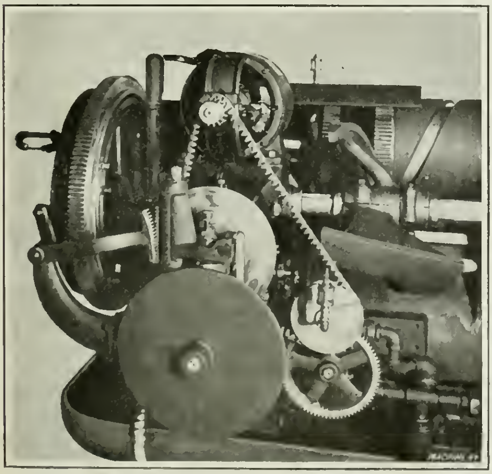


Fig. 7. Close-up View of Constant-speed Motor for driving All Members of the Mechanism except the Spindle

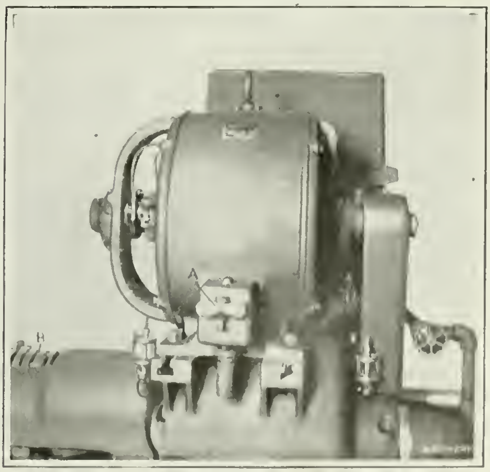


Fig. 8. Close-up View of the Adjustable-speed Motor which is automatically controlled to give Required Spindle Speeds

contact fall out of engagement. This is a very simple operation, and the attendant is not required to bother about what lever is in the operating position. It is merely necessary for the set-up man to locate each cam on the controller drum to give the proper cutting speed for the tool that is in the operating position, and then when the next tool is advanced to the work, the corresponding cam on the drum will come into action and provide for rotating the work at the proper speed for this tool.

Fig. 5 shows the contactor fingers in two positions, namely, disengaged and running; and Fig. 6 shows the solenoid-operated clutches that provide for automatically engaging the high- and low-speed gears. The solenoid plunger comes tightly to rest against a stop at either end, and there is a slight air-cushion effect. In order to prevent the clutches from causing any end thrust against the spindle bearings, the stops, Fig. 6, are adjusted so that the clearance between the top of the sliding clutch tooth and the bottom of the engaging clutch space is 0.010 inch.

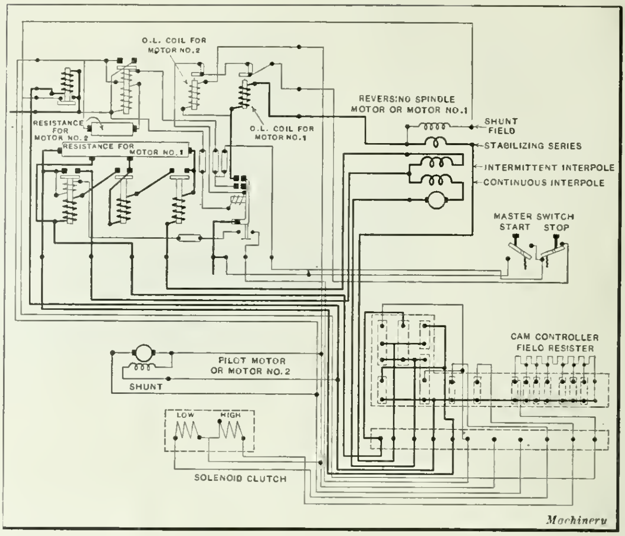


Fig. 9. Wiring Diagram of the Automatically Operated Speed Controller

When the camshaft and drum *B*, Fig. 2, have made one complete revolution, each of the cams carried by the drum has performed its function and the finished piece of work has been cut off from the bar. Then the stock will be advanced to provide for repeating the sequence of operations for producing the next piece of work, this cycle being continued indefinitely without requiring attention from the attendant except to replenish the stock. There is a control panel *D*, Fig. 2, located at the rear of the spindle driving motor, that contains the main switch, accelerators, and overload coils for both motors. By having both of the overload coils operate the main switch, the two motors are interlocked electrically and an overload on either motor will stop the whole machine.

SPINDLE SPEEDS FOR CLEVELAND TYPE A AUTOMATICS

Machine Size, Inches	Low-gear Clutch								High-gear Clutch								Motor Data[1]		Index Time in Seconds	
	Spindle Speeds in R. P. M.								Spindle Speeds in R. P. M.								Horse-power Required	Speed Range		
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8				
1½	84	99	115	135	157	184	216	252	280	328	384	449	525	614	718	840	2½	3:1	20	2 Motors
2	55	60	68	78	90	105	130	165	185	205	230	260	300	355	435	550	5	3:1	20	
2½	50	55	60	70	85	95	115	150	167	185	205	233	270	315	390	500	7½	3:1	30	
3	40	43	48	55	63	75	90	120	130	145	162	185	212	252	310	400	10	3:1	35	
3½	37	43	50	59	69	80	99	110	125	146	171	200	234	274	320	375	10	3:1	35	
4½	70	85	104	127	154	188	229	280	No Clutches or Reverse								15	4:1	40	1 Motor
5½	55	67	82	100	121	148	181	220	No Clutches or Reverse								15	4:1	40	
6¾	45	55	67	82	99	121	147	180	No Clutches or Reverse								20	4:1	40	
7¾	40	49	60	73	88	108	131	160	No Clutches or Reverse								20	4:1	40	

Machinery

[1] Note: Adjustable motor taking 115- or 230-volt direct current.

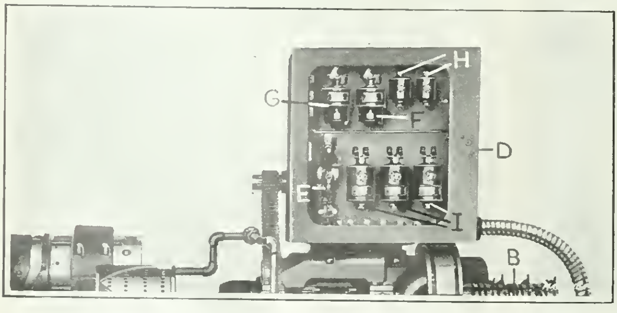


Fig. 10. Control Panel with Cover removed: (E) Main Switch for Both Motors. (F) and (G) Overload Coils for Large and Small Motors, respectively. (H) and (I) Accelerators for Small and Large Motors, respectively

Conclusion

The advantages claimed for this design, in addition to the benefits of individual motor drive, include the following features: The machines are easily set up and changes of spindle speed can be effected from a standing position as readily as changes in feed. Production is increased because the cutting speed is always maintained at a rate that is most efficient for the nature of the work that is being performed. As a case in point, consider the performance of a cutting-off operation. The peripheral speed can be held constant by increasing the speed at which the work is rotated as the tool approaches the center. This is but one of the numerous ways in which the automatic variable-speed mechanism is found useful. As another example, consider a case in which a wide range of speeds is required, as when threading with a solid die. A low surface speed is necessary for threading, while the other operations on the same piece will require much higher speeds. With the control mechanism described all operations can be performed at suitable speeds.

CINCINNATI INTERNAL GRINDING MACHINE

A No. 9 internal grinding machine has recently been developed by the Cincinnati Grinder Co., Cincinnati, Ohio. It is a production machine designed for the single purpose of grinding straight or tapered holes, and the aim has been to provide a grinder that is especially adapted for the rapid production of accurate work. This machine embodies the principle of a fixed work-base and a moving wheel-head, with centralized control that makes the machine easy to operate and eliminates non-productive movements of the operator which impair his efficiency and retard production. The machine is fitted with speed- and feed-change boxes that furnish a correct range of speeds and feeds, any one of which may be instantly obtained while the machine is running.

A self-contained drive which requires only a single pulley on the lineshaft or a motor on the floor connected by a silent chain and sprocket is another feature of this machine. The headstock revolves the work by direct belt drive and there is an automatic cross-feed with a direct-reading scale for indicating the amount of stock that has been removed from the work. These machines are manufactured on the unit system of construction. All plain bearings are scraped to master surface plates and straightedges, and the shaft journals are ground to size. These journals are supported in removable bushings that may be easily replaced when they become worn, without disturbing the alignment of the shafts. All sliding surfaces and revolving parts are provided with liberal and sufficient means for lubrication. Having made this preliminary statement concerning features of the machine, we are ready to present a detailed description of the arrangement of important parts of the mechanism.

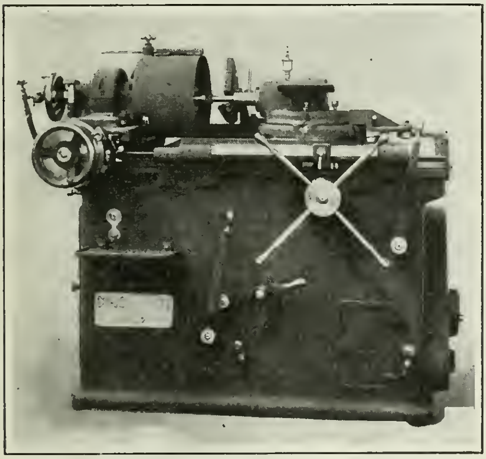


Fig. 1. No. 9 Internal Grinding Machine built by the Cincinnati Grinder Co.

Work Done on the Machine

This machine is particularly adapted for the internal grinding of straight or tapered holes in such parts as can be revolved when held in a chuck or on a faceplate. It readily lends itself to the rapid and economical finishing of holes that are true both as regards diameter and length, and duplicate pieces can be ground to identical dimensions. This machine is especially suited for grinding holes in gears, collars, cylinders, connecting-rods, bushings, ball bearing rings, roller bearing rings, sleeves, gages, and all work of like character which comes within its range. Face grinding can be conveniently done in correct relation to and in connection with the grinding of the hole, on the external face of rings, collars, cones, and all similar pieces, and also on the shoulder in the bore. This is accomplished by substituting a cup-wheel for the usual straight-sided wheel, using the face of the former for grinding the shoulder and the periphery for grinding the hole. Whenever it is imperative that the hole and the face of a part be finished accurately square with each other, it is essential that both surfaces be ground at the same setting. Should separate settings be made, the resultant accuracy would be wholly dependent upon the closeness of the chucking which might not be within the fixed tolerance. In face grinding, the position of the wheel remains unchanged, but the work-head is traversed.

Arrangement of the Mechanism

The design consists mainly of a swiveling wheel-head carried upon a sliding table, having provision for longitudinal motion, but not being movable crosswise; a work-head mounted on a cross-slide in such a manner as to provide a sidewise movement for adjusting and feeding the work to the wheel; an automatic reverse plate mounted on the front of the base for controlling the reversal of the table; a gear-box, contained in the automatic reverse plate, for varying the speed of the table; an automatic feeding device connecting the automatic reverse plate with the cross-slide feed; a gear-box on the rear of the machine for controlling the rotative speed of the work; a truing-diamond carrier always in position on the machine; a coolant tank and piping; and a complete set of water guards.

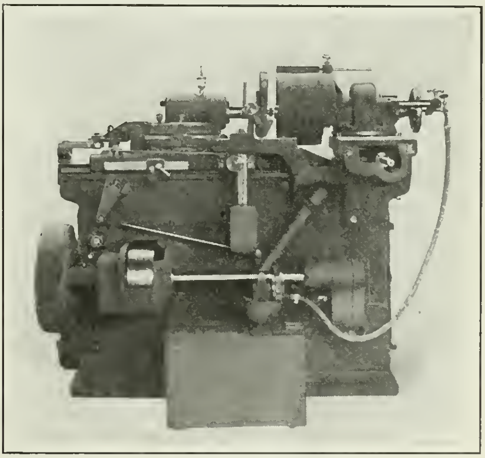


Fig. 2. Opposite Side of the No. 9 Cincinnati Internal Grinding Machine shown in Fig. 1

As it is entirely self-contained, the machine may be driven by a single pulley from the lineshaft, by a pulley from an intermediate or jack-shaft, or by a motor through a silent chain and sprocket. From the main driving shaft at the rear, motion is transmitted to the wheel-head by a belt running from a pulley on the end of the main shaft to a pulley on the drum shaft. From the drum, which is hung in ball bearings and located in the base of the machine, power is carried directly to a pulley on the wheel-spindle through an endless belt running over a set of two idler pulleys, one of which is fixed and the other floating. The weight of the latter compensates for changes in belt center distances when using different sizes of wheel-spindle pulleys.

The grinding wheel is held on a spindle carried in a cylinder, tapered on the outside and mounted in a hole of corresponding taper in the wheel-head housing, in which it is secured by a lock-nut. A range of wheel-heads from the maximum to the minimum capacity of the machine is available. Each head is a complete unit in itself, being made

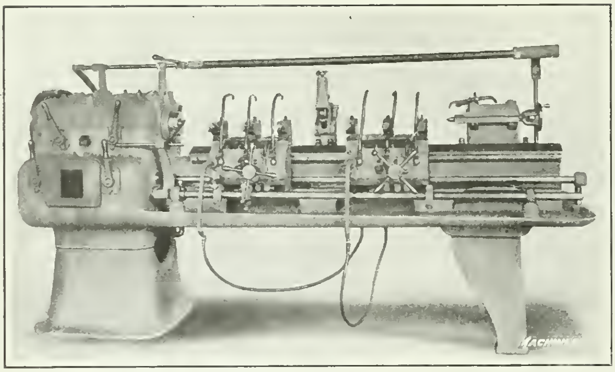


Fig. 1. Front View of 4-inch "Lo-swing" Lathe

interchangeable with all other heads. This arrangement permits of quickly substituting a head of different size when changing from the grinding of large holes to small holes or the reverse, with the additional advantage that no adjustment of the wheel-head is required when making the change. The diameter of the driving pulley on each wheel-head is made proportional to the diameter of the grinding wheels to be used on the spindle, so that the correct peripheral speed of the wheels suitable for use on any given spindle is automatically provided.

Although the wheel-head has no crosswise motion, it is capable of being swiveled 30 degrees from the normal position, thus providing ample room for gaging the work, or for placing it in or removing it from the machine with dispatch and without danger of the operator coming into contact with the wheel. The wheel-truing fixture is carried on a bracket at the rear of the machine and is never removed. It can be quickly located in proper relation to the wheel, and once in position remains fixed until a hole of another depth is ground, when it is reset. The arm holding the truing diamond may be instantly brought into the operating position, and as speedily thrown out of the way when it is not in use.

Forward and reverse movements of the wheel-head are obtained through the reciprocating motion of a sliding table. The direction and speed of this movement are controlled by an automatic reverse plate mounted on the front of the machine, which contains a clutch of the load and fire type and a gear-box supplying three changes of speed. Power is delivered to this gear-box by means of a silent chain drive running from a constant-speed sprocket in the gear-box on the rear of the machine. This latter box contains the necessary mechanism for controlling the revolutions of the work-head, receives its power from the main driving shaft through spur gears, and furnishes three speeds for the rotary movement of the work. Motion is transmitted to the work-head from a pulley in the box, by a belt, running over a set of idlers, one of which is fixed and the other adjustable so as to give proper belt tension.

This pulley is arranged with a driving clutch which is operated from and automatically disengaged by a trip actuated by the sliding table whenever the wheel-head is swiveled out of its normal position for gaging the work, or for loading or unloading the machine. Simultaneously with the releasing of the clutch, a brake is applied to the pulley, the combined action of the two instantly stopping the rotation of the work. The work-head is capable of being swiveled for taper grinding to an angle of 45 degrees or less, the swiveling being accomplished by means of a handwheel at its top, through a shaft and pinion, the latter meshing with a gear segment on the circular base of the work-head.

Power feed to the cross-slide, which carries the work-head, is received from the automatic reverse plate through a pawl and ratchet, the former being operated from a link set in motion by the table reverse lever. A cylindrical adjusting nut with direct-reading graduations is carried by the link, for varying and indicating the amount of feed. The action is automatic, and the feed movement occurs at each end of the table travel; it may be varied and may also be set to trip at any predetermined point. A mechanism consisting of a simple thumb-latch is provided for fine feeding by hand, and a handwheel is available for rapidly traversing the cross-slide. The cross-slide screw is fitted with a direct-reading circular scale, for indicating the amount of stock removed, and with positive stops for use in the production of duplicate diameters.

The tank is proportioned to hold an adequate supply of water, and it carries the pump. It is separate from the machine, being set on the floor under the main driving shaft, from which a belt runs to the driving pulley of the pump, as shown in Fig. 2. The sedimentation compartment frees the coolant from grit, passing only a clean mixture to the pump chamber for repumping, and thus insuring at all times a flow of clean water to the work. The water guards are detachable from the machine; they are sufficiently large and suitably placed to thoroughly protect the operator and the floor by catching the water splash and spray and returning it to the settling tank.

FITCHBURG 4-INCH "LO-SWING" LATHE

The Fitchburg Machine Works, Fitchburg, Mass., have recently developed and placed on the market another machine, having all the standard "Lo-swing" characteristics. This lathe is designed to handle work up to 4 inches in diameter. It is built in three regular sizes, the maximum capacities for each permitting actual machining lengths of 60, 84, and 108 inches, respectively, these being the distances from center to center. This lathe is of the all-geared head type, and in general construction follows very closely that of the 8-inch size, a complete description of which was published in the October, 1916, number of MACHINERY.

In the smaller model here described it has been found advantageous to place the intermediate shaft in the geared head on the same level with the spindle and back-gear shaft, rather than above it as in the earlier model. This lowers the top of the headstock casting but does not alter the method of driving the spindle. The two illustrations here shown furnish an excellent idea of the appearance of the machine, from which it will be

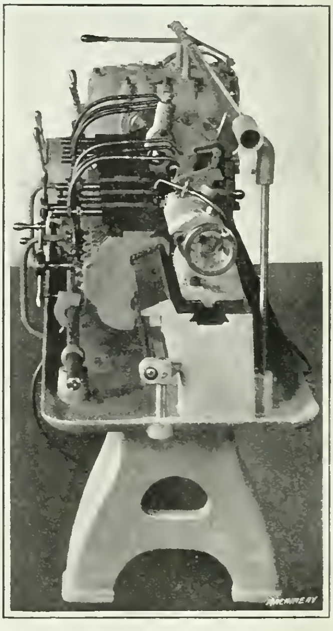
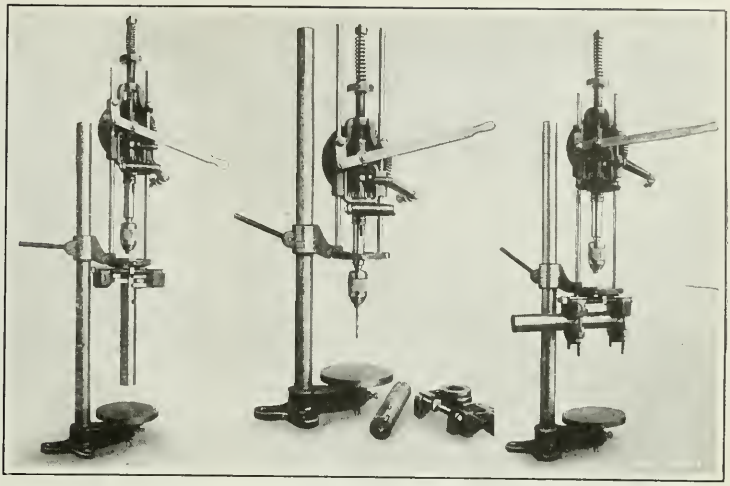


Fig. 2. End View of Machine shown in Fig. 1

seen that no radical departures in design from other lathes of this company's manufacture have been made. The driving pulley has a constant speed of 500 revolutions per minute, from which there may be obtained six spindle speeds ranging from 38 to 316 revolutions per minute. The two upper levers on the geared head are the ones used to compound the spindle speeds, while the two lower levers are those used to regulate the feeds, of which there are nine, ranging from 0.007 to 0.120 inch per spindle revolution.

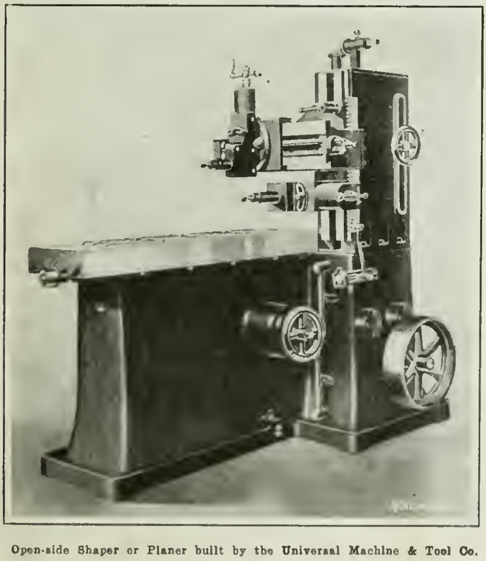
A single clutch-operated pulley obviates the necessity of employing a countershaft, so that the lathe may be belted directly to the lineshaft or to the motor as desired. The over-all lengths of the machines from the foot end to the outside of the pulley shaft at the head end are 123⅛ inches, 147⅛ inches and 171⅛ inches, respectively, for each of the three regular lengths in which this lathe is manufactured. The height from floor to the line of centers is 42 inches; to top of clutch shifter (over-all), 55⅝ inches; over-all depth, from extremity of handle on carriage capstan wheel to rear of pulley, 37½ inches; and width of base, front to back, 28¼ inches.



Three Views of the Portable Drilling Machine built by Leopold F. Glaude

UNIVERSAL OPEN-SIDE SHAPER

In the accompanying illustration there is shown a 24-inch open-side shaper and planer which is a recent product of the Universal Machine & Tool Co., Canton, Ohio. The principal feature claimed for this machine is that it combines the advantages of both a planer and a shaper. It will be seen that the column is at the right-hand side which, with the arrangement of mechanism on the machine, enables the operator to control it without going from one side to the other. It also takes any large work which necessitates overhanging the table, and permits of operating the machine without having the work hinder the operator. Four changes of speed are obtained by levers at the operator's side, giving speeds of 7, 20, 30, and 40 strokes per minute.



Open-side Shaper or Planer built by the Universal Machine & Tool Co.

GLAUDE PORTABLE DRILLING MACHINE

Leopold F. Glaude, 930 N. Washtenaw Ave., Chicago, Ill., is now building a portable universal drilling machine which is here illustrated and described. This tool is equipped for the performance of various operations such as centering, keyseating, etc., in addition to the work of actually drilling holes. It is a universal portable drilling machine, and can be adapted for numerous purposes, such as drilling holes in pipes or shafts and centering round or square pieces of work. By using an end-mill in the spindle and clamping the work in a V-block, leaving the clamping strap on another V-block slightly loose so that the shaft can slide, this outfit may be utilized as a portable keyseating machine, the desired movement being obtained by turning the screw with the right- or left-hand thread. A two-speed change-gear is provided that can be readily changed; and there is a screw and lever feed. The machine can be rigged up with a motor or flexible shaft for use by power; and it is well suited for handling various kinds of repair work such as that which is met with in garages, machine shops, etc. The centering attachment has a chuck which can be revolved by hand or kept stationary. The total weight of the machine is 45 pounds.

VAN KEUREN REFERENCE GAGES

The Van Keuren Co., 362 Cambridge St., Boston, Mass., has added to its line of modern measuring tools, various sets of combination precision reference gages. These gage-blocks are designed and manufactured primarily as reference standards of the highest type. They are cylindrical in shape and ¾ inch in diameter, affording a particularly large flat contact face, which insures long and uniform wear both in regard to flatness and parallelism of faces, and length. The round or cylindrical shape is said to be of particular advantage in that it affords the ideal distribution of metal for a reference standard, as the results of temperature change affect the block evenly. The gages are made of a high-grade alloy tool steel, especially selected for its properties in providing long wear, constancy of size, freedom from corrosion, and uniformity of physical properties. Before being used, the steel is subjected to a scientific heat-treatment and seasoning process.

Each gage is carefully lapped to a mirror finish, and is guaranteed to be of the correct size within 0.00001 inch of the nominal marked dimension. The degree of accuracy of the flatness and parallelism of faces permits the blocks to be calibrated within a few millionths of an inch where additional accuracy is required. Each gage is standardized by light wave measurement, with standards that are certified by the National Bureau of Standards, and a serial number is stamped on each gage to facilitate the keeping of records as to the accuracy of the gage when new or during its life. The gages are arranged in various sets to meet the requirements both of large manufacturing concerns and individual mechanics. A particularly useful set, here illustrated, contains five sizes in the binary fractions of an inch, namely, 1, ½, ¼, ⅛, and 1/16 inch. With this set all sizes in sixteenths of an inch may be assembled in combination, making thirty-one sizes in all, which provide the common sizes used in everyday shop work.

Combination Precision Reference Gages made by the Van Keuren Co.

LUBRICATION SYSTEM FOR UNIVERSAL BORING MACHINE

Benefits derived through the performance of metal-cutting operations under a constant flow of lubricant or coolant have led the Universal Boring Machine Co., Hudson, Mass., to provide its machines with an improved equipment for circulating and collecting a cooling fluid. It is generally known that the purpose of a coolant is to assist in carrying away heat from the point where work is being done by the cutting tools, thus keeping the temperature of the tool steel below the point where softening starts to occur. As experience has shown it to be a better policy to use too large rather than too small a volume of coolant, the pump and piping on Universal boring machines have a capacity for delivering twelve gallons per minute to the tools and work.

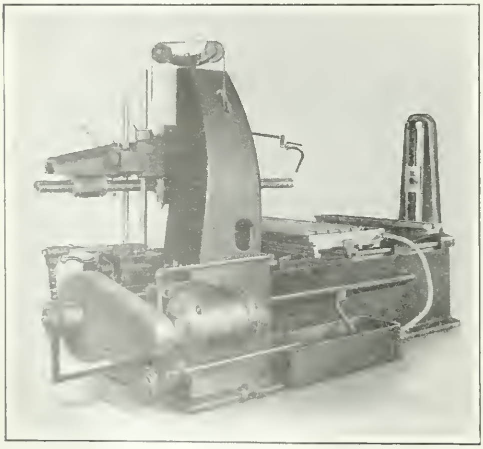


Fig. 1. Universal Boring Machine equipped with an Improved Lubricating System

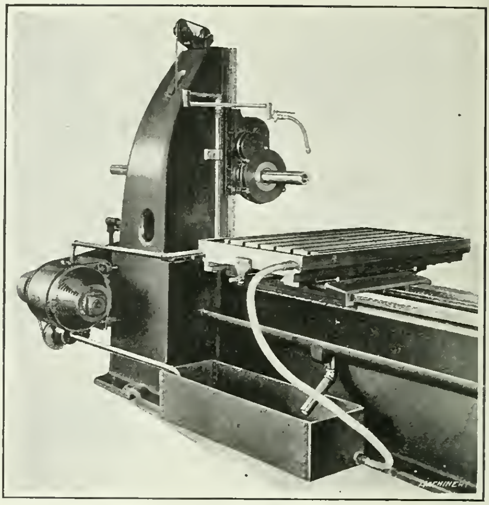


Fig. 2. Opposite Side of the Universal Boring Machine shown in Fig. 1

The type of pump which is used cannot lose its prime and the system cannot become clogged, because anything that can pass through the intake will be passed by the pump and all other parts of the system, there being no openings smaller than the ¾-inch intake. The impeller pumps by centrifugal force, and any chips that can enter pass right through the system, thus making it unnecessary to use strainers. Oil troughs are provided on the front and back of the bed and they slope toward the center. The front trough is higher than the one at the rear. Lubricant is carried by a 1¾-inch pipe from the center of the front trough through the bed to the center of the rear trough, and from there into the tank. The troughs project 4¾ inches and they are 4 inches deep.

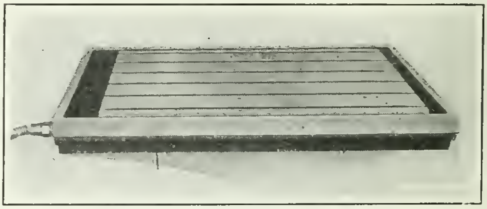


Fig. 3. Table of the Universal Boring Machine showing Arrangement of Oil Pockets

Between the ways on top of the bed there is a surface that slopes toward the center to join a rectangular trough 16 inches in length, from which the lubricant is carried into the tank. The table has oil pockets on each end and grooves in the T-slots, and it delivers the lubricant toward the rear. From there it is carried by a flexible tube into a tank at the rear. The pump is attached to the motor bracket and is driven by a belt from the motor shaft. It has a capacity of twelve gallons per minute and the lubricant is carried from the pump to the tool by piping and elbows, with a flexible tube nozzle to deliver the flow in any direction.

JONES SLOTTING MACHINE

The Jones Machine Works, Media and Edgewood Sts., West Philadelphia, Pa., is now building a 20-inch slotter which was designed to meet the requirements of shops following the latest practice in performing slotting operations with high-speed steel tools. This machine is proportioned to withstand severe stresses incident to the handling of heavy work. It is equipped with single-pulley drive and furnished with a two-speed countershaft or a direct connection to a constant- or variable-speed motor which develops 10 horsepower. Four changes of speed are available, ranging from 8 to 16 strokes per minute with a constant-speed motor, or 8 to 42 strokes per minute with a variable-speed motor or a two-speed countershaft. All bearings are bronze-bushed and equipped with sight-feed lubricators except on the change-gears, quick-return mechanism, and quick traverse, where flooded lubrication is employed.

Arrangement of the Mechanism

The machine is driven by a powerful friction clutch *A*, and there is a brake for stopping the ram. The clutch, when engaged by handle *B*, which can be operated from either side of the machine, drives a change-speed shaft on which there are mounted four hardened steel sliding gears that are brought into engagement with hardened steel gears on the driving shaft by a hand-lever *C*. Mounted on the end of the driving shaft there is a steel pinion which engages the bull gear wherein the quick-return mechanism is mounted, which is flooded with oil. The ram and crank drive mechanism follow the customary design, with the exception of improvements in the link connecting the counterweight and ram.

The feeds for the saddle, cross-slide, and circular table are of the customary intermittent ratchet feed type, and an attempt has been made to put all the operating handles within easy reach of the operator. These handles are duplicated on the opposite side of the machine for the convenience of the operator when machining special work that would necessitate his being on the opposite side of the machine; also, it is a wise provision from the viewpoint of safety. Handle *D* operates a clutch starting and stopping the feeds on the saddle, and handle *E* operates a clutch starting and stopping the feed on the cross-slide and circular table. The advantages of having the clutch handles as shown are apparent, making it possible to start and stop the feeds instantly.

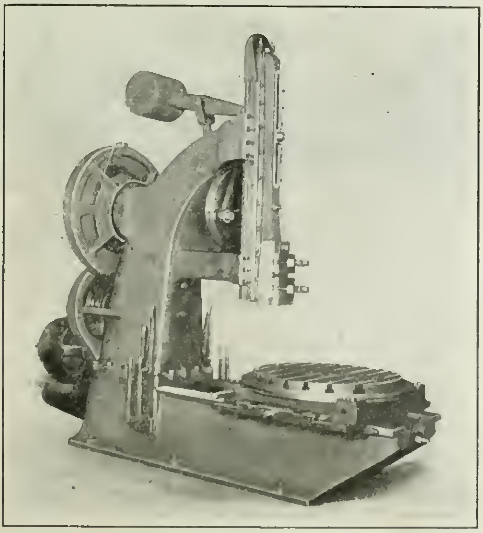


Fig. 1. 20-inch Slotter built by the Jones Machine Works

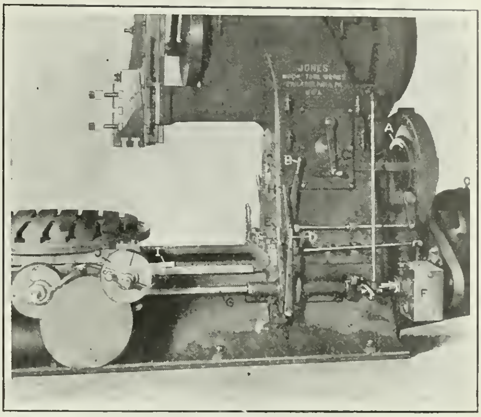


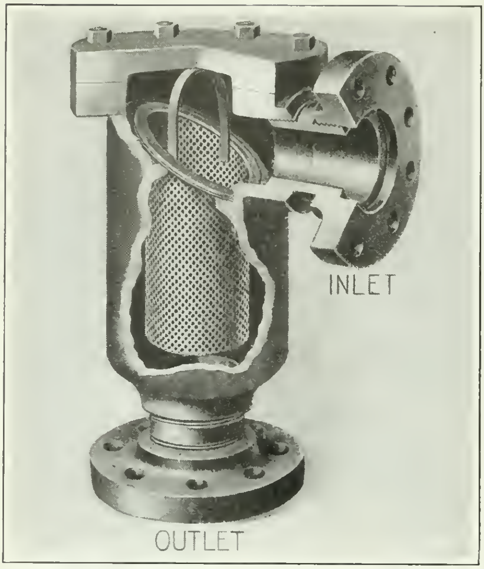
Fig. 2. Close-up View of the Mechanism from Opposite Side of the Jones Slotter

A quick traverse by power for the saddle, cross-slide, and circular table has been incorporated into this slotter, making it easy to operate. To accomplish this result, a quick-traverse gear-box *F* of simple design is driven by a belt from the main clutch shaft and located in line with the main feed-shaft *G*. This gear-box has mounted therein two steel clutch gears and two steel pinions, and carried on the same shaft as the clutch gears there is a double-ended cone friction clutch. The gears are at all times flooded with oil, as they are running all the time that the machine is working. The main clutch for operating the ram does not have to be thrown in to operate the quick traverse. To rotate the feed-shaft, pull the operating handle *H* to a forward position which will rotate the feed-shaft in one direction, and by holding the handle in a backward position, the feed-shaft will run in the opposite direction. It is necessary to hold the handle in the respective positions for operation, for when released it moves to a neutral position. The advantage of the use of a belt for driving the quick-traverse box is that it provides for safety in case the saddle, cross-slide, or circular table should come into contact with any obstruction or to the end of their respective travels.

Another improvement has been made for the operation of the cross-slide feed-screw and the worm-shaft of the circular table. The feed-gears are in constant mesh and do not necessitate the removal of the gear for the cross-slide screw and placing it in position for the circular table feed. The cross-slide screw and circular table worm-shaft have thereon small toothed clutches which are operated by handle *I*, so that when one clutch is in the working position, the other clutch becomes idle, making it impossible to engage both clutches simultaneously. The circular table, which is graduated on its periphery, is also equipped with the well-known indexing mechanism found on the milling machine. This indexing mechanism *J* is of great advantage to the operator for accurately spacing the teeth on large gears or any other work that would require spacing to any angle or a fraction thereof.

GRISCOM-RUSSELL STRAINER

Strainers are required on the suction and discharge lines of lubricating oil, fuel oil, and quenching oil systems for the removal of solid foreign material that is held in suspension in the oil. Also, power plants which secure their water supply from such sources as rivers or lakes require strainers to be placed on the intake lines to prevent weeds, sticks, water plants, and small fish from entering the pipe lines. For such classes of service, the Griscom-Russell Co., 90 West St., New York City, has placed on the market a device known as the G-R strainer, which is shown in the accompanying

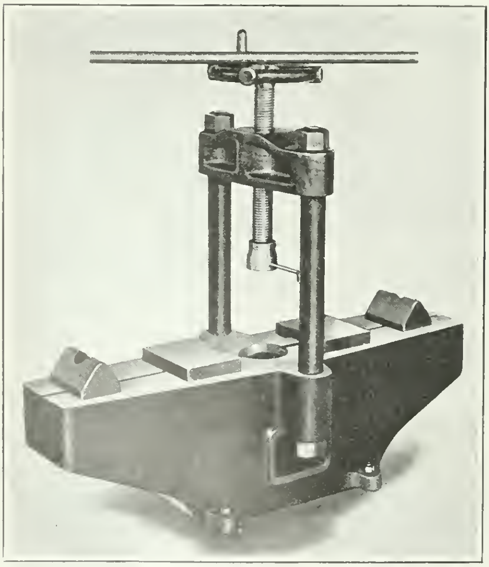


Oil Strainer manufactured by the Griscom-Russell Co.

illustration. The body is constructed of cast iron, and the strainer basket of perforated sheet steel, lined with wire mesh when the strainer is to be used on an oil line. The G-R strainer is of the single type and may be installed either as a single unit or as a strainer set consisting of two strainers connected. This set includes two three-way valves and the necessary connecting elbows, unions, and nipples. Its use permits the cleaning of either of the two units without interruption of the service.

PLETZ SCREW PRESS

Carl Pletz & Sons, 717 Sycamore St., Cincinnati, Ohio, are now building in Nos. 3 and 3½ sizes the screw press which is here illustrated and described. Both sizes use the same diameter of screw, but the No. 3½ machine will handle larger sizes of work. This press is adapted for straightening shafts, bars, rails, beams, etc.; and it is also arranged to force in or remove bushings, press gears or wheels on or off shafts and for the performance of forming operations on sheet metal. The bed is 4 feet long and heavily ribbed, with a hole cored under the screw to permit the work to drop through to the floor when it is pressed out. These cored holes also allow the pressing of pieces on or off long shafts.

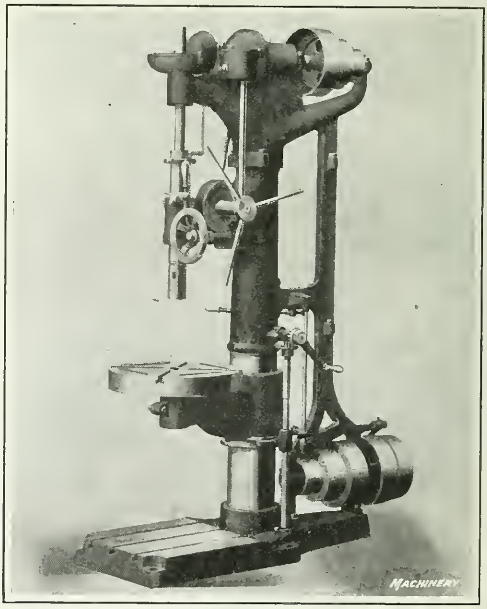


"Utility" Screw Press, built by Carl Pletz & Sons

The two upright posts are said to be strong enough to support ten times the load that will ever be applied to them in handling ordinary work. Steel is used in making the screw, and the threads are accurately chased to assure uniformity of operation. A steel pad fits on the end of the screw, and the thrust is taken on a hardened steel and bronze washer which is carried in a bath of oil. A handwheel on the end of the screw is fitted with a handle so that the screw may be quickly turned. By using a four-foot bar in conjunction with the handle, a pressure of twenty tons may be secured.

SIBLEY DRILLING MACHINE

In the December, 1919, number of MACHINERY, a description was published of a sliding-head drilling machine built by the Sibley Machine Co., 8 Tutt St., South Bend, Ind. This firm has recently added to its line a stationary-head machine, which is of quite similar design, with the exception that the sliding-head feature is not included. The fixed-head machine is built in 24-, 26-, and 28-inch sizes. The general features of its construction will be apparent from the accompanying illustration.



Stationary-head Drilling Machine built by the Sibley Machine Co.

IMPERIAL AUTOMATIC ACETYLENE GENERATOR

For use in generating acetylene gas from calcium carbide and water for the performance of cutting and welding operations, etc., the Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill., has recently developed an automatic generator which is here illustrated and described. The most important feature of this equipment is the way in which the mechanism has been simplified. It is stated that the carbide feed is simple and dependable, being automatically stopped when the torch is extinguished, and it starts automatically when the torch is relighted, thus maintaining a constant gas pressure. The Imperial automatic acetylene generator is of the medium pressure carbide-to-water type. Provision is made for feeding the carbide to the water by a device which is easily controlled. The feed mechanism and carbide hopper are fastened to the head of the machine, making it possible to remove all of the working parts by taking off the head of the generator.

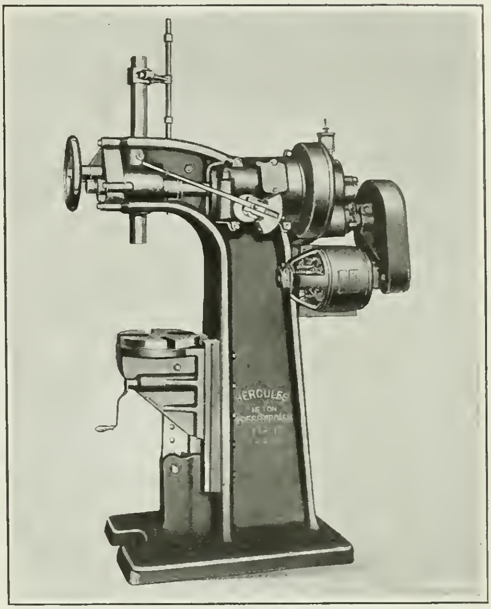
Feeding is accomplished by a simple vibrator working on the dashpot principle with but one moving part. This vibrator is operated directly by the gas flowing through it from the generator into the torch. The pressure in the generator is controlled by the tension of a spring in a diaphragm governor. Interlocking safety levers make this generator absolutely fool-proof and compel users to follow the proper sequence of operations necessary to start or stop the generator. A dependable safety blowout makes it impossible to obtain more than 15 pounds pressure, which is recognized as the maximum for acetylene gas. The gas purifier has a water seal which cools the gas and absolutely prevents a flashback reaching the gas in the generator.

Automatic Acetylene Generator made by the Imperial Brass Mfg. Co.

Equipments of this type are built in 15-, 25-, 50-, and 100-pound sizes to afford a sufficient range to meet all service requirements.

IMPROVED HERCULES ARBOR PRESS

The Hercules Machinery Co., 110 Woodbridge St., Detroit, Mich., has recently made certain noteworthy improvements in the power-driven combination arbor press and broaching machine of its manufacture. These modifications of design are said not only to increase the efficiency of the machine, but also to add to the number of operations that it will handle. The machine only occupies six square feet of floor space and it has a ram travel of 18 inches with a vertical adjustment of 14 inches for the knee, making a total working distance of 32 inches. The knee is also removable, which permits the use of other fixtures; and on account of the open column design, this machine is said to be suitable for use on conveyor lines.



Power-driven Combination Arbor Press and Broaching Machine built by the Hercules Machinery Co.

This machine has a rated capacity of 15 tons, but modifications of the design of the clutches and an increase of the gear ratio has made it possible to get as high as 20 tons gage pressure, and the machines are now being tested for 18 tons pressure. The design provides a shear pin in the main driving shaft that gives way at 18 tons to prevent danger of breaking parts of the machine. An automatic trip is furnished as regular equipment, which has the same effect as the automatic stop on a screw machine, and can be set to govern the travel of the ram. When so specified, all necessary equipment for the application of individual motor drive can also be furnished.

FACE GRINDING TABLE FOR BADGER GRINDER

The Badger Tool Co., Beloit, Wis., has recently developed a face grinding table for use on its single-spindle disk and cylinder-wheel grinders. Attention is called to the fact that

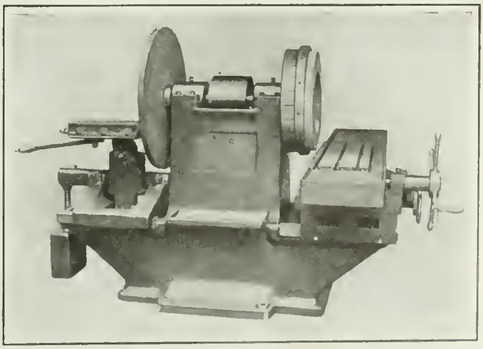


Fig. 1. No. 8 Grinder built by the Badger Tool Co., which is equipped with the New Face Grinding Table

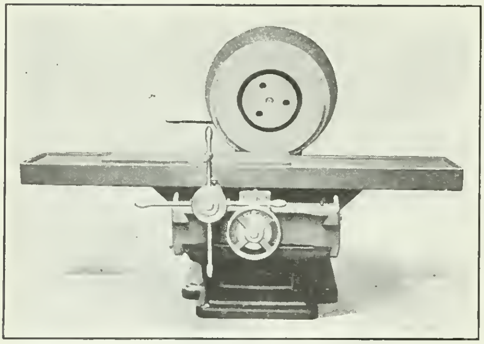
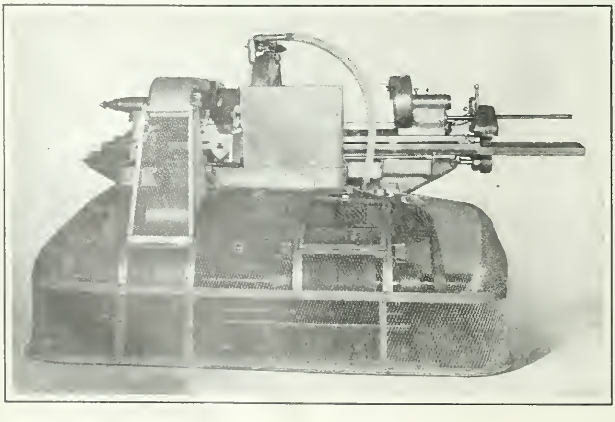


Fig. 2. End View of the No. 8 Badger Grinder illustrated in Fig. 1, showing Table in More Detail

the standard base for machines of this company's manufacture is well adapted for carrying a face grinding table of this type. The working surface of the table is 10 by 32 inches, and the longitudinal travel is 32 inches. Over-all dimensions of the table top are 14 by 73 inches, and travel is produced by means of a rack and pinion actuated by a handwheel with a leverage of 10 to 1. A graduated handwheel with a screw and nut affords a 4-inch feed movement toward the grinding wheel, and large adjustments can be made by moving the main saddle on the knee. As shown in the accompanying illustrations, this face grinding table serves a 20-inch abrasive cylinder held in a Badger chuck. The left-hand end of the spindle carries a 30-inch disk wheel and is served with one of this company's universal lever-feed tables. All table and grinding wheel equipments for use on Badger machines are interchangeable. Complete dust exhaust or wet grinding systems can be supplied; and the machines, all of which have ball bearing mounted spindles, can be furnished with either belt or individual motor drive.

GUARD FOR MODERN TOOL CO.'S GRINDER

Beginning August 1, practically all plain grinding machines built by the Modern Tool Co., Second and State Sts., Erie, Pa., will be furnished with a new phantom guard. This guard is a combination of expanded or perforated metal riveted to an angle-iron frame, giving both lightness and strength. It was first given a trial in the factory of the Modern Tool Co. Then a number of grinding machines were equipped with it and sent to other factories to ascertain their opinion. Such pleasing reports were received that the new type of guard was adopted as standard.



Guard for Plain Grinding Machines built by the Modern Tool Co.

The new guard is light and easily handled. It gives a practically complete view of all moving parts, and encloses all gears, pulleys, and belts. In this it efficiently meets the safety requirements of all state laws without extra expense. It saves space, as it permits machines to be set closer together. Instead of being square, all corners are rounded, and do not project into the passageways. Hinged portions and hand-holes make lubrication and minor adjustments easily accomplished without the necessity of removing the guard. This type of guard will not only permit all moving parts to be seen and watched, but it will act as a check against the accumulation of dirt. It can be placed in position or removed without the use of wrench or screwdriver. It is supplied as a unit, and not in sections which must be bolted or screwed together.

FEATURES OF CINCINNATI PLANERS

The following description explains certain improved features found on metal planing machines manufactured by the Cincinnati Planer Co., Cincinnati, Ohio. Machines built by this company are now furnished with a box type of arch, box type of cross-rail, and automatic stops for the cross-rail elevating and lowering device. The box type of arch is said to afford strength and rigidity to the housings and upper part of the machine. The tops of the housings have been widened to accommodate it and, as shown in Fig. 1, provision is made for securely bolting the arch in place at all four corners.

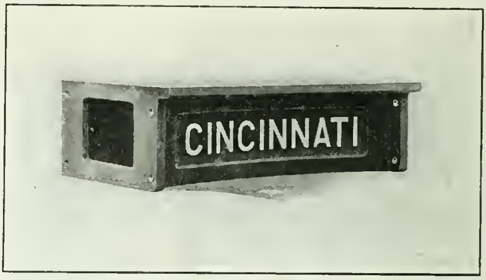


Fig. 1. Box Form of Arch now used on Metal Planing Machines built by the Cincinnati Planer Co.

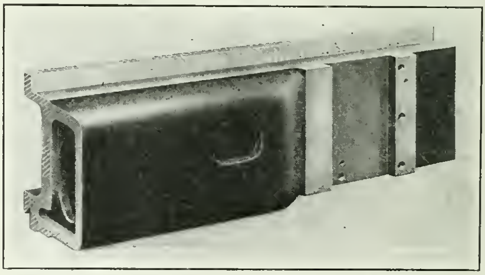


Fig. 2. Box Form of Cross-rail now used on Planing Machines built by the Cincinnati Planer Co.

The same form of construction has been employed for the cross-rail. As shown in Fig. 2, it is furnished with a deep and heavy box section which is well ribbed. This construction is said to add considerable rigidity and firmness to the cutting tools and to the machine in general. The automatic stops for the cross-rail elevating and lowering device, shown in Fig. 3, are another convenient feature. In operation, the elevating device is released by a horizontal movement of rod *D*

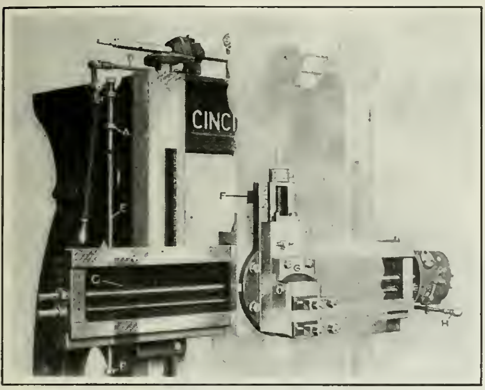


Fig. 3. Automatic Stops for the Rail Elevating and Lowering Device, New Style of Saddle for the Rail Head, Safety Clamp for Clapper-box, and Rapid Traverse for Rail Head

which is actuated by rod *E* moving in a vertical direction up or down, depending upon the direction of travel of the rail when bracket *C* comes into contact with stop-collar *A* or *B*. Stop-collar *A* remains in a fixed position on rod *E* at all times, but collar *B* is adjustable to stop the movement of the cross-rail in any position within its range of travel. In Fig. 3 there is also shown a new style of saddle which makes provision for clamping the upper part of the harp or swivel against the face of the saddle by means of a clamp *F*. Attention is also called to the clamp *G*, which prevents breakage of the clapper-box, and to the rapid power traverse mechanism *H* that provides for quickly moving the rail head into the required position.

GRANT AUTOMATIC CHAMFERING MACHINE

A double-spindle automatic chamfering machine has recently been developed by the Grant Mfg. & Machine Co., 90 Silliman Ave., Bridgeport, Conn. Machines of this type are built for different purposes, but the accompanying illustrations show one equipped for simultaneously chamfering both ends of automobile engine piston pins that are 5/8 inch in diameter by 3 inches in length. After being cut off from the bar or tube, these pins are placed in a hopper on the machine, from which they are taken by a slide and placed in the proper position to be clamped, while the cutters come in from each end and perform the chamfering operations. When the cutters recede, the clamp is released and the feeding slide, which has already brought another pin part way into position, pushes it forward and at the same time ejects the finished pin which comes down the slide at the left-hand side of the machine table. Pins of this size are chamfered at both ends at the rate of forty per minute. This type of machine is not restricted in its application to the chamfering of pins; it can also be used for a variety of other work where operations must be performed on opposite ends of a piece, such as drilling, counterboring, facing, etc. Neither is the work restricted to round pins, as square or irregular shaped pieces can be handled with equal facility.

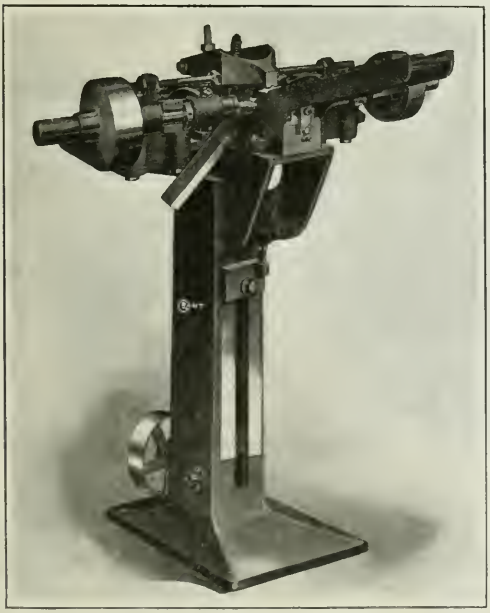


Fig. 1. Chamfering Machine built by the Grant Mfg. & Machine Co.

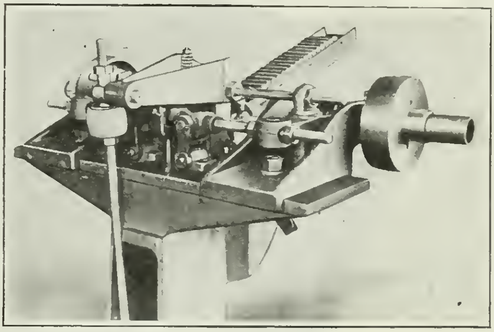


Fig. 2. Close-up View of Mechanism on the Grant Chamfering Machine

NEW MACHINERY AND TOOLS NOTES

Milling Attachment: Tri-State Milling Machine Co., Memphis, Tenn. A milling attachment for use on shapers. The spindle is worm-driven and is supported by a substantial over-arm. This attachment is adapted for mounting in the shaper ramway, the ram being moved back.

Bench Drilling Machine: G. R. Mellon, 933 Communipaw Ave., Jersey City, N. J. A bench drilling machine equipped with a turret work-rest, designed to accommodate pieces of different shapes. By pulling the table forward it is disengaged and can be turned to bring the desired form of work-rest into the working position.

Straightening Press, Arbor Press and Truing Machine: Detroit Garage Equipment Co., Detroit, Mich. A combination straightening press, arbor press and truing up machine, which is adapted for use in service stations for straightening crankshafts, etc. The machine can also be used as a punch press or as a broaching machine.

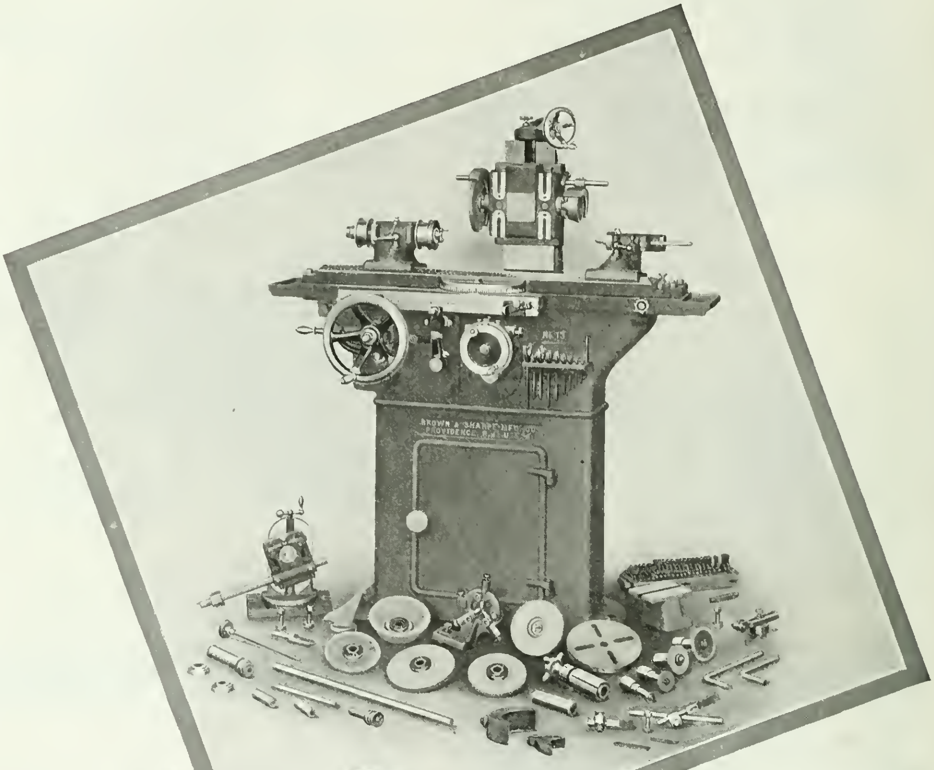
Anti-rust Compound: Conversion Products Corporation, 149 Broadway, New York City. An anti-rust compound known as "Stazon," which is an inert chemical grease derived from petroleum. It can be rubbed or brushed on the bright parts of machines destined for storage or shipment, and is said to be proof against acid fumes or moisture.

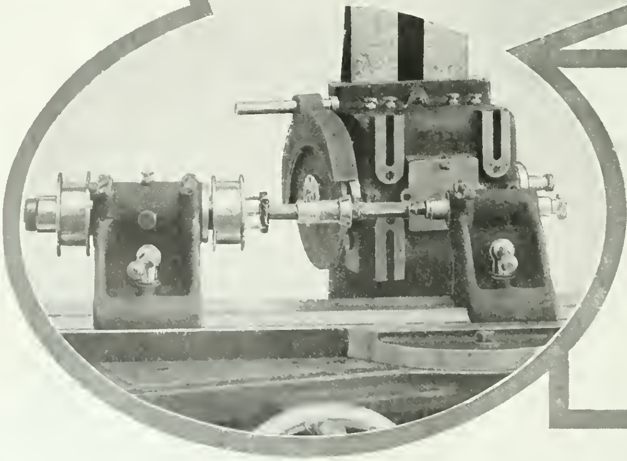
Crankshaft Straightening Presses: Metalwood Mfg. Co., Detroit, Mich. A line of hydraulic power presses for straightening drop-forged automobile engine crankshafts. Several types of these machines are made in sizes ranging from 20 to 65 tons working pressure, and with table lengths suitable for the work on which each machine is to be used.

Machine Tool Centers: Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y. A device known as the "Ettco" inserted center, which has a shank tapered to fit the spindle and an inserted center which is made of high-speed steel and threaded into the carbon steel shank. These centers are furnished in various standard sizes and tapers.

Tool Rack: International Purchasing Bureau, 203 E. 15th St., New York City. A convenient type of tool rack furnished with trays made of cast iron and arranged to swivel about a central support. There are four trays, three of which are

BROWN & SHARPE No. 13 UNIVERSAL

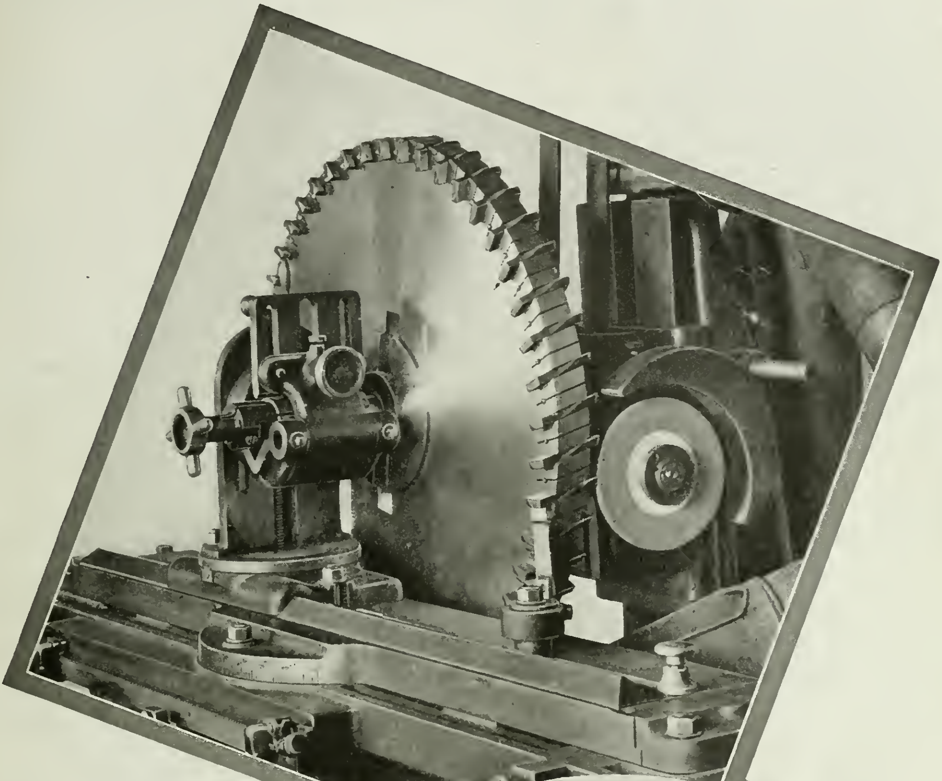


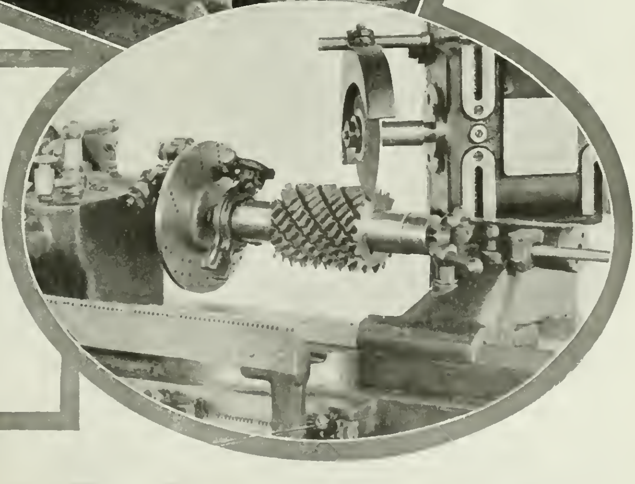


For the shop whose needs call for the grinding of a large variety of work the No. 13 Universal and Tool Grinding Machine is particularly valuable, especially where the volume of grinding does not warrant the installation of different machines for each kind of work.

BROWN & SHARPE MFG. CO.,

and TOOL GRINDING MACHINE





The No. 13 Universal and Tool Grinding Machine can be used to advantage in the grinding of

Milling Cutters
Formed Cutters, Hobs
Straddle and face mills
Beveled Cutters—any angle
Straight or taper reamers,
as well as
Cylindrical
Internal
Surface
Straight or taper work.

Write for specifications

PROVIDENCE, R. I., U. S. A.

intended for holding tools or pieces of work, while the small tray at the top is adapted for holding micrometers and other fine tools.

Electric Lamp: Cooper-Hewitt Electric Co., 8th and Grand Sts., Hoboken, N. J. A new type of auxiliary for use in connection with alternating-current lighting units, which has made it possible to raise the power factor of lamps from 52 to 85 per cent.

Bench Drilling Machine: Van Dorn Electric Tool Co., Cleveland, Ohio. This machine consists of a portable electric drilling machine, which is mounted on a stand provided with a movable head to support the electric drill and a fixed table on which the work is held.

Two-spot Welding Machine: Federal Machine & Welder Co., Dana Ave., Warren, Ohio. A rotatable-head two-spot air-operated welding machine, with a 60-inch throat depth, which is guaranteed to weld from two thicknesses of twenty-four-gage up to two thicknesses of eight-gage steel stock.

Bench Vise: V. Lowener, 114 Liberty St., New York City. A vise made by Soderfors Bruks, Falun, Sweden, and sold in this country by V. Lowener. This is known as an all-steel vise, the parts being made of Dannemora alloy steel which is said to be stronger and tougher than chisel steel.

Spot Welding Machine: Federal Machine & Welder Co., Dana Ave., Warren, Ohio. An automatic spot welding machine for operation on channels, that provides for securing two channels together to form an I-beam. This machine is capable of welding two spots at a time on two pieces of material 1/4 inch in thickness.

Keyseating Machine: Hercules Mfg. Co., Portland, Ore. A keyseating machine consisting of a cross-head driven through a rack and pinion. By means of a wood-covered friction disk operating between the two driving pulleys, which run in opposite directions, reversal of motion is accomplished, and it is claimed that a very smooth action is secured.

Portable Electric Drilling Machine: Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. A portable electric drilling machine which has a handle of the pistol grip type. The motor is series-wound, fan-cooled, and operates on voltages either 10 per cent above or below normal. Adjustable ball bearings support the armature shaft, and a ball thrust bearing takes the end load of the spindle.

Duplex Drilling Machines: Moline Machinery Co., Moline, Ill. A line of duplex drilling machines designed to afford rapid production. Details of these machines differ considerably to adapt them for handling a variety of drilling operations. The line includes machines equipped with both hand and power feed, and with the spindles either opposed or arranged to feed in the same direction.

Tiering Truck: Karry-Lode Industrial Truck Co., Long Island City, N. Y. A lifting and tiering truck intended for use over smooth level floors. This truck has a lifting capacity of 4000 pounds at the rate of 3 feet per minute, and it will deliver its load 65 inches above the floor. The platform measures 26 by 54 inches in size, and when in its lowest position it is 11 inches above the floor.

Electric Furnaces: General Electric Co., Schenectady, N. Y. Electric heat-treating furnaces of the resistance type for use in hardening automobile gears, pinions, etc. Similar furnaces are made for use in the performance of carburizing, annealing, and drawing operations. Energy is furnished by three-phase, sixty-cycle, 220-volt alternating current, and the furnaces have a capacity of 60 kilowatts.

Bench Horn Press: Enterprise Machinery Co., 32 S. Clinton St., Chicago, Ill. A machine known as the Type V "Emco" bench horn press which is adapted for rapid production in the assembling of small parts and for the performance of such operations as seaming or riveting on hollow work. The machine is made with strokes of 3/4, 1 1/4, and 1 3/4 inches; it runs at 300 revolutions per minute and weighs 130 pounds.

Pumpless Blow-torch: Pumpless Blow-torch Co., Phipps Power Bldg., Pittsburg, Pa. A blow-torch which does not require preliminary pumping and preheating. The fuel used is butane, which is obtained from natural gas and reduced by pressure to a liquid condition. This liquid volatilizes in the fuel chamber of the torch, filling the space between the surface of the liquid and the top of the chamber with gas.

Slotting Machine: Newton Machine Tool Works, Inc., Twenty-third and Vine Sts., Philadelphia, Pa. A large portable slotting machine, which consists of an upright mounted on a sub-base and carrying a tool suitably mounted on a saddle that reciprocates vertically. The saddle has a maximum stroke of 76 inches, and the tool-slide has a cross-feed of 40 inches and an in-and-out feed of 6 inches, both actuated by power.

Pipe and Fitting Wrench: J. H. Williams & Co., 61 Richards St., Brooklyn, N. Y. A tool known as the "Falcon" wrench, which has a wide range of applications, being particularly suited for use on pipe and pipe fittings. The wrench has a curved serrated jaw and a chain that extends around the pipe or fitting, so that when the handle of the wrench is pulled, the curved jaw swings inward to enable the serrations to secure a firm grip.

Universal Plate Mill: MacKintosh, Hemphill & Co., Pittsburg, Pa. A 27-inch by 40-inch reversing universal plate mill built for use in the plant of the Dominion Foundries & Steel, Ltd., Hamilton, Ontario, Canada. This mill will roll plates from a minimum width of 6 inches up to 40 inches. The top and bottom rolls are 27 inches in diameter with a lift to the top roll of 20 inches, while the vertical rolls are 18 1/2 inches in diameter.

Pneumatic Drilling Machine: Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio. A portable pneumatic drilling machine built on the turbine principle, which is known as the "Turbine Jr." drill. It is designed for drilling and reaming holes 1/2 inch in diameter through metal or for boring holes 1 inch in diameter in wood. The tool is of simple design, consisting of only fifteen primary parts and four parts that are subject to wear. The weight is 9 pounds.

Crankshaft Milling Machine: William K. Stamets, Pittsburg, Pa. For machining the outside or periphery of the webs of crankshafts of the counterbalanced type, grinding and polishing do not always produce sufficiently accurate results, and it was to meet the requirements of this work that the present machine was designed and built. The job is practically a cam-cutting operation, the desired form for the work being obtained by masters of the required shape.

Screw Meter: Selson Engineering Co., 24 Stone St., New York City. An apparatus made by Andrew Bechler, Moutier, Switzerland, and sold by the Selson Engineering Co. It enables the nominal diameter, the pitch diameter, and the root diameter of screw threads to be measured to 0.01 millimeter or 0.00025 inch. The screw meter is furnished in two models, one of which is adapted for gaging screws from 1 to 80 millimeters in diameter while the other is for measuring screws from 1 to 25 millimeters in diameter.

Inclinable Power Bench Press: La Salle Machine Works, 3013 S. La Salle St., Chicago, Ill. A machine known as a No. 0 "Verson" inclinable power bench press which is said to be adapted for the use of jewelers, electrical brass workers, and manufacturers of various novelties. The press has a stroke of 1 inch and an adjustment of 1 inch, and the distance from the bed to the slide with the stroke down and adjustment up is 5 inches. A No. 00 non-inclinable machine is also built by this company. Both of these machines can be furnished with a table and legs, if so desired.

Boring Tool: Expansion Boring Tool Co., 290 Rivard St., Detroit, Mich. A two-point expansion boring tool, designed to afford a wide range of expansion to the cutters, in addition to ample strength for handling heavy work. Another feature is the ample chip clearance that is afforded. Expansion of the cutters is accomplished by means of a right- and left-hand screw which forces the cutters out to the desired boring diameter and prevents them from working out to bore a larger diameter than is required. Tools of this type are made for boring holes from 1 to 8.81 inches in diameter.

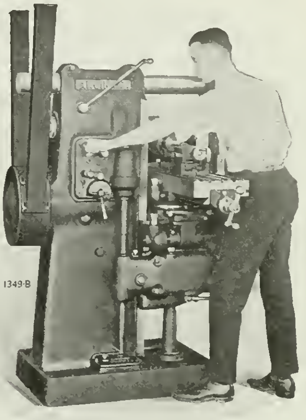
Oxy-hydrocarbon Burner: Berg Burner Co., Inc., 100 Emerson Place, Brooklyn, N. Y. A device known as the Berg burner, designed to use oxy-hydrocarbon gas, which it automatically produces from oil and water. Superheated steam is generated by the burner and combined with the oil flow as it leaves the nozzle. The hydrogen of the steam unites with the hydrogen and carbon of the oil, setting free oxygen in a superheated state, which is said to create perfect combustion. This burner may be started with cold water by burning oil in a preheating dish provided for that purpose.

Duplex Slot Milling Machine: Garvin Machine Co., Spring and Varick Sts., New York City. A No. 3 duplex milling machine especially adapted for use in railroad shops for machining such parts as cross-heads, piston-rods, etc., which must be slotted to receive tapered keys. Both sides of a slot are milled simultaneously by this machine, the work reciprocating while the cutters are fed inward intermittently. For milling a slot entirely through a piece, one cutter recedes automatically upon reaching the center of the work, and the other continues to advance, thus removing metal from the center of the work.

Milling and Grinding Attachment: Eccles & Smith Co., San Francisco, Cal. A milling and grinding attachment consisting of a vertical column carrying a saddle that has either a milling or grinding quill supported on it. A motor-driven countershaft suspended from a trolley rail, a driving wheel, an indexing mechanism, and an auxiliary countershaft form the other important parts of this device. It is attached to the tool-rest of a lathe by means of a central bolt through the column, and the saddle can be raised or lowered by a micrometer screw or it can be rotated around the column to any desired position.

Without Leaving His Position

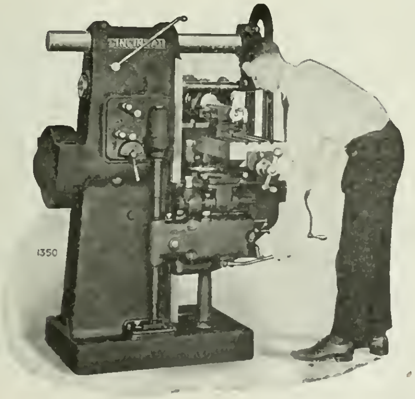
The operator can start the machine—
Change the feeds—
Change the speeds—and
Stop the machine—
When working on



The operator can usually reach the speed change levers without leaving his position. The belt is guarded 6 feet above the floor. This meets the usual factory safety requirements.

Plain, Universal or Vertical

CINCINNATI
M-TYPE MILLERS



Feed changes are all made at the front of the machine from the operator's normal position.

They are handy, compact, durable machines with unusual strength and power for their size.

ASK US FOR COMPLETE DETAILS GIVEN IN THE 1920-M CATALOG

THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI, OHIO, U.S.A.

NEW BOOK ON SHOP MATHEMATICS

Shop Mathematics. By Erik Oberg and Franklin D. Jones. 280 pages, 6 by 9 inches; 109 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $3.

This book has been published primarily for machinists and toolmakers, and for students interested in what is commonly known as "shop mathematics." The object of the book is to explain and illustrate, by numerous examples, the different kinds of problems which are commonly encountered in the construction of machinery and tools. The selection of the subjects treated is based on a careful study of the problems which are of the greatest practical value and often the most perplexing to the average shop man. The men whose training has been confined largely to the machine shop and toolroom often find it difficult to apply mathematical theories to shop problems. Because of this fact, most of the examples in this book are taken directly from the shop, and they have been largely selected from problems which shop men have repeatedly submitted for solution; but other examples have also been included in order that a somewhat broader field might be covered and important principles explained. Numerous examples are given so that the method of actually applying a rule or formula will be entirely clear.

Many of the more elementary subjects, such as addition, multiplication, division, etc., have been omitted, as practically all skilled men and most apprentices possess this rudimentary knowledge; but, in view of the fact that calculating is not a regular part of the shop man's work and he is liable to become "rusty" even in some of the simpler branches of arithmetic, a few elementary subjects which often prove "stumbling blocks" have been included, such, for example, as the multiplication and division of common and decimal fractions, proportion, square and cube root, and percentage.

While drawings should be so complete that calculations in the shop or tool-room are, as a general rule, unnecessary, in small shops, and sometimes in connection with special work, the machinist or toolmaker often finds it desirable to solve his own problems; and even though mathematics is not applied directly to the work of the shop, a knowledge of this subject will usually greatly assist the man who desires to advance. In fact, many excellent designers, as well as foremen and superintendents, are shop graduates who studied mathematics. This book, therefore, is intended not only to assist the reader in the solution of the problems liable to arise in everyday shop practice, but to lay the foundation for obtaining a higher position in manufacturing and engineering practice.

The book is divided into seventeen chapters, headed as follows: Value of Mathematics to Machinists and Toolmakers; Arithmetic Commonly Used in Shop Problems; What Formulas are and how they are Used; How to Calculate Areas of Plane Surfaces; How to Calculate Volumes, Weights, and Capacities; Figuring Tapers; Speeds of Pulleys and Gearing; Calculating Cutting Speeds, Feeds, and Machining Time; Change-gearing for Thread Cutting and Spiral Milling; Angles and the Use of Tables when Figuring Angles; Solution of Right-angled Triangles; Solution of Oblique-angled Triangles; Milling Machine Indexing; Calculations for Cutting Gears; Typical Machine Shop Problems; Examples in Elementary Mechanics; and the Use of Diagrams.

PERSONALS

R. B. Hubbell, formerly assistant sales manager of the Heald Machine Co., Worcester, Mass., has been appointed sales manager of Churchill-Morgan-Crittsinger, Inc., Worcester.

James T. Lee has become a member of the sales engineering staff of the Southwark Foundry & Machine Co., Philadelphia, Pa. For several years Mr. Lee was vice-president in charge of sales of the Hanna Engineering Works, Chicago, Ill.

Donald S. Michelsen, formerly general manager of the Worcester Pressed Steel Co., Worcester, Mass., is now general manager of the Globe Machine & Stamping Co., Cleveland, Ohio. **A. F. Schroeder**, who has been general manager of the company for almost twenty years, will continue to hold the office of president.

Edward O. Goss has been elected president of the Scovill Mfg. Co., Waterbury, Conn., to fill the place made vacant by the resignation of **Mark L. Sperry**. Mr. Goss will also retain the general managership of the concern. Mr. Sperry has been associated with the company for fifty-eight years, and is now retiring entirely from active business affairs.

W. J. Fuller, formerly with Alfred Herbert, Ltd., Coventry, England, is now associated with Harper Bean, Ltd., of London, manufacturer of motor vehicles of all types. Mr. Fuller will be located in the National Association Building, 23 W. 43rd St., New York City, and will look after the interests of the company in the United States and Canada.

R. T. Hazelton has been appointed works manager of the Cincinnati Shaper Co., Cincinnati, Ohio. Mr. Hazelton had been for several years past superintendent and chief engineer of the Cincinnati Milling Machine Co. In his new position, he will also have charge of production for the Cincinnati Gear Cutting Machine Co., which is a subsidiary of the Cincinnati Shaper Co.

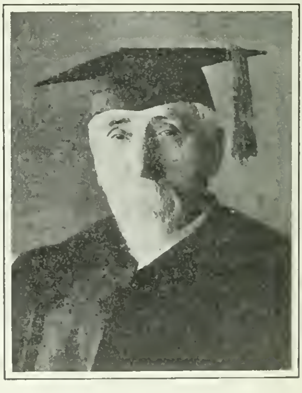
Olin H. Landreth, who until recently has been chief engineer of the Eastern Potash Corporation, New Brunswick, N. J., has been appointed consulting engineer of the company. As his duties in that capacity will require only a portion of his time, Mr. Landreth expects to devote the remainder of his time to general consulting engineering work, specializing in power development, industrial engineering, hydraulic engineering, and valuation work.

Arthur Jackson, who was formerly associated with the Gould-Shapley & Muir Co., Brantford, Ontario, Canada, and who was also connected with the Jones & Lamson Machine Co. of Springfield, Vt., selling and demonstrating Gridley automatics in Great Britain for the last five years, has been appointed Potter & Johnston representative with the Yamatake Co. of Tokyo, Japan, which is the Japanese agent of the Potter & Johnston Machine Co., Pawtucket, R. I.

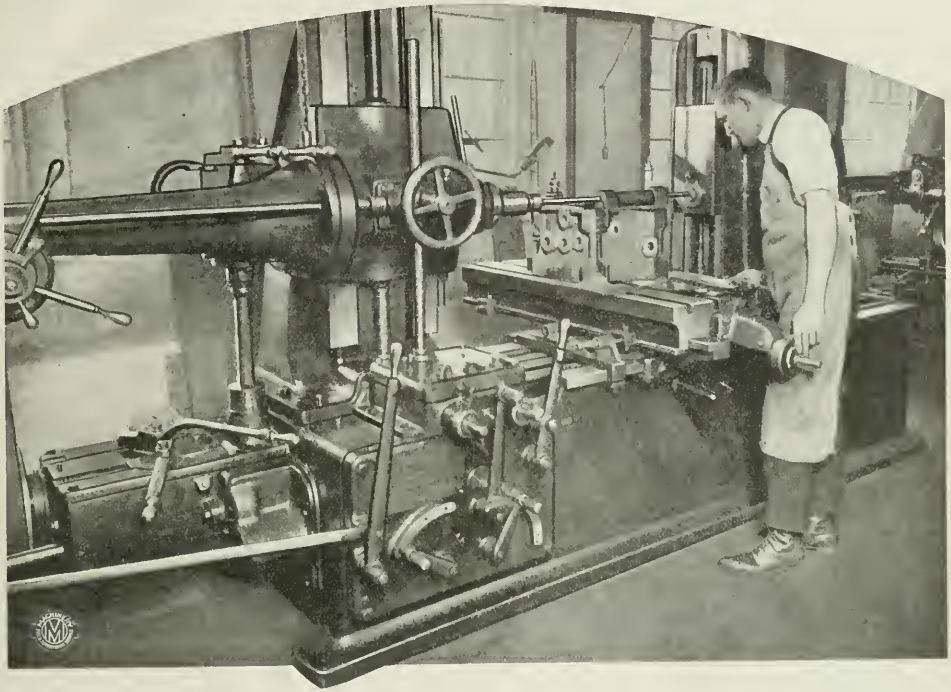
Charles Eisler has entered the consulting engineering field, and is devoting his time to designing and developing special and automatic machines for the manufacture of standard, miniature, and gas-filled lamps. The organization will also maintain a department for manufacturing wire product used in incandescent lamps. A temporary office has been established at 159 Clifton Ave., Newark, N. J.

HENRY M. LELAND RECEIVES DEGREE OF DOCTOR OF ENGINEERING

Henry M. Leland, president of the Lincoln Motor Co., Detroit, Mich., has had the degree of Doctor of Engineering, conferred upon him by the University of Michigan. In conferring this degree upon Mr. Leland, who has been called the father of the Detroit automobile industry, President Hutchins of the University of Michigan characterized his achievements in the following words: "A son of New England, but for thirty years a resident of this commonwealth, Mr. Leland brought with him the sterling virtues characteristic of early New England life, and has been a dynamic influence in the industrial development of his adopted state and a distinguished leader in movements for civic betterment. Always standing for the highest ideals, he has made a record in the field of mechanical science as applied to manufacturing development that has brought to him not only local and national, but also foreign recognition."



After having received his early mechanical training nearly sixty years ago and having worked in plants in New England that have since become famous the world over, Mr. Leland came to Detroit thirty years ago, where he engaged in the manufacture of precision machinery and tools. In 1902 he founded the Cadillac Automobile Co. together with Wilfred C. Leland and several prominent Detroit business men. He remained the active head of this concern until July, 1917, when he organized the Lincoln Motor Co. for the purpose of building "Liberty" aircraft motors. Although this company, when organized, had nothing in the way of plant or equipment, it was awarded the first government contract for the building of "Liberty" motors, and seven months later the first motor was assembled in a plant erected and equipped in record time for this work. After the armistice, the company set out to develop an automobile incorporating many new ideas, which is expected to appear soon.



Pratt & Whitney's Boring Machine Equipment Consists Principally of

LUCAS "PRECISION"

Boring, Milling and Drilling Machines

The accompanying photo, which was taken in the tool department of the P. & W. plant, shows a Lucas "Precision" Boring Machine engaged in locating and boring 21 holes, from 9/16" to 2¼" diameter, in a box drill jig. Distances from center to center, in this instance, are held within 0.001" limits; but when necessary a skilled operator makes this machine perform this same class of operation within limits of 0.0002".

There are seven of these machines in a row in the P. & W. toolroom—all devoted exclusively to manufacturing tools and jigs. Another row in the manufacturing department is an important factor in obtaining the accuracy for which P. & W. tools have long been famous.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich, Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

COMING EVENTS

September 14-18—Second annual convention and exhibit of the American Steel Treaters' Society of Chicago, Ill., and the Steel Treating Research Society of Detroit, Mich., in the Commercial Museum, Philadelphia, Pa. Department of Exhibits, 208 N. Wabash Ave., Chicago, Ill.

September 20-October 9—Sixteenth annual convention of the International Association of Machinists, at Rochester, N. Y.

October 4-9—Convention and exhibit of American Foundrymen's Association at Columbus, Ohio.

December 2-3—Nineteenth annual convention of the National Machine Tool Builders' Association in New York City; headquarters, Hotel Astor. General Manager, Charles E. Hildreth, Worcester, Mass.

December 7-10—Annual meeting of the American Society of Mechanical Engineers at 29 W. 39th St., New York City.

BOOKS AND PAMPHLETS

Standard Electrical Dictionary. By T. O'Conor Sloane and A. E. Watson. 767 pages, 5 by 7 inches; 477 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $5.

This book, a new edition of which has just been published, is a complete dictionary of electrical terms, containing definitions and descriptions, with illustrations, of electrical appliances and connections, as well as material relating to electrical theory, experimentation, and engineering. It includes 6000 distinct words or phrases. The plan is to give first a concise definition and then amplify and explain more fully. The material is arranged in two parts, the second part being in the nature of a supplement comprising over 180 pages covering the newer developments of electrical science. This arrangement is rather a drawback, as it is necessary for the user to refer to both parts of the dictionary for the term he wants.

Screw Thread Production to Close Limits. By Howard E. Adt. 192 pages, 6 by 9 inches. Published by the Geometric Tool Co., New Haven, Conn.

This treatise, by a well-known authority on screw thread production, contains in condensed form considerable information and data pertaining to the different kinds of threads, thread tolerances, thread measurement, and the production of screw threads by means of taps and dies. In the first two chapters the evolution of the screw thread and the different standards are dealt with. Then follows information on such important subjects as limits and tolerances (accompanied by numerous charts and tables); gaging devices; definitions and symbols; testing threads for accuracy; checking thread gages; threading with dies; screw cutting on automatics; special threading requirements; taper threading die-heads; adjustable collapsing taps; combination collapsing pipe taps and reamers; accurate production of brass parts; cutting speeds; cooling lubricants; screw-thread cutting terms; method of forming dies, etc. The latter part of the book contains a chapter on the "Lessons of Experience." This chapter deals, in a very specific manner, with miscellaneous threading troubles and their remedies. The book is illustrated by both line and halftone engravings, and is well arranged for reference purposes.

Tin, Sheet-iron, and Copper-plate Worker. By Leroy J. Blinn. 334 pages, 5 by 7¾ inches; 207 illustrations. Published by Henry Carey Baird & Co., Inc., 2 W 45th St., New York City. Price, $3, net.

This volume is a new and enlarged edition of a book on sheet-metal working. It contains rules for describing various kinds of patterns used by tin, sheet-iron and copper-plate workers, and much miscellaneous material relating to this class of work. The problems on pattern cutting have been supplemented by problems dealing with triangulation and skylight work, and many other new pattern problems have been added. The portion of the book treating of metallic alloys and solders has been rewritten for the purpose of presenting a more systematic arrangement and to include modern practice in this field. New material has been added in all the other departments. An idea of the contents will be obtained from the following list of chapter heads: Rules for Describing Patterns; Practical Geometry; Mensuration of Surfaces; Mensuration of Solids and Capacities of Bodies; Table of Weights, etc.; Tables of the Circumference of Circles to the Nearest Fraction of Practical Measurement; also, Areas of Circles, in Inches and Decimal Parts, and in Feet and Decimal Parts; Practical Receipts; Varnishes—Miscellaneous: Lacquers; Miscellaneous Cements; Important Metallic Alloys; Miscellaneous Receipts; Strength of Materials; Tables of Strength of Materials; Supplementary Pattern Problems.

Experimental Wireless Stations. By Philip E. Edelman. 392 pages, 5 by 7 inches; 167 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

The material in the 1920 edition of this book has been revised and expanded. The subject matter covers the theory, design, construction, and operation of experimental wireless stations including wireless telephony, vacuum tube, and quenched spark systems. The readers are assumed to have some knowledge of the fundamentals of electricity and mathematics. The basic principles of radio-communication, involving the theory and mathematics of the subject, are given in considerable detail. The material is divided into twenty-seven chapters headed as follows: Nature of Wireless Transmission; Aerials; Coil and Subsurface Systems; Grounds and Lightning Protection; The Transmitter and Resonance; Wave Length, Capacity, and Oscillation Circuits; Transformers and Spark Coils Construction Details; Auxiliary Apparatus; Condensers and Capacities; Inductances; Spark Gaps; Radiation Indicators and Measurements; Advanced Systems; Vacuum Valves and Circuits; Tube Radio-telephones; the Receiving Station; Detectors; Sensitive Indicators for Receiving Sets; Tuning and Interference Prevention; Special Receiving Sets; Receiving Condensers; Construction of Receiving Inductances; Making the Wireless Set Work; Miscellaneous Applications; Time and Weather Signals; Radio-communication Patents; and Rights of the Experimenter.

Vocational Arithmetic. By Clarence E. Paddock and Edward E. Holton. 232 pages, 5 by 7 inches; 83 diagrams. Published by D. Appleton & Co., 35 W. 32nd St., New York City. Price, $2, net.

This is an elementary book on arithmetic, written for the use of students in vocational schools and men in the shop. The volume is said to be the result of years of vocational teaching on the part of the authors, supplemented by extensive shop and engineering practice. The usual branches of arithmetic are treated in a simple way, and a large number of problems are given. These problems have been selected with a view to making them of interest and use to persons in various lines of work such as shop work, carpentry, foundry work, masonry, and excavation. The authors have striven to express themselves in simple and clear language without sacrificing exactness. The contents are as follows: Signs, Symbols and Abbreviations; Notation; Addition; Subtraction; Multiplication; Division; Properties of Numbers; Greatest Common Divisor; Least Common Multiple; Cancellation; Common Fractions; Decimal Fractions; Percentage; Commercial Discount; Interest; Compound or Denominate Numbers; Ratio and Proportion; Powers and Roots; Square Root; Cube Root; Use of Formulas; Mensuration, Plane; Mensuration, Solid; Similar Surfaces and Soils; Bolts and Nuts; Excavations; Masonry; Measurement of Lumber; Matched Boards; Boxes and Packing Cases; Shingles; Pattern and Foundry Work; Speeds of Pulleys and Gears; Toothed Wheels; Tables of Weights and Measures; Weights of Materials; and Metric System.

Shop Practice for Home Mechanics. By Raymond Francis Yates. 314 pages, 6 by 9 inches; 309 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

This book has been written especially for the use of amateurs or home mechanics, and treats in an elementary way of the use of tools, shop processes, and the construction of small machines. The author states that an examination of current volumes on shop practice has shown nothing especially adapted for the use of amateurs, and his aim in writing the present volume has been to fill this need. The subject matter has been arranged progressively, so that the beginner can study the book just as he would a book on elementary chemistry, for instance. The first chapter treats of the fundamentals upon which the science of mechanics rests, and the following chapters take up simple shop operations and the use of small tools. Considerable space is given to the lathe, as this is considered the most important tool to the home mechanic, without which little can be done in the way of serious work. Such operations as grinding, hardening and tempering steel, patternmaking, soldering, etc., are included. The book is divided into fourteen chapters headed as follows: Introduction to the Study of Elementary Mechanics; The Use of Miscellaneous Tools; Measuring Instruments and Their Use; Drilling and Reaming; Introduction to Lathe Work; Advanced Lathe Work; Special Lathe Work; Grinding Operations; Patternmaking; Hardening and Tempering Steel; Soldering and Brazing; Construction of Small Power-driven Press; Construction of a Small Grinding Head; and General Information.

NEW CATALOGUES AND CIRCULARS

U. S. Gutta Percha Paint Co., Providence, R. I. Circular advertising "Barreled Sunlight," a rice process mill white paint which is claimed to be non-scaling.

Link-Belt Co., W. Michigan St. and Holmes Ave., Indianapolis, Ind. Circular entitled "The Stars of Motordom," advertising the use of Link-Belt silent chain for motor front-end drives.

J. B. Engineering Co., Akron, Ohio. Sheets known as "Dope Sheets," containing information regarding the speeds, feeds, and general dimensions of important parts of standard machine tools.

Hisey-Wolf Machine Co., Cincinnati, Ohio. Bulletin 1002, illustrating and describing Hisey-Wolf motor-driven ball-bearing buffing and polishing machines, made for use with either direct or alternating current.

Metalwood Mfg. Co., Detroit, Mich. Circular B 23 descriptive of Metalwood universal hydraulic arbor and forcing presses of the A type, which are made in three sizes with capacities of 35, 60, and 100 tons, respectively.

Avey Drilling Machine Co., Inc., Cincinnati, Ohio. Catalogue illustrating and giving complete specifications for the Avey line of high-speed ball bearing sensitive drilling machines, which are built in combinations of one to six spindles, with hand or power feed.

La Salle Machine Works, 3013 S. La Salle St., Chicago, Ill. Circular descriptive of the Verson bench power press, adapted for light and accurate manufacturing, including such operations as blanking, forming, bending, trimming, punching, perforating, printing, and cutting.

Cleveland Twist Drill Co., Cleveland, Ohio. Circular entitled "Two New Official World's Speed Records," containing an account of the performance of Cleveland twist drills in drilling through 6 feet of cast iron in 60 seconds, and through 2½ feet of machine steel in 60 seconds.

Whipp Machine Tool Co., Sidney, Ohio. Bulletins 20 and 22, illustrating and describing, respectively, Whipp 16-inch crank shapers of the single-geared and back-geared type. Form 23, giving specifications for Whipp 16- and 20-inch single- and back-geared crank shapers.

Hyatt Roller Bearing Co., Sixth Ave. and 41st St., New York City. Circular illustrating the application of Hyatt roller bearings in tractors and farm implements, motor cars and trucks, mine cars and mining machinery, factory and warehouse trucks and steel mill machinery.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular illustrating applications of Shepard electric hoists of the cage-controlled and floor-controlled types, for handling loads of 500 pounds or less and 25 tons or more, as well as of electric traveling cranes in capacities of from 1 to 50 tons.

Uehling Instrument Co., 71 Broadway, New York City. Bulletin 111 describing Uehling Style U carbon dioxide equipment, built in single and multiple units, for serving any number of steam boilers simultaneously up to six. The purpose of the equipment is to save fuel by burning it with the proper air supply.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Bulletin 830, illustrating and describing Cutler-Hammer battery charging equipment for charging all kinds of electric vehicles, including pleasure cars, large and small industrial trucks, mine battery locomotives, ignition and starting batteries on gasoline cars, etc.

Doehler Die-Casting Co., Brooklyn, N. Y. Circulars treating of the properties, characteristics, and applications of white metal alloy die-castings, aluminum die-castings, "Do-Di" finished brass castings; "Do-Lite" babbitt-lined aluminum bearings; and babbitt-lined bronze bearings for internal combustion motors.

Hammond Steel Co., Inc., Syracuse, N. Y. Booklet treating of the characteristics and application of "Status," an oil-hardening tool steel, which is claimed to be non-shrinkable and therefore applicable for use in making cutting tools and delicate dies which must be hardened without change in either size or shape.

Wetmore Reamer Co., Milwaukee, Wis. Bulletin 14, illustrating and describing the details of construction of Wetmore cylinder reaming sets, which consist of a roughing reamer, a semi-finishing reamer, and a floating finishing reamer. Reference is also made to the adaptation of the semi-finishing reamer of the cylinder set for line and pilot reaming.

Buffalo Forge Co., Buffalo, N. Y. Catalogue 421, illustrating and describing the details of construction of Buffalo conoidal fans for heating and ventilating systems. The catalogue gives tables of fan performances by means of which engineers and architects will be able to make fan selections to meet any demands encountered in ordinary heating and ventilating practice.

F. A. Calhoun Co., Jersey City, N. J. Catalogue 5, illustrating and describing portable gas and oil-fired heat-treating furnaces. Specifications are given for high-speed steel furnaces, carbon steel furnaces, cutting tool furnaces, vertical hardening furnaces, lead hardening furnaces, oil tempering furnaces, aluminum melting furnaces, rivet heaters, and forging and bending furnaces, etc.

Norton Co., Worcester, Mass. Circular containing an article on the use and selection of Norton grinding wheels for application on Pratt & Whitney surface grinding machines. The article discusses the factors influencing the action of the grinding wheel, types of wheels to be used for various materials, storage of wheels, mounting, dressing, lubricants, wheel speeds, and table speeds.

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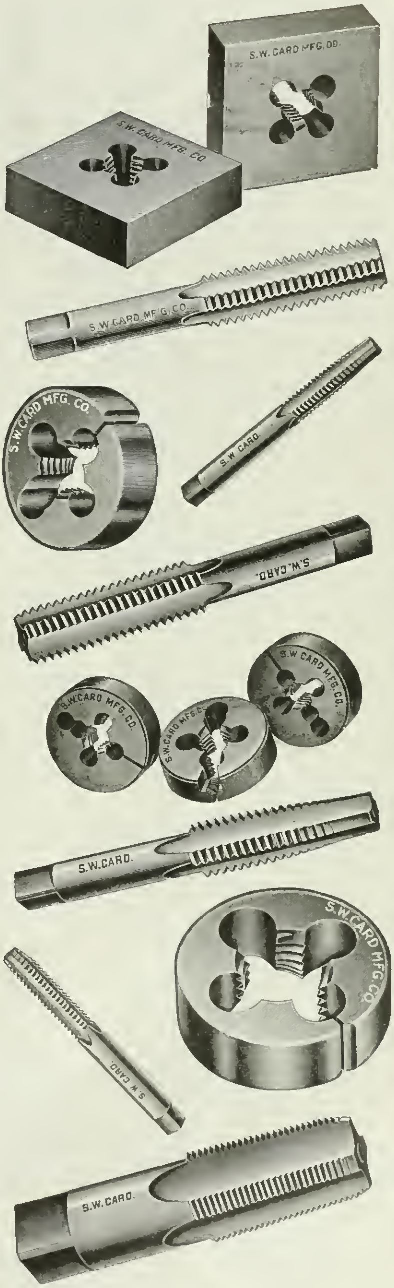
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Golden Co., 405 Lexington Ave., New York City. Prospectus No. 256, illustrating and describing the Sip machine for setting adjustable snap gages, which is made by the Societe Genevoise d'Instruments de Physique, of Geneva, Switzerland. Circular descriptive of a locating machine, which is made in four sizes, the capacity of the smallest size being 3 by 3 inches, and that of the largest 24 by 32 inches.

Independent Pneumatic Tool Co., Chicago, Ill. Catalogue 11, containing descriptions, illustrations, and tables of specifications for "Thor" pneumatic tools and portable electric drills. Some new additions to the line are presented in this catalogue, consisting of motor-driven air hoists, pneumatic sand rammers, universal vise for pneumatic drills, hose coupling, power screwdriver, hose clamp, and hose mender.

Crescent Belt Fastener Co., 381 Fourth Ave., New York City. Circular 227, entitled "Modern Scientific Methods in Belt Joining," containing a detailed description, illustrated with diagrams and sketches, of the correct method of joining belts with Crescent belt fasteners. The pamphlet gives dimensions for Crescent plates and rivets to be used with belts of different widths, lengths, and thicknesses. Copies will be sent upon request to the machinery service department of the company.

Blanchard Machine Co., 64 State St., Cambridge, Mass. Blanchard Grinder Data Book, containing illustrations, drawings, and production data on fifty different jobs which have been machined on Blanchard surface grinders. The pieces ground range from very small steel parts up to large heavy castings. The book is intended for the use of managers, superintendents, tool engineers, and foremen. It is of convenient pocket size, and contains a large amount of production data which should be of interest to those engaged in this class of work.

Edward R. Ladew Co., Inc., 54 Franklin St., New York City. Pamphlet entitled "A Study of Various Types of Belting," containing an article by Ernest D. Wilson which records the results of an investigation on power transmission by belting conducted by the Mellon Institute of Industrial Research of the University of Pittsburg for the Leather Belting Exchange. The article describes the belt-testing equipment employed, and gives the results of the belt tests that were made on leather, solid woven, balata, friction surface rubber, and stitched canvas belts.

General Electric Co., Schenectady, N. Y. Bulletin 46112, describing the deflection potentiometer, which is intended to cover a field where an accuracy is required between that of the precision potentiometer and the laboratory standard instrument. Bulletin 41021 A, describing the latest design of RF, Form A, direct-current adjustable-speed motors, rated from 2-3 to 50 intermittent horsepower. This motor is said to be particularly suitable for reversing planer operation, pipe threading, tapping, or for driving any machine repeating its cycle of operation.

Hendey Machine Co., Torrington, Conn. Catalogue covering the line of milling machines made by the company, which includes plain and universal types, made with either geared spindle or belt cone drives. The construction of the machines is described in detail, and specifications are given for the different sizes. The various attachments used in connection with these machines are also illustrated and described. One section of the catalogue illustrates the line of machines equipped with motor drive, and shows typical operations performed with these machines.

Geometric Tool Co., New Haven, Conn. Catalogue covering the complete line of screw-cutting tools and machines made by this company, which includes self-opening adjustable screw-cutting die-heads, solid adjustable die-heads, taper threading die-heads, adjustable collapsing taps, combination collapsing taps and reamers, hollow milling tools, chaser grinders, and threading machines. Following the illustration and description of each tool is a table giving complete specifications. Operating instructions are also included. The last section of the catalogue contains tables giving dimensions for standard screw threads.

TRADE NOTES

Republic Tool Products Co. has recently been organized at 300 Troy St., Dayton, Ohio, to do die and stamping work. F. H. Poeppelmeier is president and manager.

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill., announces that its publicity department was moved August 1 to the Chicago Pneumatic Building at 6 E. 44th St., New York City.

Green Engineering Co., Dayton, Ohio, is now located in its new fireproof building at 725 S. Main St., Dayton. The shop is 50 by 150 feet, and is fully equipped to manufacture automobile parts.

Gustave Wiedeke Co., 1833 Richard St., Dayton, Ohio, manufacturer of railroad and boilermakers' tools, is erecting a three-story brick addition to its plant, 80 by 100 feet, to take care of its increasing business.

Springfield Advance Machine Co. is a new concern organized at East and Harrison Sts., Springfield, Ohio, to engage in general jobbing work and the manufacture of agricultural implements. H. J. Kirchwehm is manager.

Phoenix Mfg. Co., Eau Claire, Wis., has removed its office from Cleveland, Ohio to Chicago, Ill. W. L. Harrison, who has been manager of the Cleveland office for a number of years, will have charge of the Chicago office.

Barkelew Metal Products Co., Dayton, Ohio, is now located in its new plant at E. Richard and Bowen Sts., which is a two-story brick building, 100 by 150 feet. The plant is fully equipped for turning out screw machine products.

Cincinnati Shaper Co., Cincinnati, Ohio, has just completed a new factory building which will make available 30,000 additional square feet of floor space. The program of the company calls for doubling the output in the near future.

Dole Valve Co. announces its removal to 1923 Carroll Ave., Chicago, Ill., where the company has adequate facilities for manufacturing its line of double compression couplings, priming cups, shut-off cocks, packless radiator valves, and brass fittings.

Southwark Foundry & Machine Co., Philadelphia, Pa., announces that it intends to broaden its field by adding to its present line of hydraulic and power machinery a full line of pneumatic and hydro-pneumatic riveters, and foundry molding machines.

Wolf & Fry, 845 Broad St., Newark, N. J., engineers and architects, have opened a consulting engineering office, where they are engaged in engineering, designing and drafting service, the designing of industrial buildings and the planning of factories.

Carl G. Barth & Son, consulting engineers, have opened an office in the Fuller Bldg., 10 S. 18th St., Philadelphia, Pa., where they will continue to specialize in production and costing methods, etc., based on the Taylor system of scientific management.

Dominion Oxygen Co., Ltd., Toronto, Canada, is planning to erect a chain of oxygen plants in Canada for separating oxygen from the atmosphere, and has just completed the first of these plants at Toronto. Sites for additional plants have been secured at Montreal, Winnipeg, and other points.

Lambert Machine & Engineering Co., Cleveland, Ohio, has purchased the entire stock of the **Carroll Foundry & Machine Co.**, Bucyrus, Ohio, and the two companies will be combined with a capitalization of $1,500,000. The Cleveland plant will be moved to Bucyrus, and extensive additions and improvements will be made in the Bucyrus plant.

Air Reduction Sales Co., 120 Broadway, New York City, is planning to have an exhibit at the annual convention of the American Foundrymen's Association at Columbus, Ohio, in October. Demonstrations will be given showing the adaptability of the new "Airco" welding and cutting apparatus and "Airco" oxygen and acetylene for foundry welding and cutting.

Uehling Instrument Co., 71 Broadway, New York City, manufacturer of fuel economy equipment, is now being represented in the New England states by the Smith Engineering & Supply Co., 89 State St., Boston, Mass. S. W. Smith, president of the latter company, was until recently associated with the Uehling Instrument Co. at its New York office.

National Twist Drill & Tool Co., manufacturer of twist drills, reamers, and milling cutters, whose factory is located in Detroit, Mich., has removed its New York office from 30 Church St. to 73 Warren St. This will be the eastern branch of the company, and a complete stock of the various products will be carried at the new location. V. G. Engleman, formerly of Detroit, will have charge of the eastern branch.

Pennsylvania Pump & Compressor Co., Easton, Pa., has opened the following additional sales offices: 788 Potomac Ave., Buffalo, N. Y., J. B. Laird, manager; 232 St. Clair Ave., N. E., Cleveland, Ohio, L. J. Wakefield, agent; 1956 N. Broadway, St. Louis, Mo., Corby Supply Co., agent; 423 5th St., S., Minneapolis, Minn., L. E. Pollard Co., agent; 804 First National Bank Bldg., Omaha, Neb., L. E. Pollard Co., agent.

Standard Reamer & Tool Co., 410-424 Elmwood Ave., Detroit, Mich., has been incorporated by John M. Biles, formerly general manager of the Detroit Reamer & Tool Co., and Torsten A. Gyllsdorff, formerly superintendent of the Detroit Reamer & Tool Co. The new company will manufacture a complete line of standard reamers, cutters, and special tools. The officers are as follows: President, Arthur J. Stock; vice-president, Frank J. Trippensee; treasurer and general manager, John M. Biles; secretary and superintendent, Torsten A. Gyllsdorff.

Austin Machinery Corporation, 30 Church St., New York City, announces the consolidation of the F. C. Austin Machinery Co., Inc., Linderman Steel & Machine Co., F. C. Austin Drainage Excavator Co., Toledo Bridge & Crane Co., Municipal Engineering & Contracting Co., and other large manufacturers of kindred lines with plants at Toledo, Ohio, Muskegon, Mich., Winthrop Harbor, Ill., and Woodstock, Ontario, Canada. The combined capacity of these organizations will be devoted to mass production of earth-moving and concrete-mixing machinery.

Nelson Tool & Machine Co., Inc., manufacturer of small tools and light machinery, has moved from the shop formerly occupied at 253 Norfolk St., Newark, N. J., to 82 Lewellyn Ave., Bloomfield, N. J. The new building is a two-story brick structure having a floor space of 8000 square feet. The company has recently been incorporated under the state laws of Virginia at $100,000 and is provided with greater facilities for handling the manufacture of its product. The executives of the new organization are Otto Nelson, president; J. R. Peters, vice-president; Charles W. Nelson, treasurer; and Alexander W. Nelson, secretary.

Millers Falls Co., 210 River St., Millers Falls, Mass., has purchased the plant of the **West Haven Mfg. Co.**, at West Haven, Conn., which for twenty-five years has been engaged in the manufacture of "Universal" and other brands of hacksaws, band saws and small tools. Not only will the Millers Falls Co. continue the manufacture of "Universal" saws, but it will also make at its West Haven plant a complete line of both hand and power hacksaws under the "Millers Falls" brand. Hereafter the business of the company will be carried on through its plants at Millers Falls, Mass., Brattleboro, Vt., and West Haven, Conn.

Vermont Tap & Die Corporation has just been incorporated in Newport, Vt. The active head, H. E. Paine, has had considerable experience in the manufacture of taps, dies, reamers, twist drills, and milling cutters, having held various positions with Butterfield & Co.—Division of the Union Twist Drill Co.—from draftsman to general manager, which latter position he held just previous to forming the present organization. The officers are as follows: President, P. O. Miller; vice-president and general manager, H. E. Paine; treasurer, B. W. Wilcox. Orders for equipment are being placed, and it is expected that production of machine screw taps will commence about October 1.

Acme Die-Casting Corporation, whose factory and main office are located in the Bush Terminal, Brooklyn, N. Y., has recently opened a branch office in the Machinery Exhibition Sales Department of the Philadelphia Bourse. This office is in charge of Edward McK. Hunt, who will handle the business in New Jersey, eastern Pennsylvania, Maryland, Delaware, and the District of Columbia. Offices are maintained at the present time in Detroit, Cleveland, Chicago, Pittsburg, Rochester, Boston, and Philadelphia, and it is contemplated opening another office in the near future in Newark, N. J. The company specializes in the production of zinc, aluminum, tin, and lead alloy die-castings.

Oxweld Acetylene Co., 640 Frelinghuysen Ave., Newark, N. J., manufacturer of oxy-acetylene welding and cutting apparatus, has established Pacific coast sales and distributing headquarters at 1077 Mission St., San Francisco, Cal. Additional sales representatives' offices are maintained at the following points: Los Angeles, 646 Maple Ave.; Salt Lake City, 908 Kearns Bldg.; Portland, 90 First St.; and Seattle, 433 Pioneer Bldg. Leo Romney is Pacific sales manager, with headquarters at San Francisco. The export department of the company, which was formerly located at the factory in Newark, has been removed to the Carbide and Carbon Building, 30 E. 42nd St., New York City. The department has been reorganized and is now under the direction of R. G. Noble, who will cooperate with the general sales department of the company.

Clark-Mesker Co., Cleveland, Ohio, has been incorporated to take over the machine tool department of the Cleveland Milling Machine Co. The principals of the new organization are D. B. Clark, president, who is also general manager of the Cleveland Planer Co. and the Cleveland Machine Tool Co., and who was superintendent of the Watervliet Arsenal during the war; L. H. Mesker, vice-president and general manager, who was formerly connected with the Motch & Merryweather Machinery Co., Manning, Maxwell & Moore, Inc., Cleveland Milling Machine Co., and Kearney & Trecker Co.; Charles A. Morris, secretary and treasurer. The board of directors consists of T. E. Borton, E. D. Rogers, A. V. Cannon, D. B. Clark, and L. H. Mesker. The company is now manufacturing No. 1 and No. 2 plain and universal milling machines and will soon have a No. 3 machine as well as vertical machines ready for the market.

Ackerman Bros. Co., Inc., 95 Liberty St., New York City, has been appointed direct representative in the New York district for C. E. Johansson, Inc., Poughkeepsie, N. Y., manufacturer of standard gaging sets, precision gage-blocks, snap gages, plug and thread gages, etc. The company has also been appointed representative for the Charles L. Jarvis Co., Gildersleeve, Conn., manufacturer of high-speed tapping devices; B. C. Ames Co., Waltham, Mass., manufacturer of dial indicators and bench lathes; T. R. Almond Mfg. Co., Ashburnham, Mass., manufacturer of micrometers and chucks; the Van Keuren Co., Boston, Mass., manufacturer of optical measuring equipment; Ready Tool Co., Bridgeport, Conn., manufacturer of tool-holders, centers, and lathe tools; Huther Bros. Saw Mfg. Co., Rochester, N. Y., manufacturer of metal slitting saws; and American Saw & Mfg. Co., Springfield, Mass., manufacturer of "Lenox" hacksaw blades.

VOLUME 27

MACHINERY

NUMBER 2

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It is understood that all contributed articles pertaining to machine shop practice and machine design are submitted exclusively to Machinery; when accepted and published, payment is made at our regular space rates unless other terms have been agreed upon.

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The Editor's Talk With MACHINERY'S Readers

NO one will deny that the youngest of America's big industries is at the same time its most highly developed insofar as manufacturing methods are concerned. American manufacturers have always led the world in machine tools and machine shop methods; but no industry has put machine tools to such searching tests as the automobile industry—both as to productive capacity and ability to meet the severe requirements of highly accurate work. It is in the automobile plants that we find machine tools used in the most efficient manner, utilizing methods for producing accurate work at low cost without a parallel in any other metal-working industry. These highly efficient shop methods can be applied with equally good results in practically all other metal-working plants, with the necessary modifications in accordance with the quantity of production, the size of the product, and the requirements for accuracy.

IN this number of MACHINERY several phases of automobile shop practice are dealt with. The leading article, on Cadillac Grinding Practice, describes the methods used at the Cadillac plant. A careful reading of this interesting article will indicate to the man of mechanical experience, the refinement of manufacturing practice characteristic of the work in plants engaged in building high-grade motor cars. It shows the careful attention paid to details, and presents practical ideas which can be applied to advantage in hundreds of shops. The variety of grinding operations dealt with gives a comprehensive review of the methods used in one of America's leading automobile plants.

THIRTY years ago aluminum was practically an unknown metal in the machine-building field. Then, when commercial methods for producing aluminum had been developed, exaggerated ideas became prevalent as to its importance in the metal-working industries. There were engineers of considerable reputation who expressed the belief that aluminum would replace iron and steel for almost any purpose; yet, at that time, there was no definite idea of the possible field of usefulness of this metal. Today, however, aluminum has secured for itself an important and well defined place in the metal working industries; and while we do not now believe that it will replace steel for most purposes, it is recognized that aluminum will become more and more generally used for machine parts where lightness is of importance and where the great strength of steel in its manifold forms is not required. In automobile construction, especially, aluminum is becoming one of the most valuable materials.

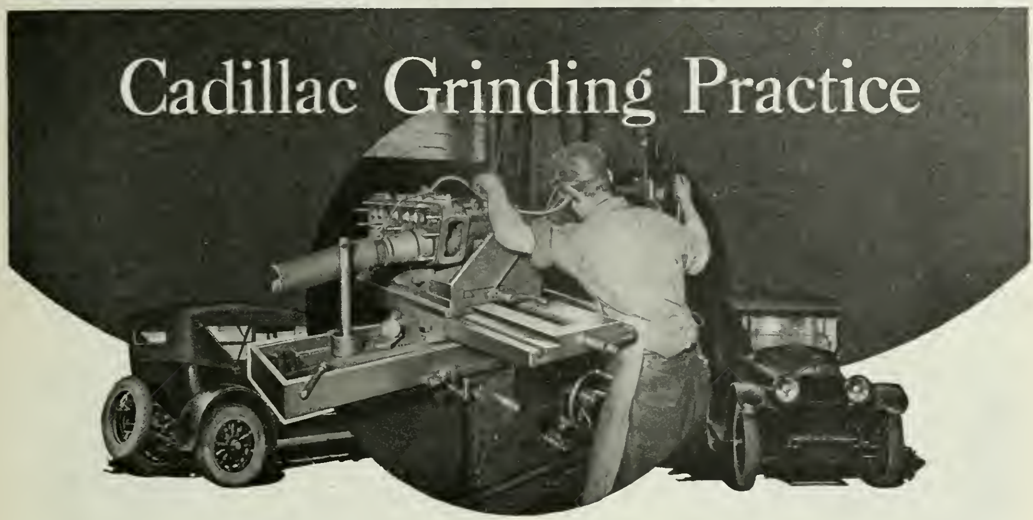
THE methods of machining aluminum differ greatly from those used in machining steel or cast iron, because aluminum is so soft that speeds and feeds which would be impossible in working the harder metals, may be very successfully applied to this light material. The practice of the Hudson Motor Car Co., Detroit, in machining aluminum transmission cases and pistons may be considered the last word in work of this kind, and a complete review of this company's practice, showing operation lists and production rates is given in the article, Machining Aluminum Automobile Parts.

THERE are many other articles of equal interest, dealing with such varied subjects as Continuous vs. Station Milling, Turret Lathe Design, Special-purpose Machines in a Machine Tool Plant, Die Design for Drawing Difficult Shapes, Manufacturing for Selective Assembly, Machine Tool Counterweights,. Continuous Production Drilling, Precision Measuring Devices, Drafting-Room Progress Record, Machining Clutch Parts on the Turret Lathe, the Manufacture of Automobile and Truck Axles. Then there are numerous Practical Letters from MACHINERY'S readers giving descriptions of new devices and shop methods, solutions of problems submitted to the How and Why columns, and that most complete review of New Machines and Tools brought out during the month. The New Tools department of MACHINERY would alone warrant the publication of a technical journal, so important is the service it renders.

THE earnest men and women—technical writers, editorial and advertising, artists and designers; the business people in many departments; the engravers, compositors and printers, and all the others engaged in the manifold useful tasks the sum of which is monthly MACHINERY, have great pride in the result, for they know it is as good as whole-hearted work and trained ability can make it, and above all others, they know it renders service.

OCTOBER **MACHINERY** 1920

Cadillac Grinding Practice



Description of Methods Employed in the Grinding Department of a Plant Building High-grade Automobiles

By EDWARD K. HAMMOND

THE average man is likely to base his estimate of the quality of a motor car by the size of the check which he has to draw in making payment for it. He knows that a machine built by one of the high-grade makers "rides" more easily and runs with less noise than an inexpensive car, but he would probably find considerable difficulty in giving an adequate explanation of the reasons for these pronounced differences in operation. If he had occasion to visit the plant engaged in manufacturing thousands of the light car which is seen on the city streets and country highways of every state in the union, and then compared these production methods with those employed in building one of the high-grade American machines, he might well be prompted to ask the question: "If those little four-cylinder cars can be produced under conditions where rapidity of output appears to be the controlling impulse of the whole organization, and still run satisfactorily when placed in service, is there not a lot of unnecessary refinement in the methods used in building the so-called 'luxury' machines?"

This question would probably call for both an affirmative and a negative reply, depending upon whether the function of a high-grade car is to provide service or luxury. From a purely utilitarian standpoint, it is obvious that a great deal of unnecessary work is done in holding the limits of tolerance on dimensions of all parts of the mechanism within extremely close margins; but although such work does not necessarily add to the amount of service obtained from the car during a reasonable operating life, it certainly is responsible for the easy riding properties and for the freedom from noise which place a car in the luxury class. Obviously it adds greatly to the cost of production to hold limits of a thousandth or a few ten thousandths of an inch on all important dimensions of a majority of parts of the mechanism, but as such a practice is one of the means of assuring a maximum degree of comfort to the user, the purchase price does stand for something more important than a highly perfected superficial appearance.

It has always been recognized that the United States has led the world in machine shop practice and in the development of the methods and processes employed in metal working. Nevertheless, the full realization of the possibilities of machine tools for quantity production coupled with great accuracy came first with the development of the automobile industry into one of the leading industries of the country. It is in the automobile plants that machine tools are found to be employed in the most efficient manner, and it is here that methods have been developed for producing accurate work at low cost that are not paralleled in any other industry. Hence, in describing machine shop practice as found in automobile plants, the best commercial practice found anywhere is recorded for the benefit of other machine shops.

Use of Hardened and Ground Parts

An example of the careful attention paid to details, which is responsible for enabling a car to operate in a way that justifies its being placed in the "luxury" class, is seen in the heat treating and subsequent grinding of many parts that would be capable of functioning with a reasonable degree of satisfaction if they were simply machined and assembled with the steel left in a soft condition. Quite obviously, this practice of hardening and grinding such parts will add greatly to the perfection of operation of a machine, as the running action will not only be smoother when the mechanism is new, but hardness will give greater durability to those machine members which are subject to a rubbing action and thus prevent the development of lost motion that is responsible for much of the vibration and noise that characterizes the operation of some types of old cars. To those who are interested in the methods used in building motor cars, either from the standpoint of the purchaser or from that of the man who is called upon to devise methods of performing manufacturing operations on their parts, this description of a number of interesting grinding operations performed on pieces of the Cadillac mechanism will prove of interest; but particular attention is called to the fact that while these are all motor car parts that are to be ground, the methods are entirely general in their application. Consequently, men employed in the planning departments of plants engaged in many other lines of manufacture should find it possible to apply similar ideas in handling their own work.

Sound Intensifier Used in Grinding Cadillac Cylinders

In finishing cylinder block castings for the Cadillac motor, the method of procedure is to take a roughing, an intermediate, and a finishing cut in each cylinder bore, after which two grinding operations are performed. For the three boring operations, the diameter of each cylinder must come within the following tolerances: roughing cut, 0.020 inch; intermediate cut, 0.004 inch; and finishing cut, 0.003 inch. After taking the final cut, the castings are transferred to Brown & Sharpe No. 23 planetary grinders, on which the cylinders are finished to the required size and degree of smoothness. For performing these operations the diameter must be brought within a tolerance of 0.002 inch. Approximately 0.010 inch is left for removal by the grinding operation and a practice is made of dividing the cut up into two stages, so that a very light finish-grinding operation is performed to assure bringing the cylinder diameter within the required tolerance.

After rough-grinding, the cylinder block is removed from the machine and allowed to cool, so that any expansion produced through raising its temperature will be neutralized; and while taking the light finishing cut, there is not much tendency to raise the temperature. In taking this final cut, it is important for the operation to be performed in such a way that the grinding wheel is cutting to a uniform depth around the wall of the cylinder, and an experienced grinding machine operator is able to tell whether his work is properly set to attain this result by listening to the sound of the grinding wheel as it follows its planetary course around the circumference of the work. The fixture has vertical and horizontal slides so that the position of the casting may be adjusted to provide for attaining this result.

Men who are constantly employed on this part of the work have learned to determine with a surprising degree of accuracy the conditions under which one of these grinding wheels is operating, but the reliability of their judgment is likely to be seriously impaired by noises produced in handling work in adjacent parts of the shop which interfere with their ability to note carefully the sound made by the grinding wheel. To overcome this possibility of trouble, cylinder grinding machines used in the Cadillac plant are equipped with listening tubes that have one end introduced into the water jacket of the cylinder casting that is being ground, while the other end is furnished with a diaphragm similar to that used in a physician's stethoscope or in a telephone receiver. Regardless of how much noise may be produced in handling jobs that are going on near him, the grinding machine operator is able to put this sound intensifier to his ear, as shown in the heading illustration, and hear exactly how the grinding wheel is cutting all of the way around its planetary line of travel. In the performance of this operation the rate of production is eighteen cylinder blocks in a nine-hour day.

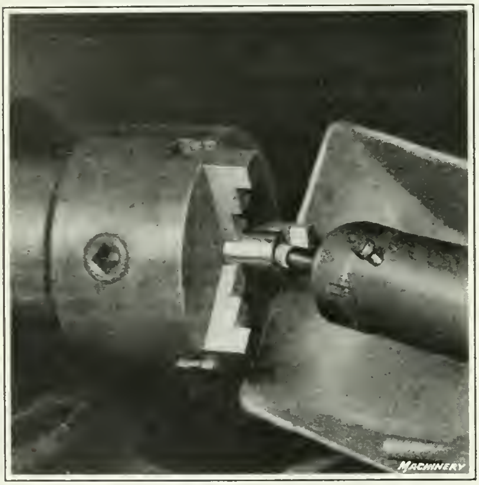


Fig. 1. Internal Grinding Machine equipped for grinding Centers in Wrist-pins

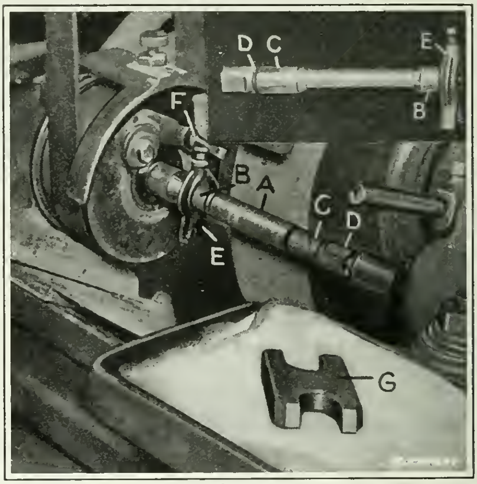


Fig. 2. Plain Grinding Machine equipped for grinding Outside of Wrist-pins

Grinding Centers in Wrist-pins

Wrist-pins used to secure the pistons of Cadillac motors to the connecting-rods, are hardened and finished to size by grinding. The grinding operation is required to bring the diameter within a tolerance of 0.0003 inch, and in order to attain this high degree of precision it is very important to have a uniform bearing surface for the tapered collars on an arbor, which support the wrist-pin by entering the holes at its ends. These bearings for the tapered supporting collars on the arbor are produced by grinding, the work being set up on a No. 75 Heald internal grinding machine, the work-head of which is placed at an angle of 60 degrees to the spindle, as shown in Fig. 1, to provide for grinding the same degree of chamfer in the work. After beveling the hole at one end of a pin in this manner, the Cushman three-jawed chuck is opened and the pin is reversed and set up for grinding a similar chamfer in the hole at the opposite end. This method of grinding not only assists in obtaining an accurate diameter for the work, but it is also of assistance in keeping the work perfectly round. In the performance of this operation the rate of production that is obtained is 700 wrist-pins in a nine-hour working day.

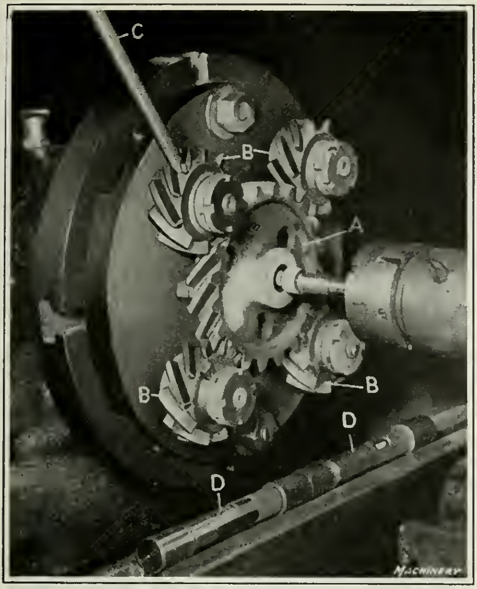


Fig. 3. Internal Grinding Machine equipped for grinding Bore of Spiral Gears

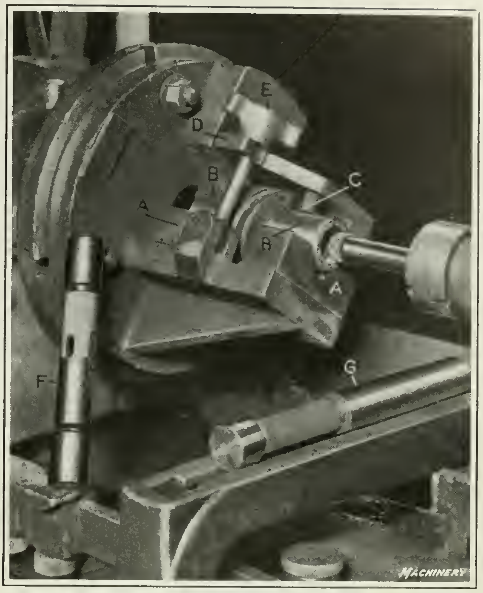


Fig. 4. Internal Grinding Machine equipped for grinding Bore of Steering Worms

Grinding Outside Diameter of Wrist-pins

Mention has already been made of the fact that the wrist-pins are required to be ground within a tolerance of 0.0003 inch of the specified size, and this job is performed on a Brown & Sharpe No. 11 plain cylindrical grinding machine shown in Fig. 2. The work comes to this grinder from the machine shown in the preceding illustration, on which the 60-degree chamfers were ground in the hole at each end, and these beveled faces are utilized as locating points. It will be seen that the arbor on which the wrist-pin *A* is set up for grinding has two collars *B* and *C*, the inner ends of which are tapered 60 degrees to fit the center bearings which have been ground for that purpose. Collar *B* is rigidly secured to the arbor, while collar *C* is a sliding fit and has a nut *D* in back of it, which screws on the threaded end of the arbor. The method of setting up the work is to remove nut *D* and collar *C* so that the wrist-pin may be slipped into place; then collar *C* is pushed forward so that its tapered end enters the hole in the wrist-pin, after which nut *D* is screwed up so that collar *C* secures the work tightly against the tapered end of collar *B*. Of course, it will be evident that the arbor is mounted between centers and that the driving of the work is accomplished by means of a dog *E* on the arbor which engages a pin *F* on the live center. A "Go" and "Not Go" limit gage for testing each piece of work as it leaves the machine is illustrated at *G*. In the performance of grinding these pieces to the close limits which are required, the rate of production obtained is 450 wrist-pins in a nine-hour working day.

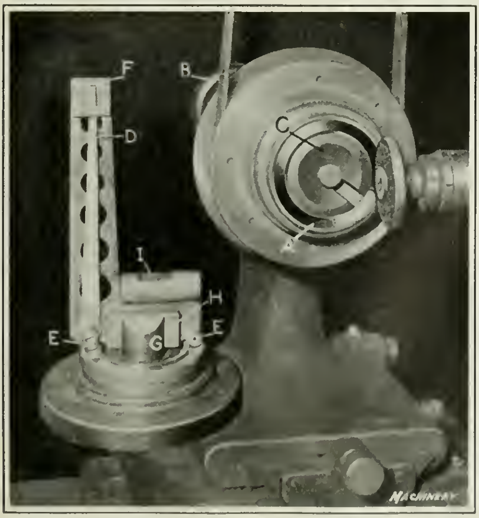
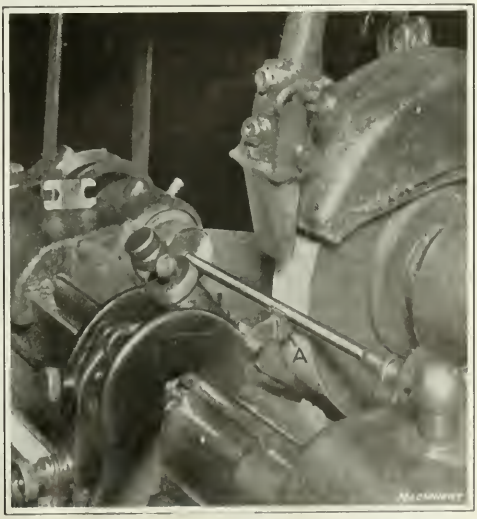


Fig. 5. Radial Grinder and Gage for grinding and testing Racew of Ball Thrust Bearings



[illegible] Operation on Long Thin Shafts where Accuracy is Essential

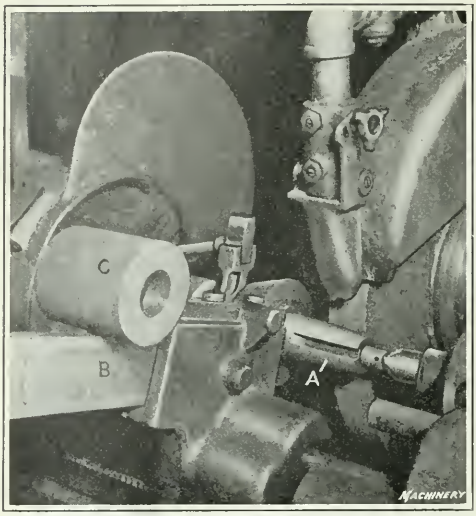


Fig. 7. Universal Grinder for grinding the Tapered Shanks of Driving Pinions

Grinding the Bore of Spiral Gears

In line with the statements which have already been made in regard to the care that is taken in finishing all parts of the Cadillac car which are required to function accurately, attention is called to the practice of grinding the bore of gears so that they will be a tight fit on their respective shafts. Fig. 3 illustrates a No. 75 Heald internal grinding machine used for grinding the bore in a spiral gear that will subsequently be assembled on the oil-pump driving shaft. On this job the method of mounting the work is one of the interesting features. It is required not only to have the bore an accurate fit on its shaft, but this bore must also be concentric with the pitch circle of the gear teeth.

It will be seen that gear *A* to be ground meshes with four pinions *B* which are eccentrically mounted on studs carried by the faceplate. A pin *C* enters a hole in one of the pinions and after the gear *A* has been brought into mesh, turning this pin causes the gear and all four of the pinions to rotate on their eccentric supports and thus move the pinions inward to serve the double purpose of bringing the pitch circle of the gear teeth concentric with the center of rotation, and of gripping the gear ready for performing the grinding operation. At *D* there are shown "Go" and "Not Go" limit gages used for ascertaining the accuracy of the hole ground in the work, which must come within a tolerance of 0.001 inch on the diameter. On this job the rate of production obtained is 120 gears in a nine-hour day.

Grinding Bore of Steering Column Worms

A somewhat similar grinding operation to the one shown in the preceding illustration is illustrated in Fig. 4 which shows a No. 75 Heald internal grinding machine equipped with a special work-holding fixture to provide for grinding the bore of a worm for use on the Cadillac steering column. Referring to this illustration it will be seen that the work-holding fixture is furnished with two V-blocks *A* in which the bearings *B* at each end of the work are clamped. Securing the work in place is accomplished by two pins, one of which is shown at *C*, that are carried by a cover-plate *D* held down on the work by a bolt and wing-nut *E*. A pin in the V-block nearest to the faceplate engages the end of the worm thread and gives endwise location. A "Go" and "Not Go" limit gage for determining the accuracy of the bore diameter ground in the work is shown at *F*, and at *G* there is illustrated an alignment gage which is used to ascertain whether the two bores in the worm have been ground accurately in line with each other. On this job the bore diameters have to be ground within a tolerance of 0.001 inch. The rate of production obtained on this operation is 100 ground worms per day.

Grinding Raceway in Ball Thrust Bearings

For use in grinding the raceway in ball thrust bearings used on Cadillac clutch spiders, a Brown & Sharpe radial grinding machine is employed, which is equipped as illustrated in Fig. 5. The raceway to be ground is shown at *A* and the machine is furnished with a draw-in spindle operated by handle *B*. At the front end of the spindle there is a C-washer *C* that slips over the head of the spindle after the raceway to be ground has been put in place. In this illustration is also shown a gage for testing the accuracy of the raceways ground on this machine. For determining the concentricity, an indicator needle *D* gives the desired information. At the base of the gage there are two round buttons *E* that enter the ground raceway, and as the work is turned under these buttons, any lack of concentricity will cause the button *E* carried at the lower end of indicator needle *D* to swing the upper end of this needle over a scale graduated at *F* thus showing both the presence of an error and its magnitude.

It is also necessary to test the depth of the raceway, and the position assumed by buttons *E* in the ball groove is the determining factor in making this measurement. At the center of the base of the fixture, there is a post *G* that is slotted to receive the flat plate *H* on the frame which supports the mechanism. Plate *H* slides down in the slot in post *G* until the buttons *E* contact with the bottom of the raceway, thus preventing any further downward movement. Sliding through the frame it will be seen that there is a pin *I* one-half of the top of which is ground to one height and one-half to another height. In the case of a raceway in which the groove has been ground to the proper depth, the upper half of this pin will project above the surface of the frame, while the lower half will be below the surface. Of course it will be evident to all experienced mechanics that this method of making a "Go" and "Not Go" limit gage to test the depth of the raceway is based upon the familiar "feeler" principle. After putting a piece of work in place in this gage, the operator slides his thumb or finger across the top surface of the frame, and if he is able to feel the upper half of pin *I* but not the lower half, the depth of the raceway comes within the required limits of tolerance. In grinding these raceways, the radius of the groove is required to come within a tolerance of 0.001 inch, and the diameter

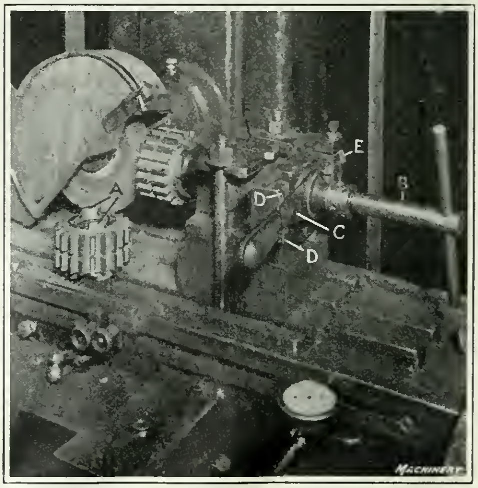


Fig. 8. Indexing Fixture on Grinder for grinding Opposite Sides of Keys A on Crankshaft Gear

of the raceway must be within a tolerance of 0.003 inch. The rate of production obtained is 300 raceways in a nine-hour working day.

Grinding Rocker Arm Shafts

Fig. 6 illustrates a grinding operation on which it will be conceded that an unusually high degree of accuracy is attained, if the long slender form of the work is taken into consideration. The pieces to be ground are hollow shafts, and it is required to hold the outside diameter within a tolerance of 0.0005 inch in performing the grinding operation. As in the case of the wrist-pin grinding job previously described, a practice is made of preparing bearings at the ends of the work to receive the centers on which the piece is supported for grinding on a Norton plain cylindrical grinding machine. It will be evident that with a long slender piece of work of this kind, care must be taken to support it in such a way that inaccuracy will not be introduced through the pressure of the grinding wheel causing the work to spring. Reference to the accompanying illustration will make it apparent that such support is afforded by means of a rest *A* which engages the work near the center. At one end of these rocker shafts there is a slot, and the live center that enters the work at this end is provided with a key to engage this slot and provide a means of driving the work. On this job the rate of production is 250 ground shafts per nine-hour day.

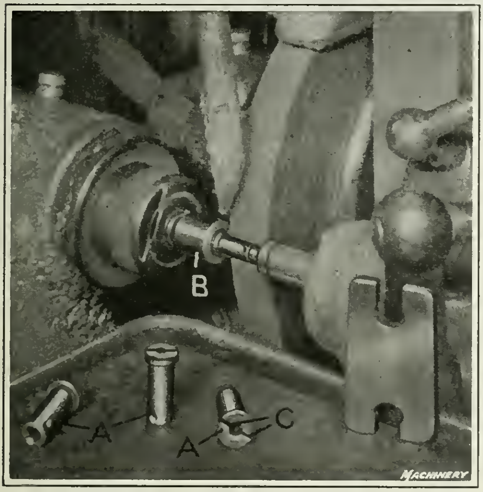


Fig. 9. Machine equipped for performing Cylindrical Grinding Operation on Small Flanged Pins

Grinding Tapered Shanks of Driving Pinions

On the driving pinion of the Cadillac motor, there is a tapered shank which must be finished by grinding to bring the diameter within a tolerance of 0.001 inch, and for the purpose of this operation a Norton universal grinding machine is employed, which is equipped as illustrated in Fig. 7. In this illustration the tapered shank of the driving pinion to be ground is shown at *A*, the work being supported on the usual arrangement of centers and driven by a dog, while the grinding machine table is set to the proper angle to give a taper of 1½ inches per foot. Attention is called to the fact that it is also required to grind a square shoulder on the pinion shank, and to provide for so doing, the grinding wheel is under-cut at the side. This practice makes it necessary to employ a "center finder" that is supported at the forward end of the sliding bar *B*, this device being employed to obtain the desired longitudinal location of the work for the shoulder grinding that is done by the side of the wheel. At *C* there is shown a ring gage that is used for testing the accuracy of the ground tapered shank. In performing this taper grinding operation the output attained is 250 driving pinions per day.

Grinding the Clutch Key on Gears

On the intermediate gear on the Cadillac crankshaft there is a clutch key formed integral with the gear, and it is necessary to accurately grind the side faces of this key. Reference to Fig. 8 will make it apparent that one of the gears on which the key is to be ground is shown in place on the grinding machine, while another gear will be seen standing on the table, and on the latter piece of work the form of key to be ground is clearly shown at *A*. This grinding operation is performed on a Brown & Sharpe No. 2 grinder equipped with an expanding arbor manipulated by a tapered pull-pin to provide for gripping the work. The key has to be ground on its two side faces, and so provision must be made for indexing it through 180 degrees preparatory to the performance of the second grinding operation that is required on one of these pieces. The expanding arbor on which the work is carried is mounted at the end of rod *B*, and secured to this rod there is also a flexible blade *C*. When the gear is indexed through 180 degrees, this blade swings over from the position in which it is shown in Fig. 8 so that it is pointing toward the back of the machine.

It will be seen that there are two latches *D* which engage the upper and lower edges of blade *C*, thus holding it in place and preventing rod *B* and the work from turning. To index the gear for the second grinding operation, it is merely necessary to take hold of the handle on blade *C* and push it toward the right until the blade is clear of latches *D*, after which the handle is swung through half a turn, so that blade *C* comes between two latches, one of which is shown at *E*. This locates the work in the proper position for performing the second grinding operation. On this job the actual grinding is done with the flat side of the wheel. The limits of accuracy are not particularly high, as it is only required to hold the work within a tolerance of 0.001 inch. The "Go" and "Not Go" limit gage for testing the accuracy of the ground key is shown at *F*. An output of 300 gears per nine-hour day is obtained on this operation.

Cylindrical Grinding Operation on Cam-roll Pins

Fig. 9 shows a No. 11 Brown & Sharpe plain grinding machine equipped for the performance of an operation which is of interest, owing to the small size of the pieces to be ground. These are valve rocker roller pins and their form will be best understood by reference to the three pieces *A* that are shown lying on the tray at the front of the grinding machine. The diameter of the shank must be ground to come within a tolerance of 0.0005 inch. It is the grinding of this shank that is done on the Brown & Sharpe machine, and for the performance of this operation the work is held by a center at the right-hand end, while at the left-hand end the flange enters a counterbore in chuck *B*. In one of the pieces of work lying on the tray in front of the grinder, it will be seen that there is a slot *C* milled across the flange and this slot is utilized for driving the work by having a diving key in chuck *B* arranged to enter this slot. An arrangement of this kind enables these small pieces to be set up for grinding with a minimum loss of time. The rate of production obtained on this operation is 1800 to 2000 pins in a nine-hour working day.

* * *

An exhibition of all types of calculating machines was recently held in Paris to commemorate the one-hundredth anniversary of the invention of the first commercial calculating machine by an Alsatian named Thomas, who, in 1820, brought out the first model of this type of machine. It is interesting to note that the five principal inventors and pioneers in the field of calculating machines, as far as the establishment of principles is concerned, all belong to France: Pascal, Thomas, Maurel, Jayet, and Bollée.

Machine Tool Counterweights

Methods of Applying Counterweights to Different Types of Machine Tools for Counterbalancing the Weights of Spindles, Slides and Work-tables

By FRED HORNER

MANY classes of machine tools will function properly only when provided with suitable counterweights. In most cases, the principal problem encountered when designing counterweights for such machines is to so locate them that they will give the least trouble and inconvenience. They must be placed where they will not interfere with the operator or the work, belts, shafting, controlling levers and rods, motor gear, or other essential details. The fulfillment of this condition depends on many factors, and differs widely in various types of machine tools, the disposal of weights being a simple matter in some instances, and more difficult in others. The mass of the balance weights, their shape, and the profile of the area available for their location are the principal factors that affect the problem. In certain forms of machines the counterweights cannot be placed anywhere near their point of immediate action, but have to be attached to chains or ropes, passing around pulleys and rollers, to some rather distant position.

Counterweights for Spindles, Slides, and Tables

The movement of the slides or spindles to be counterbalanced sometimes necessitates making holes or wells in the floor into which the weights can sink, while in other cases it may be practicable to pass them down into hollow columns, or down the backs of the columns. Other factors to be taken into account are whether they must be of a constant weight, or whether they require modification to meet various working conditions, and also whether the traversing motion of a slide or spindle tends to induce an oscillating or swaying motion, which will be transmitted to, and aggravated by, the counterweight. Where the action of a counterweight is required to be constant, the mass is always the same when the weight of the slide or spindle or both does not vary, or when it varies only a small amount, due to the changing of tools and tool-holders mounted on the slide or in the spindle. Certain kinds of slides require more or less modification of their counterweights when different machining operations are performed, due to the variations in the shape or weight of holders, tools, or special fixtures. Work-table counterweights require an even greater variation in this respect because the mass of the work, and of the jigs and

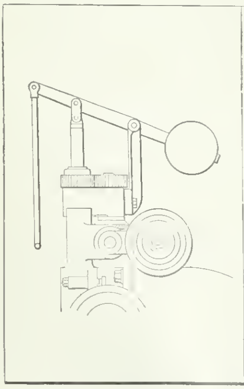


Fig. 1. Directly Applied Weight

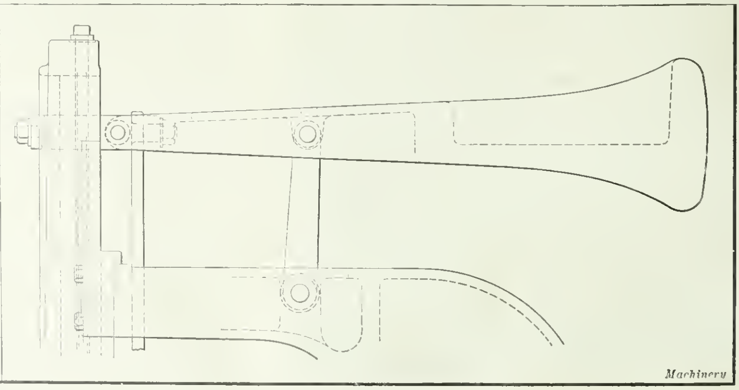


Fig. 2. Method of Balancing Slotter Ram

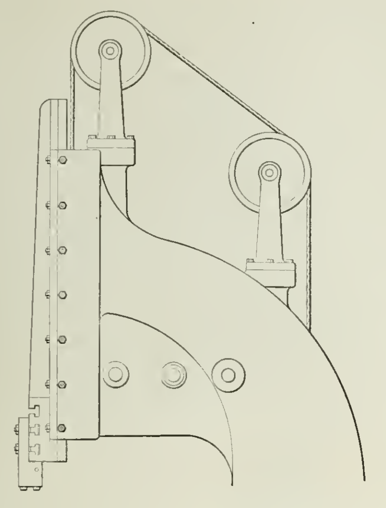


Fig. 3. Placing of Counterweights on Large Slotting Machine

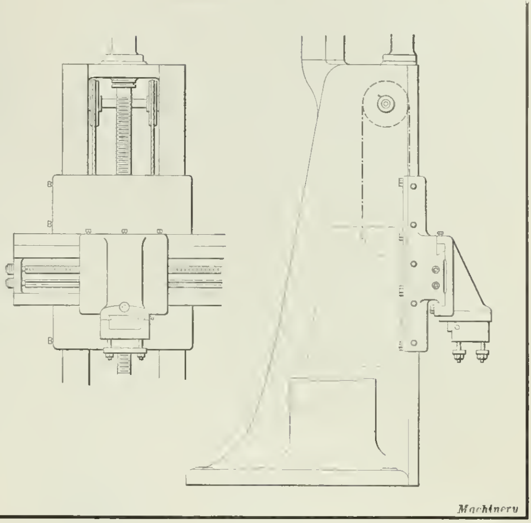


Fig. 4. Machine with Counterweight located inside of Column

fixtures, causes greater differences than do the tools. Hence the construction of counterweights for work-tables must be such that their weight may be readily increased or reduced.

In some cases changes of counterweights have to be made because of the angular setting of slides, the particular manner in which tools operate, or to secure the elimination of backlash under variable working conditions. The effect produced on the action of a counterweight when angular settings of a slide or spindle are made must be considered when designing the counterweight. In cases of this kind the weight must be so placed that it will accommodate itself to the altered conditions; this applies not only to the matter of prevention of swaying and displacement, but also to the results that are incurred by throwing the mass over at an angle. Occasionally this deflection is of little or no consequence, but often it is important. A solution of the problem may be obtained in some instances by leading chains or ropes around suitably located idlers that will bring the weight away from the working zone. In recent practice this problem has been solved by the substitution of springs as counterbalancing agents, notably in boring and turning mills, and radial drilling machines, so the objectionable weight of the counterbalance, and the problem of adapting it for use where angular settings are required, have been eliminated.

Even where the movements of a slide are not such that actual tendency to oscillation is set up, the presence of a loose swinging weight may cause minute variations in the cut, as this may result from the flexure of a frame or slide. Consequently the preventing of swaying even in a slight degree may be desirable. Usually it becomes imperative, because the swinging of a weight of any shape, or the twisting of a weight of rectangular shape, would cause it to interfere with the other machine parts, especially in places where the available space is restricted.

Principles of Counterweight Design

The employment of two or more weights for counterbalancing a single member is sometimes desirable. For in-

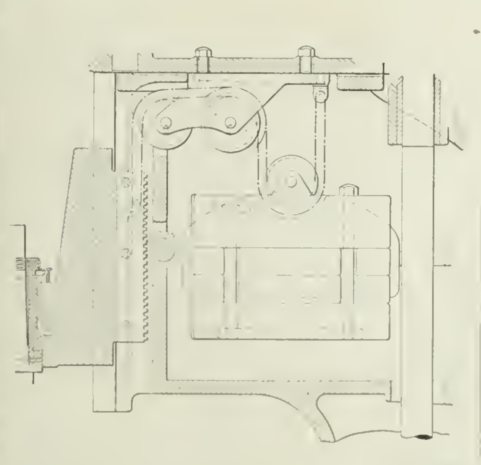


Fig. 5. Snatch-block Arrangement of Counterweight used where Travel of Counterweight is Limited

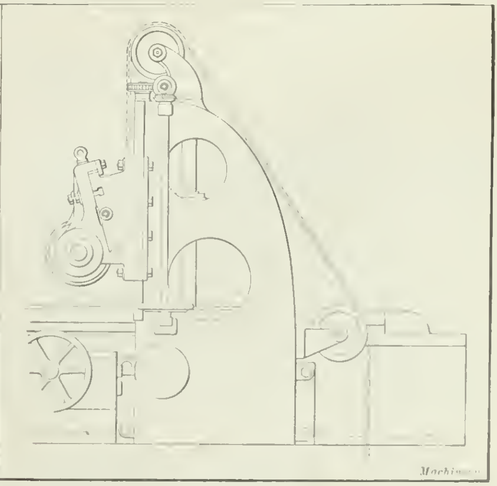


Fig. 6. Arrangement of Counterweights below the Floor Level to clear Housings

stance, a long slide may be of such dimensions that it cannot be successfully dealt with by a single weight and attachment, because the pull would be too localized—a condition which would result in the sagging of the slide at the ends to an extent that would seriously affect the operation ot the machine. In a slide of this kind, as well as in a deep heavy slide, the weight of the counterbalance is often so great that it would impose too great a stress upon a single anchoring rope or chain; or it may be of such weight that a single wire rope sufficiently strong to sustain the pull of the weight and the slide would be excessively stiff, and therefore difficult to bend around a pulley, even though a pulley of large diameter were used. The crushing and bending influences upon the frame have to be taken into account also, and the pressure caused by the pull of the chains should be properly distributed so that the metal will not be sprung in at weak places or warped laterally.

The location of screws, racks, feed-rods and other elements play their part in affecting the placing of the chains or ropes, while other factors are the question of the displacement that takes place when a sliding member is moved to its extreme positions, and the manner in which the balanced slide is guided vertically. Usually the maximum pull of the rope should come approximately midway between the extreme positions of the sliding element, so as to provide an average or even effort that will not tend to twist or tip the slide on its ways. The location of a narrow guide may exercise a modifying influence, and it may be desirable or imperative to set the anchorage of the rope approximately in line with the line of guidance, just as is done in the case of the actuating screws or other driving agencies employed with narrow guides, the screws or racks being situated as nearly in line with the guides as practicable. This discussion as to the hang of the rope only affects its coming down from the first pulley overhead, for after reaching the first overhead pulley the direction of the rope can be diverted in almost any convenient direction.

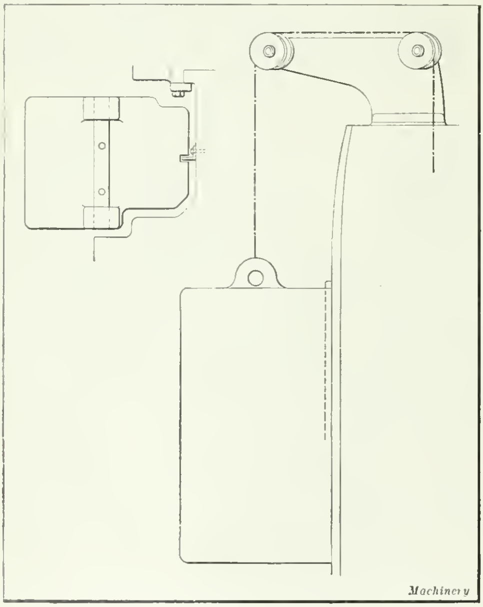


Fig. 7. Counterweight with Angle-iron Guide to prevent Swaying

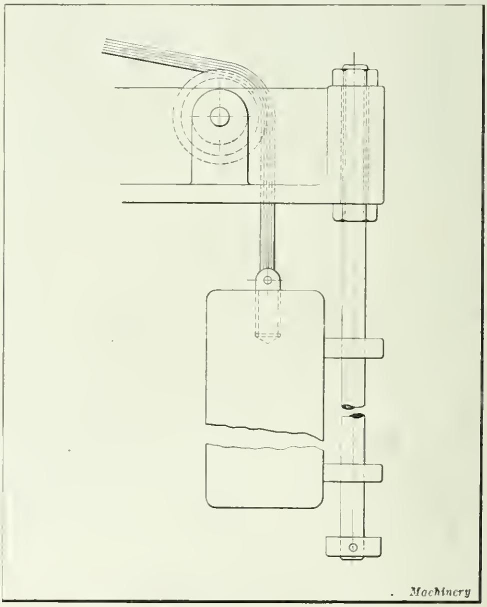


Fig. 8. Counterweight which is guided by Rod suspended from Bracket

Conditions that Affect Design of Counterweights

The relative importance of a balance weight is affected by the type of feed or movement through which a slide, spindle, or table receives its motion or adjustment. Thus, in vertical rack-fed machine parts there is nothing to prevent the instant sliding down of the part as soon as the pinion is free to revolve; but in screw-fed or worm-fed parts, the self-sustaining principle comes in; hence varying sets of conditions affecting the design are met with. In one case a rack feed will prove an advantage, allowing a slide to be rapidly adjusted, fed, or withdrawn; it also permits a spindle, such as used in light drilling machines, to fly up to the starting point as soon as the hand pressure is released, and it adds to the sensitiveness of the control. In movements that must have compensation for variations, such as are necessary in profiling or cam-cutting operations, the rack affords an elastic medium for letting the movements take place. The cross-rail of a planing machine, because it is self-sustaining, has been generally neglected from the point of view of balance, though plano-miller cross-rails are always balanced, presumably because they usually carry a greater weight in the form of spindle, driving means, arbors, etc.; but examples of counterbalanced planer cross-rails are not entirely lacking, and it is likely that the practice will extend so as to reduce power costs, or human exertion, as well as the wear on the surfaces of the actuating screws, gears, etc.

Different Methods of Counterbalancing and their General Application

What may be termed direct balancing is used when a constant to and fro movement of a weight and attaching medium would not be desirable, or perhaps practicable; it is also used in the case of a great many lever feeds and adjustments, the direct attachment of a weight being the simplest and best construction. This principle is applied to both hand- and power-operated parts, to cause return of the part ready for another movement, or to maintain a tool, roller, or pin in continuous contact. With the latter type we are not concerned in this article, for this contrivance does not come under the head of a counterweight proper, but is a feed weight, such as used in hacksawing machines, circular cold saws, and certain other machines.

The most common use of a directly applied counterweight is found in certain types of drilling machines that have a lever feed, the operator's hand being placed upon the projecting end, or upon a pull-rod. The weight then occupies a position more or less near the other extremity of the lever, as shown in Fig. 1. For tapping spindles, this system is peculiarly applicable, because tapping machines have to be self-feeding after the tap has started; hence the nicety with which their spindles are balanced affects the operation and the quality of threads produced. The balancing of a slotting machine ram, such as shown in Fig. 2, exemplifies the equalizing principle, which is here employed to eliminate friction and save power in order that an even, steady movement may be secured. This device is seldom employed, however, on the largest machines, where the great mass of such a weight would become objectionable. For larger machines, some such disposition of the weights as illustrated in Fig. 3 is necessary, the ropes or chains being brought down to the most suitable place for the counterweights, either into the frame, or down the back of it. The choice of position is usually determined by the arrangement of shafts, pulleys, motor, and other details. Sometimes, as in the case of portable slotters, the arrangement illustrated in Fig. 4 can be employed, in which the whole counterweight tackle is carried within the column.

The restricted depth behind the sliding head is occupied by weights suspended in snatch-block fashion, so that half their effective pull is transmitted to the head, with a doubled length of movement. The opposite arrangement is encountered in some designs of multiple drilling machines which have very tall columns, on which the sliding heads do not travel more than about half their length, owing to the great depth of the head mechanism. Here the head is hung to the snatch-block pulley, the anchored end of the rope goes up to an attachment on the overhanging bracket at the top, and the free end passes around the top pulley and down to a set of weights inside the column which are approximately half the weight of the head.

A similar result is obtained by the wheel-and-axle device which is occasionally employed on plano-millers and other tools having similar requirements. With this method two pulleys are cast or otherwise fastened together; the rope attached to the slide is fastened to one side of the small pulley, and that of the balance weight to the opposite diameter of the large pulley, which is twice the size of the other.

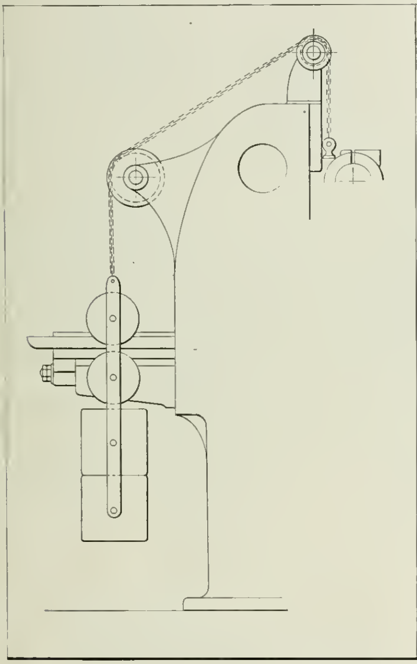


Fig. 9. Arrangement of Weights where Space is Limited

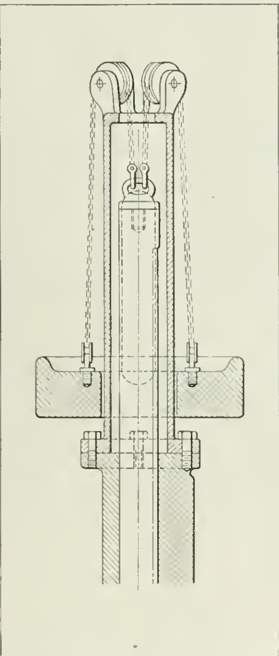


Fig. 10. Ring Counterweight for Drilling Machine Spindle

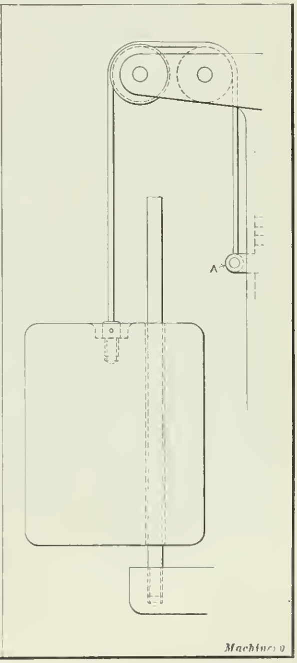


Fig. 11. Counterweight which slides over Guide Rod

Pillar drilling machines, such as shown in Fig. 13, are another type of machine in which the pillar provides a suitable container for the weights. In this case it will be seen that both the mass of the table and of the drill head are balanced by weights enclosed by the pillar. A weight is also used in some instances for balancing the rack sleeve instead of using a coiled spring, which is the method commonly adopted. Another departure from conventional methods of counterbalancing consists in using an equalizer bar which is coupled to the sleeve and sliding head, and chained to a single weight within the column. In these drilling machines no limitations of vertical length of movement hamper the placing of the weights, nor do they, as a rule, in some other types of machines, such as vertical milling and vertical boring or chucking machines. But when the contour of the frame is such that there is no clear drop for the weight, a modification of the system must be sought.

An example of this may be observed in Fig. 5, which shows the arrangement employed in a vertical milling machine. The leverage gained on the greater diameter of the counterweight pulley, by a reduced weight and extended length of drop, thus acts on the smaller pulley and thence on the slide. This arrangement is feasible only when the vertical movement of the slide is such that the available space is of sufficient length for the fall of the weight.

The disposal of weights in a machine having a frame of parabolic shape is made difficult when the driving and control gear occupies the spaces beside the curved frames, for then it is usually necessary to run the weights down below the floor level, as in Fig. 6. But often a space of sufficient area to accommodate the weights can be found if the weights are flattened or shaped so that they will just clear the driving and control details. In some cases, guide strips may be fastened to the floor and to brackets at the top, extending beyond the parabola, and the weights thus kept in position. If there is enough space for the weight to slip down the back of the standard, it is often placed this way. This method is commonly used on horizontal boring and drilling machines.

Guide strips are included to promote smooth working and prevent swaying. Even on a straight-backed standard the latter consideration has to be borne in mind, especially when a slight lateral displacement would cause the weight to come into contact with parts of the machine. A shaped or specially formed weight which is guided by an angle bar is shown in Fig. 7. An example of counterweight disposal where the space for drop is ample, but the lateral space rather cramped, is shown in Fig. 9. In this case the employment of flat weights mounted on pins passing through a pair of side bars forms a construction which permits of modifications both in width and depth, as may be required to suit different conditions.

Counterweights Provided with Guide Rods

When a weight is located in a comparatively open space with considerable clearance around the weight, the provision for prevention of swaying may take the form of a guide strip or strips, or a tube into which it descends, or the weight may be cast in tubular form, to slide over a rod or tube, this being rather convenient, as it permits the addition of extra ring weights as required. The principle of an encircling weight is favored in drilling machine spindles and those of massive size on boring and turning mills for deep boring operations. The ring weight is placed around a tube encircling the end of the spindle, and the chains or ropes pass up over two or three pulleys and down to the spindle top, or an extension of the spindle. A drilling machine spindle thus arranged is shown in Fig. 10.

On the saddles of radial drilling machines, where compactness is desirable, the balance weights are designed to fit as snugly and closely as possible to the spindle and guiding ways, so that the swaying tendency will be reduced to a minimum, and the uneven twisting effort also eliminated as far as possible. A guiding bar is generally fixed so as to pass through the weight, or through lugs on the weight, and should be a close fit in the hole. A few variations of this type of counterweight design are shown. In Fig. 11 there is a rod screwed into a bracket extending from the saddle casting, and the weight is passed over this, the chain going up, and thence down to a ring *A* on the spindle nuts, the ring having a lug that is slotted out and drilled to suit the anchoring end of the chain. Usually it is more convenient to hang a rod down from a bracket adjacent to the chain pulley, such as shown in Figs. 8 and 12. A nut or a pin ought to be placed at the bottom of the rod to catch the weight in case of chain failure. A very snug-fitting counterweight is shown in Fig. 14, where the weight is cast of such shape that it will ride high up around the pulley. The guide rod, in this case, is made square, to prevent twisting.

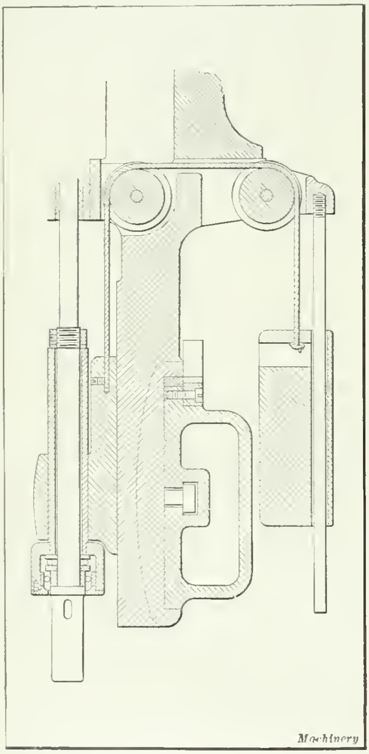


Fig. 12. Counterweight provided with Guide Rod to prevent Swaying

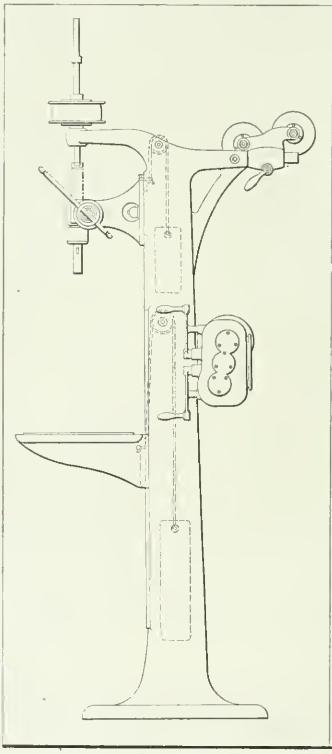


Fig. 13. Drilling Machine with Counterweight enclosed in Pillar

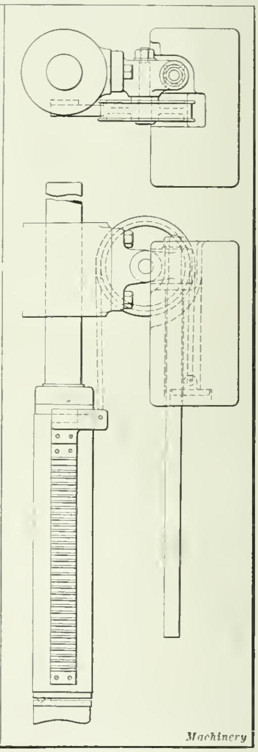


Fig. 14. Counterweight which clears Supporting Pulley

Counterweights Located Some Distance away from the Point where their Force is Exerted

The proper disposal of counterweights at some comparatively distant point from the spot where their force is exerted is a problem which occurs in designing boring and turning mills. As the front of the machine must be entirely clear from encumbering weights, it is necessary to locate them either above the framing, or at some place at the side or rear of the uprights.

In only a few designs can the weights be located at the front, these being principally in case of the counterbalancing of light rams or spindles, a feature also encountered in plano-millers. The long boring rams fitted with encircling weights, mentioned previously, are not in the same category, because the top of the ram extends to such a height that it is out of the way of the work and the operator. The prac-

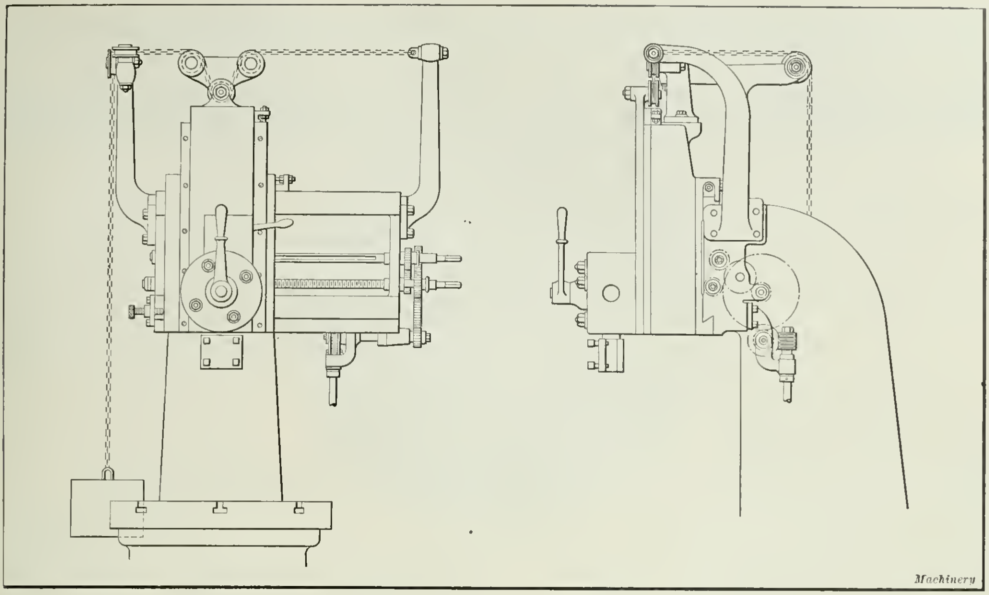


Fig. 15. Chain Arrangement for Counterweight of Boring Mill

tice of mounting tall standards on the top of the cross-girder of a boring and turning mill is often followed, the standards carrying the pulleys. Usually, however, the familiar horizontal chain arrangement is employed, the chain passing around pulleys that deflect its course from the horizontal to reach down to a pulley on the ram, by which the latter is lifted. A simple lay-out for a small boring mill is shown in Fig. 15. With this arrangement the various movements of the ram and saddle do not interfere with the motion of the chain. In larger rams, the pulley on the ram is carried farther down, sometimes being located a distance from the top of the ram that is equal to half its length, and sometimes being located close to the tool-holder, thereby providing for a greater length of feed.

The common practice of attaching the anchorage of the counterweight directly to the slide to be balanced does not provide a perfect means of sustaining the weight, because a slight backlash between the teeth of the pinion and gears connecting thereto may allow the tool or cutter to drop so that it will dig into the work. Therefore, some designers prefer to maintain a reverse tension against the feed pinion, and thereby sustain the weight of the slide and at the same time absorb backlash between the intermeshing teeth. A vertical milling machine having such a provision is shown in Fig. 16, where it will be seen that the end of the chain is secured to a wheel *A*, keyed on a shaft carrying a gear which meshes with the rack pinion. The latter may be operated by hand or power through the shaft *B*. On one

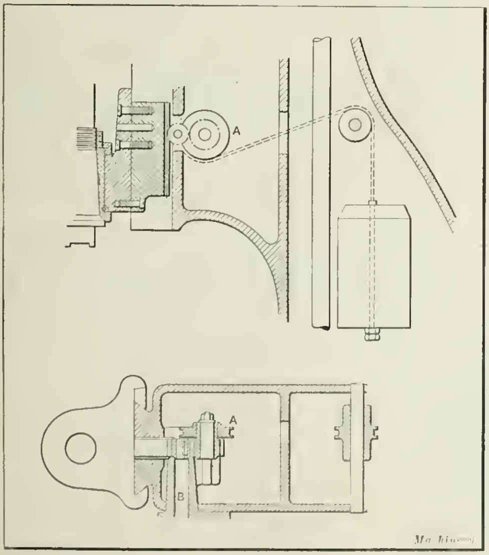


Fig. 16. Counterweight Arrangement for absorbing the Backlash between the Feed-gears

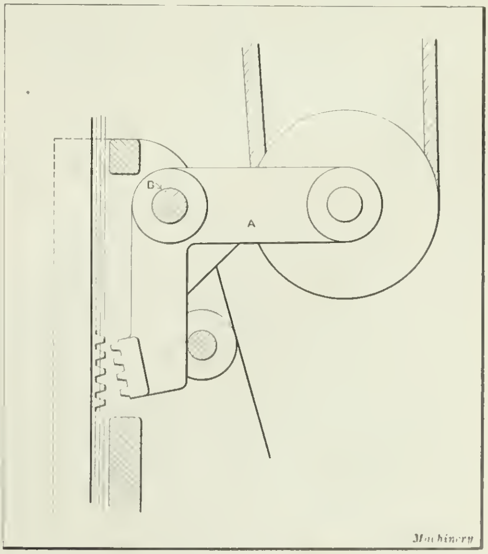


Fig. 17. Safety Arrangement for locking Slide or Spindle in Case Weight Chain fails

type of vertical turret lathe a modification of this principle is employed, the balancing effort being applied to the feed rack in the slide through a separate pinion, concentric with the feed pinion. In this manner an upward tendency is exerted against the teeth of the feed pinion.

The chances of a cable or its connections breaking are rather remote, as a high factor of safety is provided for. But if this should happen, the consequences would be much more serious in some kinds of machines than in others. The more costly effects, for example, would arise from the dropping of a gang of drills on the drilling machine table. To prevent such accidents, one of the machine tool builders furnishes an automatic safety catch of the kind illustrated in Fig. 17. Should the cable fail or the weights become detached, the anchorage arm *A* drops down, and in swiveling cn the pivot *B* throws the rack portion into engagement with the feed rack.

* * *

PUMPS FOR CORROSIVE LIQUIDS

The development of the chemical industry continually makes demands upon the manufacturer for apparatus of a special kind which is required to operate under conditions which call for properties entirely outside the ordinary characteristics of mechanical equipment. Attention is called to this question in a recent issue of *Engineering*. Strongly corrosive liquids have to be pumped and stored, often at a high temperature and considerable pressure, and not only must this be done with complete safety to the operators, but the apparatus must be neither dissolved, corroded or eroded in the process. Should the pumps, piping or vats be attacked by the substance in contact with them, their rapid destruction might be the least of the trouble. Any such attack would necessarily contaminate the chemicals with the dissolved material, and might easily be serious enough from this point alone to render the process impracticable.

When the conditions are very severe, pumps of the reciprocal type are out of the question, as the centrifugal pump with its natural simplicity of construction, its absence of internal rubbing surfaces and its freedom from valves possesses obvious advantages. Centrifugal pumps, therefore, are widely used for pumping corrosive liquids, and they are made of various materials. Ferro-silicon will resist some acids, but cannot be used for hydrochloric acid or in processes where contamination with iron must be avoided. Lead and regulus metal are also used for pumps, but are unsuitable for some acids and for solutions containing metallic salts. Ebonite pumps have been built, but these naturally will not withstand hot liquids, while certain chemicals will attack them. Moreover, ebonite is a bad material for rubbing surfaces.

The substance which is most generally suitable for resisting the action of corrosive liquids is some kind of silicious ceramic material, as this can be obtained in forms which are quite insoluble in almost any liquid. Ceramic material is also of a very hard nature, so that it is practically unaffected by erosion. Hence, in spite of its somewhat unsatisfactory mechanical properties, it has been brought into use for many purposes. A new acid-ware, called ceratherm, was prepared during the war under the necessity of finding some substance suitable for apparatus for the condensation of large quantities of acid gas. Like silica-ware, it can be plunged when red hot into cold water without cracking, and its good heat conductivity permits of a rapid equalization of temperature in vessels of which it is made.

A modified form of ceratherm, having a higher tensile strength, and possessing the further advantage of being more easily manufactured to accurate dimensions, has been adopted by Guthrie & Co., of Accrington, England, in the manufacture of their acid-proof pumps and other articles. The material is entirely unaffected by almost every chemical solution and may be brought into contact suddenly with either hot or cold liquid without any danger of cracking.

The requirements of the chemical industry usually call for a pump designed for lifting comparatively small quantities, say, from 20 gallons to 100 gallons per minute, against a head of anything up to 120 feet. Comparatively high efficiencies are claimed for these pumps, although when the total power absorbed is so small, the question of efficiency would not seem a serious matter. Pumps in this class have been built for a head of 300 feet, which corresponds to a pressure of 130 pounds per square inch in the pump casing. Some pumps have been constructed to deliver 400 gallons per minute at a head of 90 feet when running at 1000 revolutions per minute. They have been used successfully for some years on a commercial scale for pumping sodium peroxide, both hot and cold solutions, a substance which is very troublesome to pump and for which a metallic pump would be useless as the slightest particle of metal passing into the process would do considerable damage. There are other liquids such as hydrochloric, nitric and acetic acids, both hot and cold, that are also being handled successfully by pumps of this type.

* * *

DEVELOPMENT OF AUSTRALIAN INDUSTRIES DURING THE WAR

Many new industries were started in Australia during the war, mainly because it was found difficult to obtain many manufactured products from England or America. Among the industries in the metal-working field developed at this time may be noted those engaged in the making of copper tubes, sheet copper, cotton insulated electric wire, steel wire and bars, electrolytic zinc, non-ferrous castings, locomotive tires, and automobile bodies.

For many years prior to the war the iron and steel industries in Australia had been encouraged by means of subsidies from the government, but this plan met with only limited success. During the war, however, steel works were established in New South Wales. Largely due to the operation of these works, the value of iron and steel products imported in the form of pig iron, structural rolled steel shapes, girders, plates and sheets, and wire and rails was reduced from over £6,000,000 in 1913 to less than £3,000,000 in 1918. As a matter of fact, the tonnage imports decreased in even a larger ratio than is indicated by these figures, because of the large increase in prices during the period covered by these figures.

The Australian tariff policy, never too liberal, will in the future probably be still more centered upon protecting the industries started or expanded during the war, with the view that all Australian requirements, as far as possible, may be filled by Australian mills and factories. This applies especially to those industries the raw materials of which are available and produced in Australia.

* * *

RULES FOR HANDLING DIE-BLOCKS

The following rules for the handling of die-blocks are given by the Pennsylvania Forge Co., Bridesburg, Philadelphia, Pa., in a recent publication entitled "Die-blocks":

1. Never harden a block unless the impression has been carefully polished. Rough impressions are the cause of many failures.

2. Never charge cold blocks into a hot furnace.

3. Never rush heating operations. Take plenty of time and save trouble.

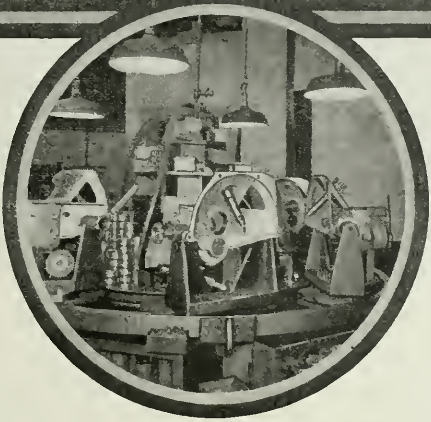
4. Never quench a block that shows uneven heating. If properly "soaked," the color and temperature will be the same throughout.

5. Never allow a block to become dead cold in the bath.

6. Never postpone the drawing of a die-block. Draw it immediately after hardening.

7. Drop-forging dies should never be stored in a cold, drafty place after hardening.

Machining Aluminum Automobile Parts



ON account of its lightness and other desirable physical properties, aluminum is finding a steadily increasing field of application in the construction of machine parts. For this reason, information concerning the most advanced practice in machining aluminum is a matter of considerable importance to men who are called upon to specify the methods of performing manufacturing operations. One point which is sometimes overlooked while deciding upon the conditions under which machining operations are to be performed on pieces made of this metal is that it can be cut at very high speeds. In planning all classes of machining operations on production work, the selection of the most desirable cutting speed should be based upon the attainment of the highest rate of output that is consistent with the frequency with which tools have to be ground. If a high rate is attained at the expense of excessive tool grinding, the advantage may be more than offset; and similarly, cutting tools may be protected from wear at the expense of production. The most satisfactory method of procedure is to secure a balance between these two factors, but in machining aluminum, speeds that would be too high in cutting almost any other commonly used metal can be successfully employed.

In constructing the Essex car, built by the Hudson Motor Car Co. of Detroit, Mich., the transmission case is made of aluminum having a minimum tensile strength of 16,000 pounds per square inch, with a minimum elongation of 1.5 per cent in two inches. In the accompanying operation sheets, information is given in regard to the order in which machine work is done on these parts. For each operation the cutting speed is tabulated, and reference to these data will be of interest to men who have occasion to recommend cutting speeds for use on aluminum, as it will serve to indicate the speeds under which representative machining operations can be performed on this metal. However, it must be borne in mind that in this case, as in all others where speeds and feeds are recommended, such suggestions serve only as a starting point in ascertaining what rates are best adapted to the requirements of existing conditions on each job. It is only by taking the average figures and then experimenting with rates above and below them, that the ideal conditions of speed and feed can be determined.

Machining Operations on the Essex Transmission Case

Fig. 1 shows the Essex transmission case, and in Table 1 there is presented complete information concerning the machining operations performed on this piece. On these parts

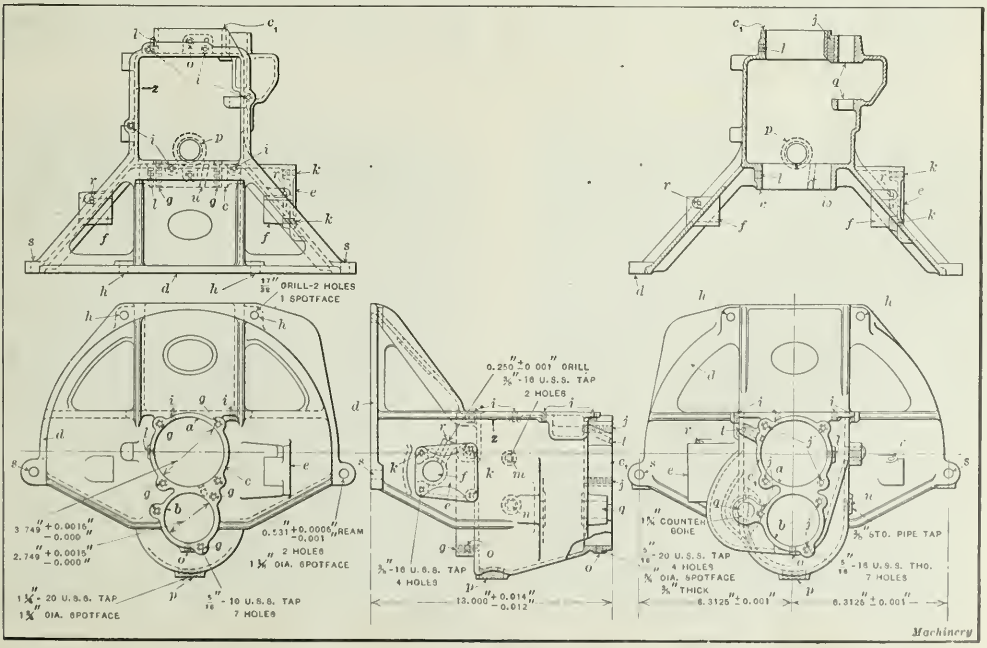


Fig. 1. Essex Transmission Case on which Machining Operations are to be performed

there are a number of operations which are of interest, owing to the jigs or other special tools that are employed on standard machines, or on account of the necessity of building special machines to afford an ideal method of handling the work. As an example of one of these special equipments, the reader's attention is directed to Fig. 2, which illustrates a special Barnes four-spindle horizontal boring and reaming machine that is utilized for operation in the main bearing *a* and countershaft bearing *b*, Fig. 1. On the bed of this machine there is a block that carries two finished pads, one of which is shown at *A*, Fig. 2. These pads engage a previously milled cover face *z* on the transmission case and afford a preliminary location. There are two V-blocks *B* carried by the pivoted cover *C*, which come down on the outside of cylindrical surfaces on the transmission case to provide for clamping it in place.

To facilitate operating the machine, it will be noticed that counterweights are provided at the back of the cover plate, so that when the latch *E* is turned to allow it to slide through a slot in the cover, these counterweights raise the plate without requiring the expenditure of physical effort by the workman. After a fresh casting has been put in the jig and the cover has been pulled down and secured by latch *E*, clamping of the work is accomplished by tightening a T-head bolt *F*. So far as the actual machining operations performed in the main and countershaft bearings are concerned, there is nothing of exceptional interest. It will be seen that there are two opposed spindles at each end of the machine, which provide for simultaneous operation in all four bearings, and it is this provision for handling all of the operations at the same time that is the point of exceptional interest on this job, as it not only saves time but also assures having the bearings bored in accurate alignment, which is a point of vital importance.

TABLE I. ORDER OF MACHINING OPERATIONS ON ALUMINUM CASES

Oper. No.	Name of Operation	Type of Equipment	Cut. Speed Feet per Min.	Prod. Time, Minutes
1	Rough-inspect	Bench	....	....
2	Mill face z, Fig. 1; bore bearings a and b	"Milwaukee" vertical miller and Barnes horizontal boring mill	420 and 175	5.91
3	Hand-ream bearings a	Stand and work-holding fixture	....	1.64
4	Mill front and rear bearing faces c and c_1	"Milwaukee" vertical miller	471	5.58
5	Mill front flange d	Special milling machine	576	2.42
6	Mill bracket e	Toledo hand miller	419	2.43
7	Drill and ream bearing f	Aurora drilling machine	103	3.05
8	Inspect	Bench	....	....
9	Drill seven holes g, two holes h, six holes i, and seven holes j	Baush multiple drilling machine	302, 101 and 98	3.65
10	Drill four holes k, two holes l, two holes m, and one hole n	Baush multiple drilling machine	100	3.35
11	Drill two holes o; drill, spot-face, and tap hole p; and drill and ream holes q	Aurora vertical and Carlton radial drilling machine	220 and 90	4.53
12	Spot-face, countersink and tap two holes l; spot-face two holes m; countersink and tap six holes i; spot-face, countersink, and tap two holes o; and spot-face holes f	Carlton radial drilling machine	104, 230 and 270	3.43
13	Countersink and tap seven holes g, seven holes j, two holes m, one hole n, and four holes k	Carlton radial drilling machine	145, 123 and 104	3.20
14	Drill two holes r	Kokomo drilling machine	114	0.55
15	Spot-face bearing q to length	Kokomo drilling machine	178	2.75
16	Drill holes t and w	Carlton radial drilling machine	190	0.92
17	Hand-ream bearings a and f	Stand and work-holding fixture	....	2.04
18	Line-ream bearings b and q	Stand and work-holding fixture	....	3.20
19	Finish-mill flange d	Special milling machine	336	2.60
20	Drill and ream holes s	Sipp sensitive drilling machine	134	1.85
21	Spot-face four bosses h and s	Sipp sensitive drilling machine	256	0.73
22	Press bushings in holes f	Greenerd arbor press	....	0.73
23	Line-ream bearing f	Bench and work-holding fixture	....	1.73
24	Wash and remove burrs from bosses m	Tank	....	0.35
25	Solder defects in castings	Soldering copper	....	....
26	Inspect	Bench	....	....

Machinery

TABLE 2. ORDER OF MACHINING OPERATIONS ON LYNITE PISTONS

Oper. No.	Name of Operation	Type of Equipment	Cut. Speed Feet per Min.	Prod. Time, Minutes
1	Inspect	Bench	....	....
2	Bore, face, and chamfer skirt a, Fig. 5	Warner & Swasey turret lathe	750	0.80
3	Center boss b and face end c	Warner & Swasey turret lathe	880	0.48
4	Turn outside diameter d and rough out grooves e	Porter-Cable short-bed lathe	435	0.93
5	Finish ring grooves e	Porter-Cable short-bed lathe	287	0.98
6	Drill, bore, and ream wrist-pin holes f and cut oil-grooves	Warner & Swasey turret lathe	150	1.6
7	Mill faces g	Briggs milling machine	245	0.30
8	Chamfer face h	Burke milling machine	120	0.42
9	Drill two oil-holes in face h	Leland-Gifford drilling machine	60	0.63
10	Chamfer wrist-pin holes at i	Sipp drilling machine	200	0.22
11	Drill four oil-holes j	Sipp drilling machine	40	0.27
12	Mill oil-grooves in wrist-pin holes f	Sipp drilling machine	160	0.34
13	Grind clearance k	Landis grinding machine	5700	0.56
14	Rough- and finish-grind outside diameter d and clearance on lands l and m	Special grinding machine	5700	1.34
15	Finish-face surface c	Porter-Cable short-bed lathe	1060	0.70
16	Remove center boss b	Sipp drilling machine	275	0.28
17	Broach wrist-pin hole f	Atlas arbor press	....	0.55
18	Hand-ream wrist-pin hole f	Bench and work-holding fixture	....	0.77
19	Mark center line on face c	Bench and gage	....	0.15
20	Wash and dry	Tank and cloths	....	0.10
21	Final inspection	Bench	....	....

Machinery

Milling the Bearing Faces

In Fig. 3 there is illustrated a vertical-spindle Milwaukee milling machine which is employed for milling the front and rear faces *c* and c_1, Fig. 1, of the main and countershaft bearings. The feature of this job is the provision that has been made for milling both ends of the bearings on a single machine by providing two work-holding fixtures. The fixtures utilized for this purpose are of quite simple design, consisting of two pilots that enter the main and countershaft bearing holes at *A* and *B* to provide for locating the work, these holes having already been bored so that they are available for use as accurate locating points. It will be apparent that the fixtures are so arranged that the front and rear surfaces of the bearings on the two castings are held at the same level, thus enabling a single milling cutter to be brought easily into engagement with the second piece of work after it has completed its operation on the first piece of work.

Very little pressure is required to hold the castings for performing these milling operations, as the thrust is downward; but on the left-hand fixture it will be seen that a hold-down bar *C* is provided, which is slipped into a hole in the base of the fixture with the bar in engagement with the lower side of a square opening in the transmission case. On the right-hand fixture, there is a clamping member *D* which enters the same opening as bar *C*; but clamp *D* is made of sufficient width so that it extends practically the entire distance across the opening in the casting. With a duplex work-holding fixture of this kind, the milling machine operator is kept constantly employed, because while the cut is being taken on a casting held in one fixture he is able to occupy his time by removing the milled casting from the other fixture and setting up a new piece in its place. It will be obvious that with this arrangement a great saving in time is effected.

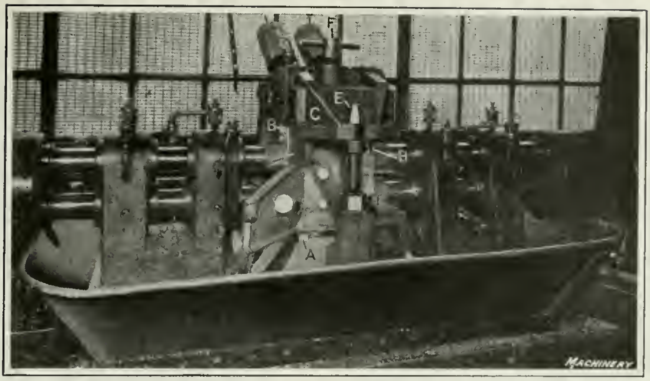


Fig. 2. Special Quadruple Opposed-spindle Machine for boring the Main Shaft and Countershaft Bearings in Essex Transmission Cases

Flange Milling Operation

Fig. 4 shows a special milling machine developed for use in facing off flange *d*, Fig. 1, of the Essex transmission case. For the performance of this job, the main bearing is again used as a locating point for the work, which is secured on a pilot *A* entering this bored hole. As there is but a single milling cutter *B* which occupies a fixed position on the machine, it will be evident that provision must be made for feeding the work to the cutter. This result is accomplished by having the arbor that carries the transmission case casting so located in relation to the cutter-arbor that by rotating the work-holding arbor by means of a handle *C* at the rear of the machine, provision is made for swinging the flange of the casting over the cutter *B*, and thus facing it off in the desired manner. This arrangement constitutes a very simple and at the same time, a very rapid method of performing the required milling operation.

Assembling the Transmission Case

The progressive principle is applied in assembling Essex transmission cases, but the arrangement of the work-benches utilized for this purpose is somewhat different from that commonly employed. Reference to Fig. 6 will make it apparent that the benches are of circular form, instead of being straight, which is the more common arrangement. There is a circular track running around each bench on which work-holding fixtures are free to travel, the transmission case casting being so mounted on its fixture that it may be swung into almost any desired position to give convenient access to the particular point at which a part of the mechanism must be attached. Contained in cabinets beneath the level of the bench, and also in bins on the pyramid shaped stand above the bench, there are supplies of the various parts that must be assembled into the transmission. Following the usual practice in progressive assembling, the men are stationed around these circular benches so that as soon as one man has completed his part of the work, he pushes the fixture along to the operator working next to him, so that this man may proceed to do his part and then push the partial assembly along to the next man in the line. The particular feature of these circular benches is that for conditions that exist in the Essex shops, it is more convenient to employ them than to adopt the use of long straight benches. Doubtless the same arrangement could be employed in the assembling departments of many other plants with equally successful results.

Machining the Essex Piston

Essex engines are furnished with pistons made of lynite which is essentially the same as aluminum, so that the previous remarks relative to progressive practice in performing machining operations on parts made of aluminum applies with equal force in the case of lynite which is finding general application in metal products where a combination of strength and lightness is required. Fig. 5 illustrates the Essex piston, and in Fig. 7 there is shown a close-up view

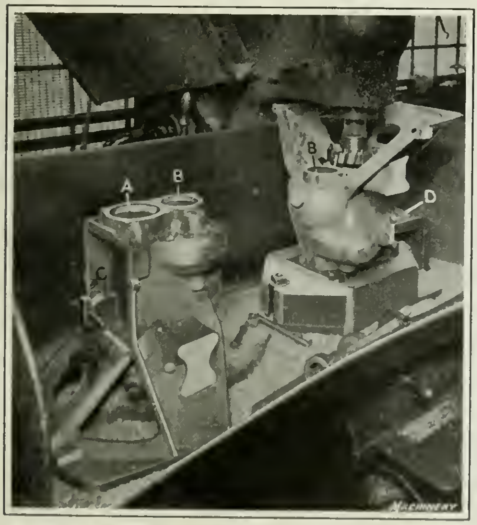


Fig. 3. Vertical-spindle Milling Machine equipped with Double Jig for facing Ends of Main Shaft and Countershaft Bearings

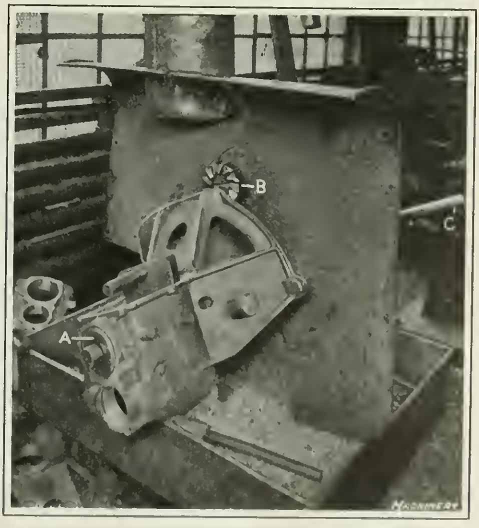


Fig. 4. Special Rotary-feed Milling Machine designed and built for Use in facing the Flange of Essex Transmission Cases

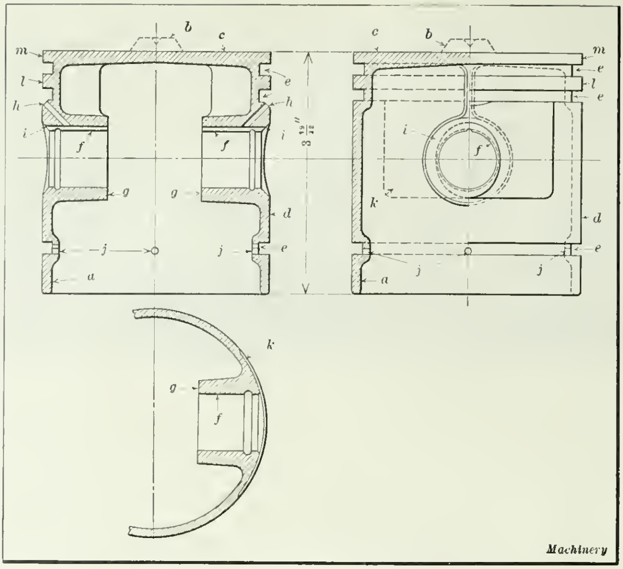


Fig. 5. Essex Piston on which Machining Operations are to be performed

of a Porter-Cable short-bed lathe which is equipped for cutting the ring grooves in the piston and for turning the outside diameter. Lathes of this kind are especially well adapted for performing operations on such parts as motor car engine pistons, because the work is of small size, and ample capacity is provided on a short-bed lathe, without taking up an unnecessary amount of floor space in the shop. In the case of the machine shown in Fig. 7, the three tools *A* carried at the back of the cross-slide are utilized for rough-turning the piston ring grooves, and tool *B* at the front of the carriage is employed for rough-turning the outside diameter of the piston. At the front end of the piston, the work is supported by an ordinary lathe center which enters a hole drilled in boss *C* that is left on the piston for that purpose. At the opposite end there is a special center *D* that is mounted on the lathe spindle to provide for entering the bored skirt of the piston, shown at *a* in Fig. 5.

Drilling Two Oil-holes

Reference to Fig. 5 will make it apparent that two oil-holes *h* are drilled diagonally from the middle ring groove into the bearing holes for the wrist-pin. Fig. 8 shows a Leland-Gifford sensitive drilling machine equipped for the performance of this operation. From Table 2 it will be seen that the first step is to bore out the skirt of the piston at *a*, and that this point is used for location in performing many of the subsequent operations. In providing for drilling the wrist-pin oil-holes, there is a pilot extension on disk *A* which fits into the bored skirt, and a smaller pilot that extends up into the piston with a hole in it through which pin *B* can be slipped. This pin also extends through the wrist-pin holes in the piston and provides for clamping the work by tightening screw *C*, which draws the arbor and pin *B* in toward the base of the fixture. The arbor is splined so that it cannot turn, and pin *B* serves the additional purpose of locating the oil-holes to be drilled in the proper relation to the wrist-pin bearings. It will be obvious that the drill bushing is located at *D*, and after one of the two holes *h*, Fig. 5, has been drilled, the work is released from the fixture and reset at 180 degrees from its first position, ready for drilling the second hole.

Grinding Clearance on Pistons

It is required to grind a clearance of from 0.010 to 0.015 inch under the gliding surface of the piston adjacent to each end of the wrist-pin bearings, and for that purpose use is made of a Landis cylindrical grinding machine. The form of the clearance to be ground is clearly indicated at *k* in Fig. 5. For the performance of this operation, the work is mounted in a manner quite similar to that employed on the Porter-Cable lathe shown in Fig. 7, an ordinary center *A*, Fig. 9, being utilized at one end, while a special center

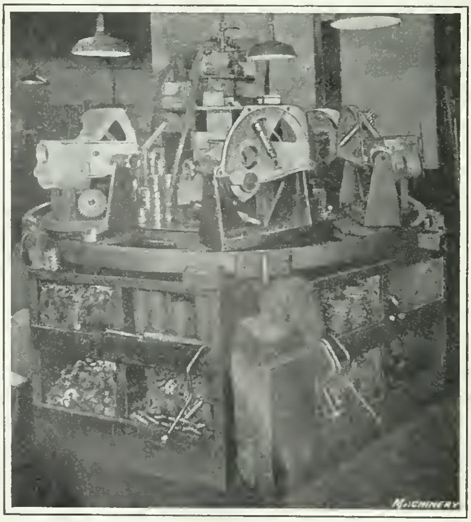


Fig. 6. Progressive Assembling Bench that carries Fixtures around a Circular Path where Parts to be assembled are distributed

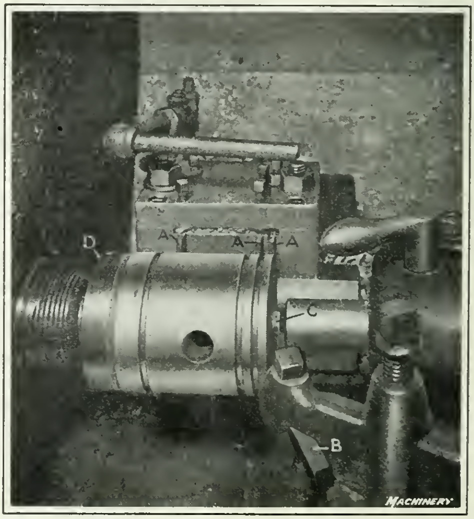


Fig. 7. Turning the Outside Diameter and roughing out the Ring Grooves of Essex Pistons on a Short-bed Manufacturing Lathe

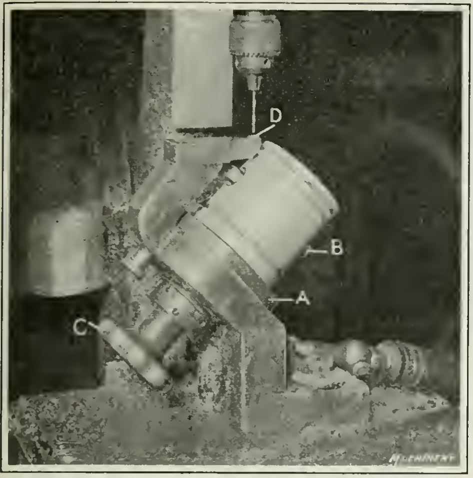


Fig. 8. Jig for drilling Two Inclined Oil-holes leading to Wrist-pin Bearings

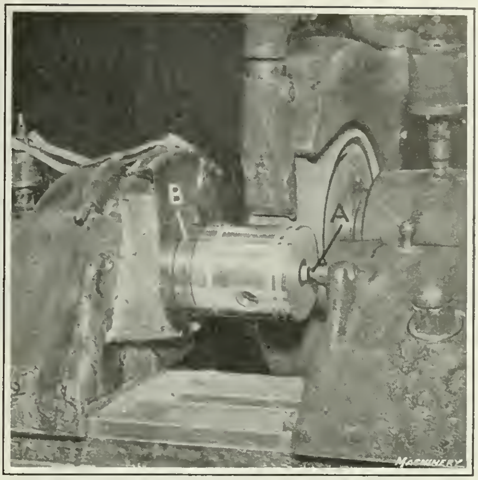


Fig. 9. Cylindrical Grinding Machine equipped for grinding the Clearance on Essex Pistons

B at the other end enters the finished opening *a*, Fig. 5, at the base of the skirt.

Conclusion

On account of the fact that this article deals with the machining of motor car parts, it may appear that it should prove of the greatest interest to those engaged in automobile manufacture; but it may be pointed out that the information contained in this article, relating to the conditions under which aluminum may be machined, is applicable to any industry where aluminum is employed, and will prove of value not only to those engaged in automobile building, but to all readers who have not had much experience in the machining of aluminum.

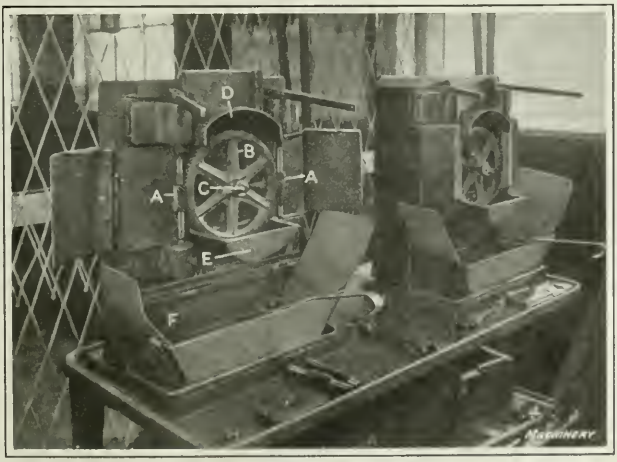
* * *

MACHINE FOR LAPPING MULTIPLE WORMS

The accompanying illustration shows two special machines built by the De Laval Separator Co., Poughkeepsie, N. Y., for the purpose of lapping the threads of the multiple-threaded worms carried on the vertical spindle which drives the cream separator bowl. The worms, shown at *A* in the illustration, are integral with the steel shaft, and have seven threads. The lap employed is a phosphor-bronze worm-wheel *B*, exactly like the wheel with which the worm threads mesh when in service on the cream separator. These improvised laps are mounted on a driving shaft *C* which is gear-driven for the purpose of stepping up the speed to approximately the amount that is used on the cream separator, that is, from 6000 to 9000 revolutions per minute.

The worms to be lapped, run in mesh with the lapping wheel. One of these worms is held vertically on centers at each side of the wheel as clearly shown in the illustration. The driving shaft has a bearing in the slide *D* to which a vertical reciprocating motion is imparted by means of a cam attached to the inside of the driving gear on the back of the machine. A trundle roll, located below the slide, supports this member by reason of its contact with the cam, so that as the cam revolves with the driving gear, the entire unit, slide, gear, cam, and lapping wheel, is raised and lowered. A suitable coil spring is employed to maintain contact between the roller and the cam. As the revolving worm-wheel lap is traversed up and down in mesh with the threads of the two worms, which are held in a fixed position, it carries a liberal mixture of oil and four-minute carborundum in its teeth. It will be apparent that this lapping compound is carried in trough *E* and that the worm-wheel picks up the mixture as it revolves. The action of the worms and wheel under these conditions will result in lapping the worm threads into perfect running engagement with the teeth of the worm-wheel. The time required to lap the threads to the desired degree is approximately three minutes.

In the illustration the machine at the right is shown as it appears when in operation, while in the case of the machine shown at the left, the guards used to enclose the worms and keep the lapping compound confined, are open for the purpose of enabling a clear view of the worms. The guards catch the lapping compound thrown against them so that it will drip down into the supply can *F*. It is the duty of the operator to keep the trough sufficiently filled with the lapping compound taken from a supply can so that the wheel will be submerged a depth equal to at least that of the teeth. F.R.D.



Special Lapping Machine for lapping Threads of Seven-threaded Worm Screws

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MACHINERY'S ANNUAL INDEX

The yearly index to the twenty-sixth volume of MACHINERY for September, 1919, to August, 1920, is now ready for distribution. Copies will be sent upon request.

* * *

INCREASED BUYING CAPACITY OF THE RAILROADS

The increased freight and passenger rates which have been granted to railroads by the Interstate Commerce Commission will bring an additional revenue of about $1,400,000,000 or $1,500,000,000 to the railroads annually. The railroads were allowed about 90 per cent of all that they asked for, and it has been determined that with present rates, they will earn approximately 6 per cent on an investment which has been estimated by the Commission at $18,900,000,000. Of the additional revenue that will be earned by the railroads under the new rates, $625,000,000 will go toward the wage advances allowed by the Railway Labor Board a couple of months ago, while the remainder—nearly $1,000,000,000—will add to the purchasing capacity of the railroads and enable them to obtain much needed equipment—locomotives, passenger and freight cars, and more efficient equipment for the railroad shops.

It is expected that the added revenue will enable the railroads to increase their efficiency so that they can cope with the increased demand for freight service—in which respect they failed during the past year. With additional freight cars and increased average car movement per day, in addition to shop facilities that enable the railroads to keep their locomotives and cars in first-class condition, railroad service—both passenger and freight—should greatly improve. Daniel Willard, president of the Baltimore & Ohio Railroad states that the responsibility now rests with the railroad managers. The government has done its part. The improvement, of course, cannot be immediate, but within six months or a year there should be a noticeable change. Meanwhile, the railroad shops will be equipped with modern machine tools enabling them to handle the repair work in a more efficient manner than in the past. This will bring additional business to machine tool builders and will aid in keeping this basic industry busy.

* * *

THE DESIGNER AS A PRODUCER

The designer is often classed as a non-producer in spite of the fact that he may be, and often is, one of the greatest producers in the plant, measured by his ability to increase production. The man running a high-power heavy-duty machine may at the end of the day be able to point to a large pile of finished parts; here we have direct proof of the fact that he is a producer. But the designer cannot readily present such concrete evidence, especially to those unacquainted with his fundamental work. The value of a designer as a producer becomes apparent when we consider the relation the design of the parts of the machine to be built bears to the output. The experienced designer not only considers the intended use of the part and the required strength, but how the casting or forging can be modified to increase production and still serve its intended purpose; it is here that the direct relation between designing and producing is apparent.

The cost of manufacturing is often greatly reduced by simple changes in the general shape of a part, by the use of temporary lugs or flanges for holding it in a chuck or fixture, by the coring of internal grooves and recesses to avoid unnecessary machine work, and so on. While the function of the member and its strength are usually considered first, the designer's work with reference to economical manufacturing practice may be the most important part of his duties. The designer who understands manufacturing practice is often the direct cause of higher rates of production in the machine shop, pattern shop, foundry, and forge shop. When originating jigs, fixtures, dies, special cutting tools, etc., the designer has much to do with the rate of production. Such gains, whether resulting from the design of the product or of special tools used in its manufacture, may in the case of standard parts be effective for years, and represent large dividends on the hours or days spent in perfecting the design. The designer's opportunities as a producer are almost limitless, and his practical value should be measured in terms of the output of both the drafting-room and the shop.

* * *

BUSINESS TRAINING IN ENGINEERING SCHOOLS

Years ago engineering was considered a science that should be kept as far apart as possible from commercial and business considerations. The engineer was supposed merely to develop engineering ideas while others attended to the business problems connected with the engineering undertaking. It was soon found, however, that engineering and business were closely related, especially when the engineer occupied an executive position, and that he should have, in addition to his engineering training, a business training as well. At the present time, therefore, there is a general movement in technical schools and colleges toward the teaching of business administration as well as engineering. Stevens Institute of Technology, one of the pioneers in this development, for over twenty years has given its students instruction in the commercial and business side of engineering. The Massachusetts Institute of Technology has followed with what is probably a still more extensive course in engineering administration, combining instruction in general engineering subjects with a study of the methods, economics, and laws of business.

There will be a greater harmony, economy, and efficiency in the operations of industrial and manufacturing enterprises when engineers have a better conception of business practice, and the engineering schools can render a great service by educating their students in correct conceptions of the relations between business and engineering.

The Industrial Outlook in Europe

By ALEXANDER LUCHARS, Publisher of MACHINERY

THE published views of travelers about European conditions differ as widely as the election prophecies of politicians, and neither the extremely pessimistic nor optimistic statements appear to the writer to be accurate. In some countries, notably Belgium and France, there has been steady industrial improvement during the past year. Labor in those countries has virtually quit striking and gone to work producing. Government employes in France are prohibited from joining the trade unions, and those they have formed have been ordered dissolved. In Great Britain an industrial reaction is in progress and conditions are not so good as in 1919, but they will improve if the coal strike is settled, as many hope. The present set-back should be only temporary. In Germany conditions have lately become decidedly worse; the people are completely discouraged over the outlook and the financial situation appears to be beyond the capacity of the government to handle. In Italy they are approaching chaos on account of the apparent weakness of the government, which lacks sufficient popular support to return the seized factories to their owners.

The first consideration for American manufacturers who are interested as sellers in foreign markets, is whether future European trade is worth fighting for through the uncertain years just ahead. The answer, of course, is that we must either continue to fight for those markets or give them up indefinitely. Foreign markets for machine tools that are lost now, cannot be regained by the easy pre-war efforts when competition from foreign manufacturers was negligible. The fluctuating value of the dollar in Europe is one of the main difficulties of selling American products.

Great Britain

In spite of the overhanging miners' strike and the drop in automotive production, the general feeling is optimistic. Nearly all the engineering establishments are busy. The return of plants to peace conditions has been practically completed, although some concerns like the large armament makers have great difficulty in adapting themselves to new conditions, owing to the nature of their plants.

The Olympia exhibition, organized by the Machine Tool Trades Association, which opened at Olympia early in September, was larger than any similar exhibition ever held in this country. All the space in the great building was occupied by over two hundred exhibitors of machinery. Further details will be found in the article "The Machine Tools at the Olympia Exhibition" on page 123.

Prices of Machine Tools in Great Britain

The average increase in machine tool prices since August, 1919, is about 25 per cent, made necessary by the increased cost of material and labor. British manufacturers do not readily give out their current prices, but the following figures, representing the principal groups of machine tools, are reliable:

	Prices in £'s 1919	Percentage Increase, 1920
Engine lathes, 17-inch swing	160	25
Engine lathes, 12½-inch swing	175	20
Engine lathes, 9-inch swing	80	38
Shaping machine	200	25
Shaping machine	145	10
Horizontal boring and milling	900	15
Radial drilling machine	220	40
Plano-milling machine	900	15

The following are specific merchants' quotations for new tools:

Pickersgill 20-inch swing by 10-ft. bed gap lathe	£275
Cunliffe & Coom 6-inch slotter	110
Gridley 2¼-inch, four-spindle automatic	800
Vertical miller, Smith & Coventry, Model C	920
13-inch swing Yorkshire lathe with chuck	100
Pedestal drilling machine, 1¼-inch capacity	58

Examples of recent quotations for imported German machines are as follows:

Single-spindle ball bearing sensitive drilling machine, drilling up to 13/16-inch diameter	£38, 10s.
20-inch swing lathe, Heudey type, with 4-ft. 6-inch bed	£320
Universal milling machine with table 33 by 9 inches	£330

Government machine tool sales have dropped off, although the distribution of such tools did not apparently lessen purchases from the makers. Rather, this source of supply proved of use in reconstruction work, as such tools were available for immediate delivery following the war and helped production at that time. The prices obtained at some of these sales exceeded those for new tools, or tools "re-conditioned" by the manufacturers. At a recent government sale several 15-inch swing all-geared lathes brought £210 each, average; the same tools were offered new at £175.

Labor and Wages in Great Britain

A comparison between labor costs in Great Britain and America is of special interest to our manufacturers, as that determines our ability to sell our products abroad in competition with British manufacturers.

In the engineering and shipbuilding trades, wage advances over pre-war rates amounted to 3s. 6d at the end of February last for men on time rates, together with a bonus of 12½ per cent on total earnings; and for men on piece work a general advance amounting to 26s. 6d per week, together with 10 per cent on pre-war prices and a bonus of 7½ per cent on total earnings. In March last a further advance of 6s. on the base rates, with a corresponding advance to piece workers was awarded by the Industrial Court. Thus a turner's average wage has increased from 36s. in 1914 to 64s. 6d. plus 12½ per cent in 1919, and today is 75s. 6d, plus 12½ per cent. The system of payment by results does not appear to make much headway.

France

The sale of new American machine tools is almost at a standstill in France, but a fair business is being done in small tools and considerable in second-hands. Few German machine tools are being sold on account of advanced prices and delay in deliveries, but German small tools are now coming in. Before the war some of those compared favorably with American products.

The French automobile manufacturing industry has recently undergone a severe setback, most of the largest works having cut down their output.

French manufactures and exports have so increased in volume that as soon as raw material is available the industrial future appears secure. On July 1, 1920, nearly 77 per cent of the French factories had resumed work, and their output was 65 per cent of the 1914 production, as compared with less than 10 per cent of the same production in July, 1919. French exports for the first 8 months of this year were 14,406,438,000 francs, compared with 5,743,218,000 francs for the corresponding period of last year, and the largest part of this increase was in manufactured products.

Germany

The machine tool business was dull during the spring and summer, with no indication of improvement as autumn approached. Manufacturers had considerable stocks on hand for prompt delivery, but domestic prices were firm, as there was no prospect of a reduction in labor or other costs. The official prices for exports have been reduced, but this has not stimulated sales. Some manufacturers in the automotive and other machinery industries have been running on half time since August, with a considerable reduction in the number of hands employed. Industrial conditions generally are worse than a year ago.

Spain and Italy

Machine tool business was fairly good in Spain earlier in the year, but recently has fallen off and lately few orders were being placed. This market, although a limited one, should increase to a moderate extent and warrant cultivation by American manufacturers of machine tools that can be sold in competition with European products.

Italy has an abundance of labor, and in the early summer was making fair progress toward industrial recovery, when the Mechanics' Labor Federation demanded a further increase of 60 per cent in wages. The refusal of the Master Mechanics Association to grant this increase was followed by the seizure of factories in the metal manufacturing districts, and the development of conditions which resembled those of the beginning of the Russian Revolution. Some of the workmen's ideas were represented by the following printed regulations issued in August by their leaders:

1. Production must be reduced to a minimum.
2. Work must be simulated, thus obviating any absurd pretext of the management to resort to dismissal or lock-out.
3. No files or other tools must be used unless they be in perfect order and fully suitable to the job on hand.
4. Every repair to machinery must take the longest possible time.
5. Nobody, and for no reason, must attend to a different job from the one on hand, such as repairs, oiling, etc.

Lastly, should the firm dismiss workmen, these must take no notice of the dismissal, and must continue to re-enter the factory. Should the managers then resort to forcible ejection, the operatives must proceed to violent acts. Should a lock-out be enforced, the works must be re-entered at all costs, even to breaking in.

Some of these read like jokes, but they are not.

Switzerland

The eight-hour day has brought a considerable increase in the cost of manufacture and has also affected the prices at which Swiss products are sold. The Swiss watch-making industry is not yet selling its normal product on account of the financial conditions in the usual markets. Most watch manufacturers are running on reduced schedule, some as little as three days a week. There is a fair demand for American machine tools, but this has been somewhat affected lately by the efforts of a group of Swedish manufacturers, called the Swedish Machine Tool Makers' Export Co., Ltd., of Stockholm, which has been making a canvass of Swiss factories for possible customers.

During the year 1919, and especially during the latter months of that year, the Swiss bought considerable amounts of German machine tools, but the increase in prices and the delay and uncertainty of delivery since the beginning of 1920 has largely cut down the sales. Swiss buyers say that German machine tools are not up to their pre-war standard.

Sweden, Norway and Denmark

The rate of exchange for dollars makes it impossible to buy American tools except for special work and such tools as cannot be obtained elsewhere, and manufacturers are trying to get along with Scandinavian tools, waiting for the rate of exchange to become more reasonable. During the war a number of Scandinavian manufacturers took up the manufacture of machine tools and are now making fairly good machines at a lower price than the American product The increase in the prices of German tools has affected their purchase and comparatively few are now coming into Scandinavia. Although the general industrial situation there is similar to that prevailing all over Europe, the better dealers do not feel discouraged over the future.

During 1919 German machine tools were offered in Sweden so cheaply that many of the large manufacturers anticipated future machine tool demands by buying for the equipment of plants not yet in operation. A concise but comprehensive review of the present conditions in the Swedish machine tool industry was given in the article by Oscar Lindbom in the August number of MACHINERY, page 1130.

Belgium

The production and sale of Belgian manufactures continues to increase phenomenally, the total exports for the first five months of 1920 being nearly fifteen times those of the same period of 1919. The general industrial situation in Belgium continues favorable, many shops having work for months ahead. Lately, however, orders have dropped off, due perhaps to the confused political outlook or to the curtailment of banking facilities.

Some dealers complain that the delay in deliveries of American tools caused by strikes here will help the sale of German tools in that market. The larger and better known concerns are not buying in Germany unless they cannot get machines elsewhere. Most of such purchases are made by small and unimportant firms.

Russia

In response to numerous inquiries about conditions in Russia and the outlook there, I obtained information from several reliable sources up to as late as August last.

General conditions have been correctly described by correspondents of American journals who have been permitted to see the favorable side. One of my correspondents is an Austrian engineer who was a prisoner in Russia for four years, and after his release visited Petrograd, Moscow, and other industrial centers. He said that all railroad shops, machine shops and factories, including those belonging to foreigners, are now owned, and some of them operated, by the state and managed by commissars. Terror is the factor used for control. No commissar can tell when he may be removed by a meeting of workmen or by some remote authority above him. The legal day is supposed to be eight hours, but men work from two to four hours, spending the remaining time in smoking, talking and political discussion. The wages in machine shops vary. In Petrograd and Moscow from 4000 to 6000 rubles a month are paid; in Siberia from 1500 to 2000. There is no such thing as liberty in Russia, but there is deep and widespread dissatisfaction with Bolshevism, although no one dares to say a word against it for fear of being put in prison or shot.

The most primitive methods prevail in what machine shops are running, each commissar working according to his own ideas. Material is almost unobtainable, and that is not to be wondered at, because it is not usually paid for. The shop equipment is, to quote, "in awful condition," and most of the small tools have been stolen. About 80 per cent of the locomotives are "sick," and are to be seen stalled along the railroads. Traveling is almost impossible even if a ticket is obtained, and only commissars can obtain them. Others wait for weeks unless they pay someone with influence to get a ticket for them. The most rabid Bolsheviks are now turning against the present tyrannies, and if an organized movement of the people were possible, or a series of victories gained by an outside army, the present rulers would quickly disappear.

Machine Tools at the Olympia Exhibition

Editorial Correspondence

London, September 16

THE British exhibition of machine tools and accessories, held at Olympia, near London, in the early part of September, was the great event of the year in the British machine tool industry. One of the main objects of the Machine Tool Trades Association of Great Britain in promoting the exhibition at Olympia—the first to be held since 1912—was to extend the export trade in machine tools. During the war, the machine tool manufacturers were so occupied in satisfying the requirements of munition makers that the overseas markets were neglected, and in fact the Ministry of Munitions would permit the export only of such machine tools as would be likely to help in the production of munitions for allied countries.

In order to bring as many foreign engineers to London as possible, for the exhibition, a widespread scheme of publicity was organized, upward of 12,000 invitations being issued to engineers all over the world. Every inch of the great floor space of the Olympia building was booked, and although new designs were not numerous, the exhibits generally emphasized the point that the importance of mass production has been brought home to the British machine tool industry to an extent which assures buyers of quality and uniformity of production, which have been the chief features of the American competing machines.

Outstanding developments are featured in the exhibits of the Associated British Machine Tool Makers—a group of leading manufacturers who are combined with the express object of promoting and developing standard machine tools. These firms between them cover, as far as customary machine shop requirements are concerned, all the needs for a manufacturing installation. The policy of confining their attention each to one particular branch of the machine tool field has permitted the concentration of accumulated experience to specific essentials. The association is doubtless destined to have a far-reaching effect on the machine tool trade of Great Britain. The constituent firms include such firms as Smith & Coventry, Ltd., Lang & Sons, Ltd., and William Asquith & Co., Ltd., who with other well-known makers are working in a cooperative manner and specializing along individual lines. The exhibit of Alfred Herbert, Ltd., was also very comprehensive. American machines were shown in great numbers, mainly at the stands of the great merchant houses of Burton, Griffiths & Co., Ltd., and Charles Churchill & Co., Ltd., but German machines were rigidly excluded due, not to the fear of German competition, but to the policy that the Machine Tool Association adopted during the war when the exhibition was projected.

New Machine Tools Exhibited

As was to be expected, a great many of the machine tool manufacturers showed new designs at the exhibition. There were a great many radical departures, and many improvements on older types. It would not be possible in the following to mention all the new designs or improvements that were on exhibition, but attention will be called to a few of the more important.

The Alfred Herbert Exhibit

Alfred Herbert, Ltd., Coventry, occupied not less than nine stands. New and redesigned machines included a No. 20 combination turret lathe fitted with a new type of head having a 7-inch hole through the spindle instead of the previous bore of 4½ inches; No. 9 combination turret lathe fitted with quick-power motion to the turret slide, power rotation to the turret, and single-pulley drive; No. 13 hexagon turret lathe with a sixteen-speed headstock; a new No. 5 auto-lathe, which is fully automatic in all operations except chucking, stops automatically at the conclusion of the work, and has automatic speed and feed changes that can be made while the tools are cutting. An outstanding novelty is a 4-foot radial drilling machine built by Tangye's, Ltd., to Herbert designs. The features are an arm of circular section giving a three-point bearing to the saddle, an instantaneous electrical reverse, lubricant circulated by an independent motor, a speed range of from 28 to the unusually high maximum for a machine of this class and size of 547 revolutions per minute. Then there is a new 50-inch broaching machine with two speeds and single-pulley drive; a cold-sawing machine fitted with a chip removing device; a Tangye axle-turning lathe with diameter and longitudinal stops, and a Tangye axle-ending and centering machine, the high productivity of which is aided by such improvements as a constant quick-power traverse to heads and saddles, and an additional tool-rest with automatic feed for turning the axle collars while the tool in the front rest faces the ends. Sample sets of precision sizing blocks are shown, for which the firm is arranging to act as sole distributor for the Pitters Ventilating & Engineering Co., which has taken over the manufacturing rights under the Brookes & Sears patent. The size blocks are accurate to one part in one million in all sizes down to 1 inch, and uniformly to the same accuracy for smaller sizes. Alfred Herbert has now a new gage department, and has introduced an indicating plug gage giving "Not Go" effective diameter readings; and also a universal thread measuring machine giving readings to 0.00001 inch.

Turret Lathes, Screw Machines and Automatics

H. W. Ward & Co., Ltd., Birmingham, have introduced a new 7-inch center all-geared hand screw machine of attractive appearance. The headstock has eight spindle speeds, to each of which reversing motion is applied, and the spindle has a 2⅛-inch bore. A special new patented quick-withdraw motion is included in the cross-slide, whereby the nut is withdrawn from the work. The turret is of the usual form, but has ten automatic feeds which are entirely independent of those of the cross-slide. The firm's 7-inch center combination turret lathe has many of the features of the foregoing machine, but is capable of dealing with a heavier class of forgings and castings, also bar work up to 18 inches long. The third is of a powerful rigid dual-purpose type, designed for production from the bar, castings, and forgings. The headstock is of the all-geared type, having eight speeds forward and reverse. The spindle has a bore of 4½ inches through its entire length. The turret is of hexagonal form mounted on a saddle having longitudinal motion by hand and power feed along the bed. Ten automatic feeds are available through the gear-box beneath the headstock and these feeds are independent of those of the cross-slide. Quick power traverse and automatic rotation are provided. The cross-slide has hand and automatic motions.

Thomas White & Sons, Ltd., Paisley, have concentrated on a new line of automatic screw machines. Built in three types, the machines comprise a universal machine for average machine shop bar work up to 1 inch or 1¼ inches diameter, and a larger machine for bar work in three sizes from 1½ inches up to 2½ inches diameter, also a special manufacturing type of machine for use where a large repetition output is required.

Thomas Ryder & Sons, Ltd., Bolton, exhibited an automatic piston and piston ring manufacturing lathe, which will simultaneously turn, bore, and cut off bushing castings into rings. Concentric or eccentric rings can be produced with equal facility.

Lathes

John Lang & Sons, Ltd., Johnstone, showed a new 6½-inch center automatic screw-cutting lathe. This machine is a new design specially intended for automatically cutting internal and external screw threads. After the lathe has been set up and started, it is entirely automatic in all its operations until the full depth of the thread is reached, when a device comes into operation which limits the movement of the tool-slides and prevents the tools from feeding any deeper into the work.

Drummond Bros., Ltd., Guildford, exhibited, as an entirely new departure, a spiral hob relieving lathe, which is primarily intended for tool-room work in hob and tap making, and similar work of a precision nature. The lead-screw is made to very close precision limits and together with the headstock spindle is hardened and ground.

The Centaur Works showed a 5-inch center brass finishers' lathe. In the automatic turret machine class the Centaur Works also showed a three-operation automatic machine for bars up to ⅜ inch diameter.

Archdale Automatic Milling Machine

James Archdale & Co., Ltd., Birmingham, have introduced a new type of automatic horizontal milling machine especially suitable for quick cutting and rapid handling. The work, after it is secured to the machine table, is quickly carried to the cutters, when the cutting rate of traverse is engaged and the cut proceeds. At the end of the cut the feed is tripped, the cutters are stopped to prevent them marking the work and the table returned quickly to the starting point. The duties of the operator are thus limited to removing finished pieces, chucking new ones, and manipulating a lever.

Stirk Planers

John Stirk & Sons, Ltd., Halifax, exhibited a 5- by 5- by 16-foot planer which embodied an improvement in the Stirk split field drive and is exhibited for the first time. The principal difference over the original Lancashire drive is the Stirk disk and master switch actuating a set of five contactors which constitute the reversing switch proper and take the place of the oil switch. The equipment consists of a motor-generator, a reversing motion, master switch, starter or primary motor, contactor and regulator, and a panel for generator, start, stop and inching buttons. The arrangement permits a quick-return reverse to the table motor, and enables cutting and return speeds to be varied independently.

Smith & Coventry Gear-cutting Machinery

Smith & Coventry, Manchester, showed a new spiral bevel gear planer which is a development of the Robey-Smith bevel gear planing machine, and which is now ready for the market. The dividing movement is made at each reciprocation of the tools as in the Robey-Smith machine, by which the heating of the blank and the wear of the tools are distributed uniformly around the whole wheel, successfully avoiding the trouble often arising of the last tooth being too thick or too thin. While the other spiral bevel machines generally use an empirical curvature of tooth, the present machine produces a correct geometrical spiral; that is, the blank moves at a uniform rate about its axis, in relation to the movement of the tools across its face. By reason of this, one common limitation in the adjustment and use of spiral bevels is eliminated, and more correct action is obtained, the teeth being symmetrical in any surface of revolution about a line in such surface passing through the axis.

Asquith Drilling Machines

William Asquith, Ltd., Halifax, exhibited three entirely new models of radial drilling machines, comprising a five-foot high-speed radial, a portable universal radial, and a ball-bearing girder radial. These machines are intended to meet the demands for a medium size high-speed machine to drill holes of moderate diameter in work which does not call for so heavy a machine as the central thrust type. A novel feature is the triple lock lever, which simultaneously clamps the saddle to the radial arm the radial arm to the sleeve, and the sleeve itself to the internal pillar; thus two operations usually performed separately are synchronized. An improved friction feed device is applied so that the spindle can be adjusted vertically on disengaging, or finely by hand without disengaging. The portable universal radial machine is especially intended for drilling operations which are to be performed on assembled or partly assembled work. The radial arm is built in two sections, one of which is fitted to the column and is provided with a horizontal slide to carry the other portion; thus vertical and horizontal adjustments of the drill spindle may be made. The radial arm will also swing through a complete arc around the column and has a tilting motion by hand through an arc of about 30 degrees. The drilling head is so arranged as to swivel to any angle, either horizontally or vertically.

Grinding Machines

Jones & Shipman, Ltd., Leicester, are developing a fine range of grinding machines and equipment. The new 24- by 12-inch internal and external grinding machine is a type suitable for all kinds of cylindrical work, external and internal, parallel or taper, with a capacity of 24 inches between centers by 12 inches swing. There are eight variations of table travel, and automatic sizing is obtainable on the machine. A very fine range of super-high-speed spindles, designed to run at speeds of from 5000 to 100,000 revolutions per minute, is available for the internal grinding work on this machine, so that every possible requirement in fine internal precision grinding can be met within the limits of the capacity of the machine.

Herbert Hunt & Sons, Old Trafford, exhibited a new twist-drill point sharpening and thinning machine. The principle upon which the machine is designed is to revolve the drill continuously in one direction. The amount of clearance to the tops is obtained by imparting a swiveling and a reciprocating motion to the drill-holder slide, through cams and worm-gearing, while at each complete revolution the drill is fed forward a predetermined amount.

Miscellaneous Machines

In vertical boring mills, Webster & Bennett introduce a new type of machine embodying features of interest. The new Dickinson 3½-inch spindle horizontal boring machine, fitted with a facing head is shown by the Atlas Engineering Co. Edward Herbert, Ltd., showed a new gate sawing machine of the radial type for cutting off gates and runners from steel and other castings. The machine will cut through a 24- by 24-inch section at a height of 6 feet from the floor plate. It is fitted with automatic relief by an oil dashpot.

The brief descriptions given deal with some of the more important developments in machine tool design. Although some of the new models may not possess features as fully developed as in certain American models of the same class, there is nevertheless evidence that British makers are fully alive to modern requirements, and noteworthy developments of importance are to be found in the new Herbert No. 5 auto-lathe, the Archdale manufacturing milling machine, and the drilling machine group generally. A new development revealed by the Olympia show was the steel plate frame type of punching and shearing machine introduced by Craig & Donald, Ltd., Johnstone. Such machines, hitherto exclusively German-made, have enjoyed a large popularity in this country.

The Foreign Trade Situation

By W. LaCOSTE NEILSON, Vice-president and Foreign Manager of the Norton Co., Worcester, Mass.

Having lived in Europe since 1909, and having been constantly engaged in commercial affairs in different European countries, W. LaCoste Neilson, vice-president and foreign manager of the Norton Co., who returned from Europe two weeks ago, has had an unusual opportunity to become intimately acquainted with the actual conditions in the European market, and to form an opinion of the prospects of the foreign trade in American machine tools in Europe. The information given in the present article is based upon first-hand knowledge obtained by Mr. Neilson during the last few months, while visiting each of the countries referred to. Mr. Neilson's statements in regard to the foreign exchange prospects and the resumption of a normal foreign trade will be of especial interest to manufacturers.

THE question asked by all exporters of machinery to the European countries is "When will Europe return to normal industrial conditions, and how soon may it be expected that the export trade in machine tools to the European countries will assume normal proportions?" This is a question that is difficult to answer in a few words, or, with any degree of certainty, because the factors involved are numerous, and the conditions in the different European countries vary. At present, as we all know, there is a serious depression in practically every European country. This depression will become more marked all over Europe during the next six months. After that, a gradual normal industrial development will take place. During this development there will be a good demand for American machinery of all kinds, and especially for American machine tools. The demand caused by a normal industrial development will be accentuated by the requirements which will then be pressing for machinery to replace the equipment that has been worn out or become obsolete during the last decade.

In other words, there will be a period during which comparatively few American machine tools will be bought by the European countries, and after that there will be a period when this field promises to furnish a better export market than at any previous time. The present depression may be estimated to last from six months to two years. Subsequently, all industries will again work along normal lines.

When the nations enter upon this new period of reconstruction, the present fluctuations in foreign exchange will become stabilized, but it is believed that there will be an entirely new basis of foreign exchange, and that we will not return to the figures we were in the habit of considering standard previous to the war. There will be new values as to currency between different countries which will be established as new standards. It is not likely that sterling will again be equal to $4.86, or that the franc will be worth 19.3 cents. Speaking in general terms, there are reasons to believe that, as compared with sterling, the dollar will permanently be worth from five to ten per cent more than it was before the war; and as compared with francs and lire, from twenty-five to fifty per cent more. When these new exchange values are established, we will become used to considering these as actual and permanent exchange rates, and foreigners will no longer feel that they are paying more for goods billed in dollars than they ought to pay.

Industrial Conditions in England

The industrial conditions in England depend definitely upon the actions of the labor unions and upon the courage and ability of the Government in dealing with the demands of the unions. A strike on the part of the coal miners in England means the entire tying up of British industries for months. A compromise on the part of the Government with the coal miners does not solve the problem, but merely defers the final clash. In England, more than anywhere else, the unions are in an almost controlling position. But the unions themselves are controlled by a minority, the same as elsewhere, and this minority, in turn, follows blindly a few leaders, who are thus in a position to dictate to the whole labor body. Hence, the steps now planned by the labor unions in England cannot be said to be based upon the concerted action of the whole union membership, but rather upon the passive acquiescence of the membership in the actions and aggressions of their leaders. The whole industrial situation in England hinges upon the coal situation; and a satisfactory solution of this problem, which means a firm stand of the Government, is the only thing that will save the British industries from a very serious depression and many failures.

The financial situation is not satisfactory, and in addition to the attitude of labor and high wages, industry is hampered by high cost of materials and excessive taxes, amounting now to 60 per cent on the excess profits of a business. Most of the older British concerns in the industrial field are financially sound, but it is hard for them to obtain ready cash, and in any transactions with them credit must be extended for a reasonable length of time. The automobile builders are in the most serious financial position, and some of them may not be able to pull through the present crisis. For six months at least, no exports of any account, in machine tools, should be expected to Great Britain.

British machine tool building has been considerably developed during and after the war, and the British are aiming to supply, as far as possible, their own needs in this direction and also to enter into competition with the United States in the world's markets. When the present depression is over, however, the requirements for great additional equipment to replace the old and worn out machinery of British plants will necessitate large imports. The domestic manufacturing facilities will not be able to measure up to the demand. Notwithstanding the present activity in machine tool building in England, the country does not produce a sufficient amount of machine tools to take care of the requirements for the rebuilding of the British industries.

Practically every type of machine tool made in America is now also being built in England; but there are many types, the output of which is insufficient to take care of the normal industrial demands, let alone the unusual requirements that will present themselves when the present depression has passed. It is evident, of course, that meanwhile England will offer a strong competition to American machine tools in the world's markets; but nevertheless, American machine tools will play an important part in the rebuilding of the British industries. Eventually England may supply most of her own needs in this direction, but that time is still quite far off.

Prospects of Foreign Trade with France

France has had less labor troubles, everything considered, than any other country that took part in the world war, except Belgium. The French workmen have settled down and are not likely to cause any trouble that will be of national importance. In France, the greatest difficulty is credit. There is a potential demand for practically all kinds of American machine tools, but importation of machine tools is extremely difficult on account of the abnormal rate of exchange. In spite of this, there is no evidence of a large development of a machine tool building industry in France. The firms that built machine tools before the war are continuing to do so, but there has not been any unusual expansion in this field. It is likely that the United States will continue to supply the French industries with the bulk of their machine tool requirements, and France will become one of our most important markets. In about two years or so the rate of exchange will become stabilized—at a higher value, to be sure, than before the war—and then the trade with France will probably become greater than ever.

France made many plans during the latter part of the war and during the armistice with a view to building up great industries in fields that had not formerly been highly developed in that country. These plans have not materialized, except on a small scale. France will probably settle down to conditions similar to those previous to the war, and will devote her energies to the building up of the industries that in the past have been pre-eminently French.

Industrial Conditions in Belgium

It is well known that Belgium was recovering more rapidly from the effects of the war than any other of the European countries. At the present time Belgium is experiencing a business depression, the same as the other countries. This depression is in part a reflection of difficulties in adjacent countries and partly the result of financial difficulties. When it appeared that Belgian industries would be readily rehabilitated, confidence was shown in purchasing materials. This led to very considerable purchases, and although it cannot be claimed that an over-expansion resulted, more money was spent in the last year than the financial position justified.

The new confidence that must be acquired before Belgium undertakes serious business will come as a reflection of such new confidence as may be established in other European countries. In the meantime there is no indication of an unusual development in the manufacture in Belgium of machine tools. Although copies have been made of a variety of types of German machine tools, there has apparently been no production on such a scale as to seriously interfere with the prospects of American manufacturers. When business in Belgium speeds up, and this should take place in a year or two, we may look forward to a good normal trade with that country.

Conditions in Italy

As every newspaper reader knows, the industries of Italy are at the moment being seriously injured. The progress which had been made during recent years will be offset, and when the Bolshevism now rampant subsides, more assistance from the outside will be necessary than would have been the case had there been no revolutionary movement.

Italy has had less experience in the production of engineering supplies than any other of the European nations of comparable size, and is therefore less fitted to manufacture modern machine tools. During the war her efforts were confined mostly to the production of war materials, including guns, munitions and ships, and the efforts to manufacture machinery for these and other purposes were almost negligible. It is logical to suppose we will have a good market in Italy when business operations by the business people can be resumed, and when money is available for business. The recovery in Italy may be slower than in adjacent countries because of the weaker position of capital and of those qualified to control operations.

Industrial Conditions in Other European Countries

There has been a development in Scandinavia, especially in Sweden, of natural resources and of industrial capacity along many lines, including machine tools. This naturally will decrease the demand for foreign-made machine tools, although the developments are in large part designed for the export trade to Russia and Germany. When conditions improve, a demand for equipment from foreign sources will result, in order to keep the export industries in operation.

Holland, as all are aware, has increased her trade, but the bulk of it has been an agents' trade, and materials imported have been exported. Holland's exports to her colonies in the Far East will not only continue but will materially increase. In the meantime the manufacturing plants of the country have been stimulated, and in some types of machinery her productive capacity will probably be sufficient to meet her requirements. This (and the fact that Holland will naturally revert to importing German machinery) gives small promise of any appreciable trade for American manufacturers, except in specialties.

The economic and political situation in Germany is so uncertain and the possibilities of failure or success are influenced by so many factors, that it would not be possible to discuss the matter in a brief way. However, one feature of the situation is especially prominent. All industry is being seriously hindered through a shortage of coal. Germany is delivering coal to France and Belgium at the same time that production is below normal owing to the condition of the mines and the labor conditions. There is no immediate prospect of any improvement, and it is impossible to forecast events, industrial or other, in that country.

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ABRIDGED METHOD OF LONG DIVISION

By A. B. SCHLESINGER

In examples containing long division, time can be saved by performing the division as usual for obtaining the first figures of the quotient and then finishing the operation with the slide-rule. This method is much more accurate than using the slide-rule alone and much more rapid than a complete long division.

The rule for this method is as follows: Cut off one figure from the end of the divisor after each regular long division step, and continue until there remain only three figures in the divisor. Use the slide-rule to obtain the quotient when dividing the last remainder by the final three-figure divisor.

Example—Divide 3.1416 by 2.1348

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21348) 31416 |1
       21348
       -----
2135 ) 10068 |4
        8540
       -----
213 )   1528 = 7.17
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Dividing the remainder 1528 by the last divisor 213, by use of the slide-rule, the quotient 7.17 (approximately) is obtained. These three figures are the final three in the answer, and the other digits are 1 and 4, as shown in the above computation, so that the result is 1.4717 (approximately).

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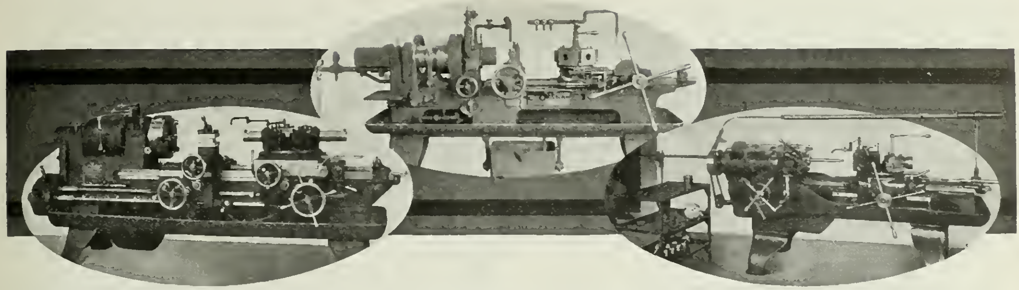
INDUSTRIAL DEVELOPMENT IN INDIA

There has been a remarkable industrial development in India during the last few years. During the last financial year, new companies were organized with an aggregate capital of more than $1,000,000,000. In nearly all of these companies both native Indians and Europeans are represented on the boards of directors. As a large part of this new capital must be expended on plant and machinery of various kinds imported from foreign countries, there is a great opportunity for export trade to India. The United States occupies a very strong position in the Indian market, and is second only to Great Britain in the import trade of that country. In the automobile field, the United States has practically a monopoly on the Indian trade. During the past year, out of a total of 9925 motor cars imported, 9353 came from the United States.



Turret Lathe Design and Construction

Important Points Involved in Turret Lathe Design, and Some of the Advantages and Disadvantages of Current Practice

By ARTHUR F. BENNETT

IN the following article the writer proposes to examine some of the features of turret lathe design, confining the observations made to four American and one English machine. These machines are rated as hand screw machines or turret lathes of from 2- to 4½-inch bar capacity, or up to 18 inches chucking capacity.

The Headstock and its Design

The following principles in the design and construction of turret lathe heads have been developed in practice and may be regarded as standard:

1. The work should be held rigidly, and a sufficient number of speed changes should be provided.
2. The various speeds should be in a geometrical ratio, and the ratio should not be greater than 1.5. The speeds should be instantly available, either forward or reverse, without stopping the spindle and without interfering with the other speeds when selecting the one required.
3. There should not be more than two change-speed levers, and these should be so located that they can be easily operated.
4. Fine-pitch gears are desirable because they reduce the noise commonly produced when coarse-pitch gears are used.
5. The transmission shafts should be short and stiff, thereby reducing torsional and bending stresses.
6. Complete automatic lubrication should be provided so as to relieve the operator of this duty and insure satisfactory lubrication of the bearings at all times.
7. The interior mechanism should be accessible, so that replacements and adjustments may be easily and inexpensively made.

Various designs of work-spindle noses are shown in Fig. 1, arranged alphabetically according to their relative merits from the standpoint of effectiveness in attaching the chuck. For the same size machine this depends upon the shape, size, threaded fit, and end abutment. Other things being equal, the largest threaded end, such as shown at *A*, will provide the best joint, the auxiliary fit (also incorporated in designs *B* and *C*) being an additional means of centering. The nose shown at *D* is the simplest and most economical to manufacture. The large sectional view shows in an exaggerated manner the tendency of U. S. form threads on the spindle nose to center the chuck.

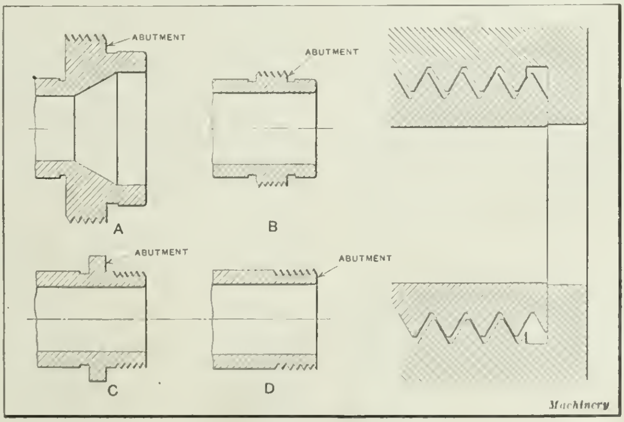


Fig. 1. Designs of Turret Lathe Spindle Noses

Casting the head and body in one piece gives a construction of maximum rigidity and is most generally used. This gives the greatest simplicity from the machinist's point of view and also provides permanent alignment of these two members. However, the Hartness cross-sliding head is a radical departure from the above construction, and is equal in effectiveness to that incorporated in any other turret lathe. In connection with the discussion of head design, it is necessary to observe not only its construction, but also to consider the tool and its substructure. The advantage of the cross-sliding head is the flexibility which it lends to the use of the tools for the purpose of performing facing operations.

Spindle Speeds and Operating Levers

Nine spindle speeds are the minimum and twelve the maximum number in general usage. All makers maintain the geometrical ratio of 1.5. In all cases a separate lever is used for starting, stopping, and reversing the direction of rotation of the work spindle. It is the author's opinion that too many levers are used in some cases. Means for providing effective speed changes which will operate instantly is a weak point in many heads. There are three speed-changing mechanisms in use (usually in combination with each other), namely, friction clutches, sliding gears, and ratchet and pawl mechanisms. The clutches and the gears are operated by levers conveniently located within reach of the operator, while the rachet and pawl mechanisms are operated automatically by a spring which depends upon friction for operation. Owing to the exacting requirements and heavy duty frequently imposed upon these mechanisms, they often fail to function properly. Friction clutches of the cone type require cams, toggles or wedges to operate them. These clutches are admirably suitable for use on shafts having low torsional stresses, but become expensive and large on spindles (such as work-spindles) that are subject to high torsional stresses—otherwise these clutches are compact and simple.

Sliding Gears

Sliding gears of chrome-nickel steel are giving very good service in machine tools as well as in automobile transmissions. They are simple and make a neat type of speed-changing mechanism. In order to avoid destructive clashing when under load, and to guard against stopping the spindle when changing speeds, a suitable mechanism must be provided. The ease with which two spur gears may be engaged by sliding axially depends upon their relative rate of rotation, as well as upon the shape of the engaging ends of the teeth. In meshing sliding gears, the power should be disengaged from the driving gear just before engagement, allowing the driving gear to rotate by its own inertia until moved into engagement with the driven gear.

Disengagement of the sliding gears when working under load is also destructive; hence the power must be released from the driving gear as sliding commences, and withheld until the gears are out of mesh. With this cycle of operations, the only destructive forces acting upon the teeth are those of the momentum caused by the gear-driving transmission, and the axial force required to slide the gear. The constant speed employed in machine tool drives does not permit as favorable an application of sliding transmission as is found in automobile design, since in the automobile, the motor has a variable speed which may be throttled down until the speed of the driving gear is very nearly equal to that of the driven gear.

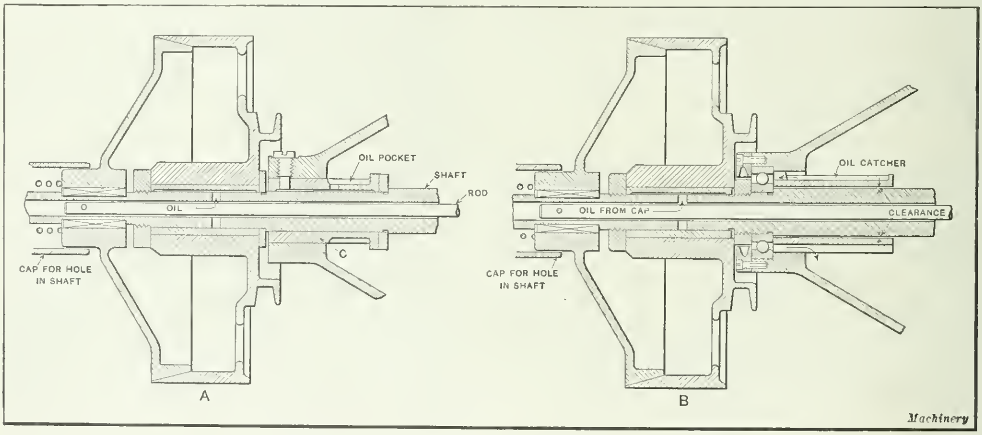


Fig. 2. (A) Typical Overhung Construction of Constant-speed Driving Pulley, showing Lubricating Arrangement. (B) Overhung Driving Pulley improved by Addition of a Ball Bearing

Ratchet and Pawl Mechanisms Clutches

Certain leading manufacturers of turret lathes have experienced difficulty with the rachet and silent pawl mechanism. These mechanisms are generally used in transmitting low speeds and high pressures. As usually designed, the pawl is not made of large enough proportions to withstand the shocks to which it is subjected. Variations in workmanship also cause considerable trouble. These variations may occur in machining, heat-treating, assembling, or in two or three of these operations. The possible trouble these conditions may cause can be minimized by correct design with reference to these variations.

The friction clutch engages nicely and with the least amount of shock, but if the sliding gears are properly arranged, they have the advantage of greater simplicity. From the operator's point of view this means that no slippage will occur during a cut and consequently no adjustment need be made. Although occasional replacements are necessary, these occur at long intervals. From the standpoint of the turret lathe manufacturer, the simplicity of the sliding gear construction means a reduced machining cost, reduced cost for assembling and for conducting the "running-in" test which the machines receive prior to shipment, and reduced multiplicity of parts. Friction clutches involve more working surfaces, bearings, and mechanism than do sliding gears, and as a result increase the possibility of trouble. Frequently defects do not appear in the clutch until the running-in test is reached, so that delays and added expense often result.

Belt Speed

All turret lathe builders are agreed upon the advantage of the constant-speed pulley drive. Most of them, however, fail to recognize the economy of high belt speeds. Frederick W. Taylor, in his investigations on the subject, found that the most economical speed at which leather belts should operate is between 4000 and 4500 feet per minute. One of the leading turret lathes employs a speed as high as 2400 feet per minute, while several employ a speed as low as 1500 feet per minute. The only reasons the writer can suggest for the use of low belt speeds are: (1) Difficulty in assembling large pulleys on the countershaft; and (2) lack of suitable bearings for the driving pulley on the machine.

The first-named cause may be remedied without difficulty, and the second may be overcome by the judicious use of one or two ball bearings, the driving pulley bearings being about the most difficult to lubricate, as may be seen by referring to Fig. 2. This illustration shows at *A* a typical overhung construction of constant-speed driving pulley the tendency of which is to wear bearing *C* bell-mouthed. At *B* a similar pulley is shown, provided with a suitable ball bearing, which is an effective means of minimizing the trouble.

Means of Lubrication

Splash lubrication is most generally used in the head. A very good example of this lubrication system is that employed in the Herbert turret lathe, in which the oil is wiped from the face, near the periphery, of the large spindle gear and of the friction clutch, and thence guided by inclined channels to the front and rear boxes and to the driving pulley bearings, thus insuring a copious supply of oil to these important parts. Reference to Fig. 3 will show the general arrangement of this lubrication system, from which it will be apparent that the spindle gear, when running at high speed, will throw the lubricant on the driving pinion and result in an oil spray for all the revolving members contained within the head. This English machine is also a notable example of accessibility of design, the head cover of which may be easily removed by reason of its being held in place simply by gravity and suitable ledges, so that it may be readily lifted from the head. The cover joints are oil-tight, although no fastenings are employed to make them so.

Bed Design

From actual tests it has been demonstrated that the box tubular form of bed is the best design for resisting the torsional and bending stresses to which it is subjected. The resistance of the bed to these stresses is usually determined by the thickness, depth, and continuity of the walls, as well as their distance from the neutral axis. With respect to wall continuity it is impractical to avoid providing holes for the removal of cores and for the passage of chips into the pan. Most makers observe the correct principle of bed construction except possibly in regard to the location of supports, which should be placed as nearly under the fixed and moving loads as is possible. By this means the tendency of the bed to twist and spring when resting on an uneven surface is avoided. The correct and incorrect location of supports with respect to loads is shown at *A* and *B*, respectively, in Fig. 4.

In American lathe design, vees continue to be the popular guiding surfaces for the saddle and the slide, one good design in this respect being made with the front vee wider than the rear, thus taking care of the greater amount of wear to which the front vee is subjected. The rack seems to have no better situation than immediately under the front vee.

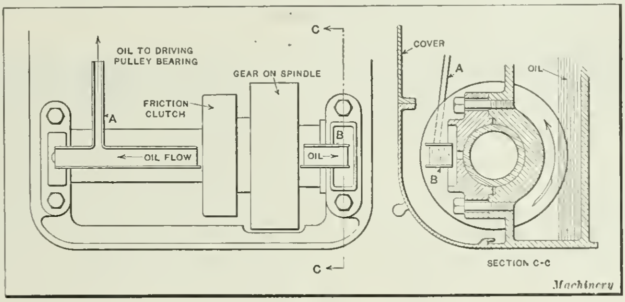


Fig. 3. Lubricating System employed in an English Turret Lathe

The Chip Pan

The requirements of the chip pan are that it shall contain the average day's run of chips and provide a water-tight tray in which to catch the cutting compound and return it to the pump; that it shall not prevent the operator from standing close to the work; and that the chips may be removed from the pan without difficulty. These conditions are followed closely in practice except for the provision for removing chips. This operation usually takes considerable digging and scraping, which can be avoided if free access both to the front and rear of the pan is provided for, so that a truck can be run beside the pan and the entire contents easily transferred to it. Sheet steel is probably the most used metal for chip pans, its chief advantage being that it is cheaper than a cast pan.

Apron Mechanism

The functions of the apron are as follows: (1) To contain reducing gears; (2) to impart to the saddle its longitudinal motion; (3) to contain the various feed control mechanisms. The cutting tool operates at a considerable distance from the point at which the power is applied to the machine. The best means for transmitting this power is by a comparatively small diameter shaft. The tool must also be fed into the work at a reduced rate of speed from that of the driving gears; to transmit this power it follows that in order to maintain maximum rigidity at the tool point, the correct place to make the reduction with the least amount of strain is as close to the point of application as is practicable. For this reason the apron and its gearing are provided.

Strength Required in Apron Mechanism

Past and present performances of many makes of machines would indicate that this part of the machine should receive greater attention by designers. Indications partially substantiate the statement of Mr. Taylor who maintained that this entire mechanism should be made strong enough to allow the feeding pressure to be as great as the driving pressure upon the lip of the tool. The best place for the location of the feed control on a turret lathe is on the apron, and this feature has been well taken care of in most turret lathes. The most practical control should be designed to operate with one hand, but not much has been done to develop such an improvement. This might also be said of the feed-reversing mechanism, of which it might further be noted that while the right- and left-hand worm-wheel is a very ingenious mechanism, it does not wear well, and hence, in some cases, does not reverse readily. The reduced wearing surface is shown in Fig. 5, in which at *A* is shown a section of a worm-wheel tooth, hobbed right- and left-hand, and at *B* a tooth section hobbed right-hand only, both sections being taken on the pitch line. One well-known engine lathe maker casts the apron integral with the saddle—a construction which seems commendable to the writer.

The Saddle

The functions of the saddle are to provide a base of maximum stability for the turret; to provide long guiding surfaces and to house certain mechanisms. It should be sufficiently heavy to absorb shocks. The vee bearings for the saddle are subject to much abrasion by the action of small particles of chips, sand, scale, etc., the tendency for this foreign matter being to work into these bearings. This is the case in all slides which are in any degree exposed. Assuming that the guide over which the slide first passes is covered with dirty oil or dust, the action of this dirt will be to travel clear along the surface in contact. One good way to overcome trouble from this source would be to force out the unclean matter with clean oil. If, in such a scheme, felt wipers could be employed, the arrangement would not be open to the objection of requiring specially shaped pieces of material for this purpose.

Lubrication is often, by necessity, the last condition to be worked out in many designs, and unfortunately, by pressure of circumstances, is given the least consideration. The principle of self-lubrication should be developed and applied to every unit in so far as possible, so that all moving parts can be automatically lubricated.

Types of Turrets

There are two types of turrets used on the lathes under discussion—the flat turret and the hollow hexagon turret. The advantages claimed for the flat turret are: (1) Suitability for holding any type of turning or single-point boring tool in any position relative to the work; (2) provision for maximum area of support upon which these tools can be mounted and rotated; (3) provision for the largest diameter in which to locate a locking pin and upon which gibs may bear; (4) possibility of boring or turning all diameters within the full capacity of the machine (in conjunction with a cross-slide) without the use of special equipment for each size; (5) and the possibility of using hexagon turret tools.

The principal advantage of the hexagon turret is its rigid support with respect to thrust and torsion. From this it would follow that heavy forming cuts could best be made with this type of turret. Comparison between the set-ups on the hexagon and those on the flat turret show that the holders for the single-point turning and forming cutters used on the hexagon turret are very much overhung. This may be overcome to some extent, at an increase in cost of tools, by piloted supports, or by the use of an auxiliary carriage. The auxiliary carriage is a feature which will doubtless pay for itself many times over as a time-saver.

Types of Tool Stops

There are two principles which may be employed to arrest the motion of the tool: (1) arresting the force which produces the motion; and (2) diverting the force. Under the first of these may be classified the observation stop and the positive stop or abutment; under the second may be mentioned the cam and the knock-off or tripping mechanism.

The problem of constructing an accurate stopping mechanism presents certain difficulties which have not yet been fully solved. Multiple tooling requires a stop for each tool or group of tools. The ideal place for the feeding pressure to be applied to the tool is almost in line with the tool lip. The stop should be in this line also, which condition is usually impracticable. The tool in turning accurate shoulder lengths should remain stationary until it has, at the end of the cut, faced the shoulder square. Deflection of the cutting edge of the tool radially with reference to the work results in a double error in the diameter of the work produced. For this reason the turning of accurate diameters is more difficult to accomplish with the use of a stop than the turning of accurate shoulder lengths.

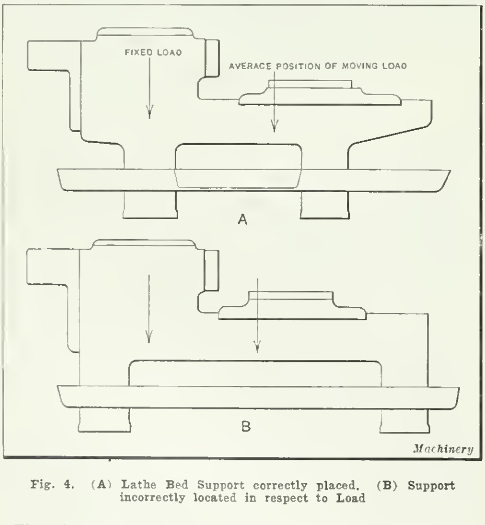


Fig. 4. (A) Lathe Bed Support correctly placed. (B) Support incorrectly located in respect to Load

The observation stop, as usually constructed, consists of a fine-pitch screw, nut, thrust bearing, a large-diameter and finely graduated dial, and a pointer, together with the usual slides, the gibs on which are set up so as to avoid any vibration or looseness. The effectiveness of this mechanism depends upon the operator's eye and sense of touch. The most important parts of the mechanism from the designer's point of view are those relative to the dial and the lead of the screw. In this and all other types of stops, it is probable that the oil films play an important part in the accuracy obtained in the work.

The positive stop consists of an abutment so located that pressure may be brought to bear against it, thus putting an initial stress upon the mechanism. This form of stop is generally the easiest to use, since it relieves the operator of eye strain; also the variations resulting in the work from the employment of this form of stop are, as a rule, within the tolerances allowed in the shoulder lengths on the work.

The stop obtained by the action of cam feed is very effective. The force in most cam mechanisms is, when feeding, increased from a minimum to a maximum, and decreased to zero at the termination of a cut. A great deal can be said about the employment of cam feed mechanisms on turret lathes, but this subject is not within the scope of the present article.

The self-acting trip mechanism is open to objection on account of the sudden release of feeding stresses caused by the quick disengagement of the feed. This objection is usually overcome in a measure by the use of an auxiliary positive stop, against which the operator must hold the tool.

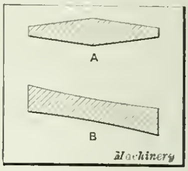


Fig. 5. Sections at Pitch Line of Feed-reversing Mechanism Worm-wheel

In conclusion the writer wishes to call attention to Mr. Taylor's discovery in 1883 that a 40 per cent increase in turning speed is possible in machining steel, by the use of a copious supply of water to dissipate the heat generated at the tool lip. This should be considered especially in multiple tooling arrangements.

* * *

HOW MANY OF THESE ACCIDENTS ARE PREVENTABLE?

Recent figures published by the Bureau of Labor Statistics, Washington, D. C., show that there are 38,000,000 wage earners in the United States and that of these, 700,000 annually meet with accidents serious enough so that they are incapacitated for work for an average of four weeks each. This is equivalent to a loss of at least $50,000,000 in wages. There is no record showing how big a sum was paid in compensations, but doubtless it ran into many millions. If on the one hand workers were more careful, and if on the other, part of the money spent in compensation had previously been spent in providing safe working conditions, safeguards, and education for the workers in regard to dangerous practices, it is likely that the number of accidents could have been very materially reduced.

Statistics covering industrial accidents also show that the largest number of accidents per hour occur between 11 and 12 o'clock in the forenoon, and between 4 and 5 o'clock in the afternoon. The fewest number of accidents occur between 7 and 8 o'clock in the morning, and between 1 and 2 o'clock in the afternoon. There is a steady increase in the number of accidents per hour from the beginning of work in the morning until noon, and from 1 o'clock until the closing hour. Obviously, men are more alert when they begin work, and become either fatigued or careless as the hours pass on.

* * *

SOUTH AMERICAN TRADE OPPORTUNITIES

There appears to be great activity in the railway and industrial fields in most of the South American countries. The Argentine Republic is expected to expend $40,000,000 for rolling stock and railway electrification. A considerable amount of machinery for industries of all kinds will also be imported during the next year, particularly electrical machinery and machinery used in the flour milling industry and agricultural work. Chili affords a good market for structural steel and hardware, agricultural machinery, and tractors. In Ecuador nine textile mills are planned, and in Venezuela sugar machinery is being bought. In connection with the railway shops, mining industries, and textile mills, there will, of course, also be repair shops that will require a certain number of machine tools.

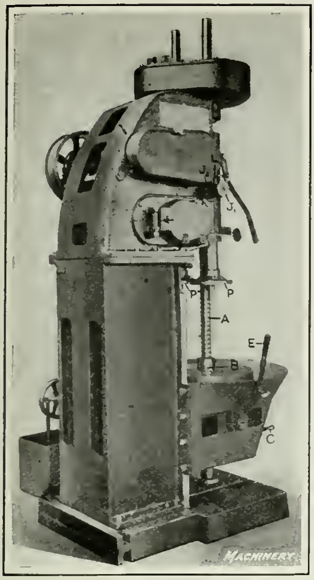


Fig. 1

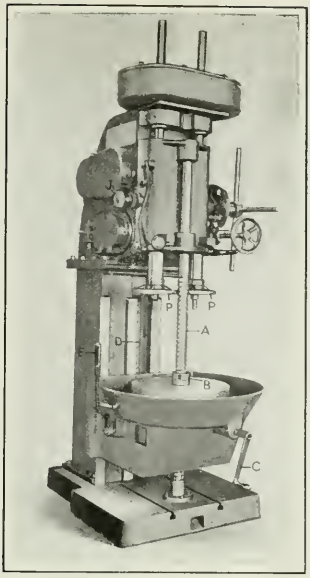


Fig. 2

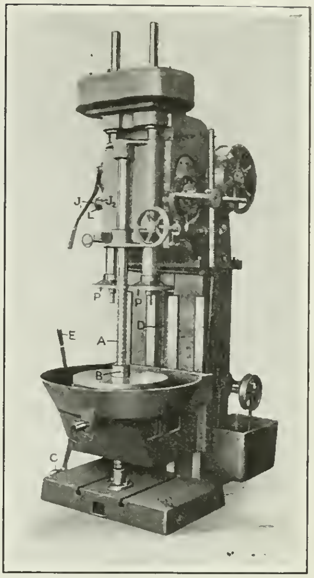


Fig. 3

Continuous Production Drilling

Methods Whereby High Production is Obtained in Drilling—Based upon the Practice of Baker Bros., Toledo, Ohio

To attain maximum efficiency in the performance of any machining operation, there are two general factors to take into consideration. Means must be provided for actually cutting the metal at a satisfactory rate, and care must also be taken to see that the idle time of both the machine and its operator are reduced as far as possible. It will often happen, especially in cases where the time required for taking the cut is relatively short, that the non-productive period during which the operator is loading and unloading the jig or fixture is considerably greater than the time during which the machine is engaged in the performance of work. Bearing this fact in mind, designers of several different types of machine tools have endeavored to make provision for keeping both the machine and the operator constantly employed.

A case in point is shown in the accompanying illustrations which show a production drilling machine which has recently been added to the line of Baker Bros., Toledo, Ohio. This is a two-spindle machine and it is equipped with an indexing table that provides for carrying successive pieces of work under the spindles. There are three stations on this table, and the usual practice is to have fixtures of the same design mounted in each position. Possibly the arrangement will be best understood by referring to Fig. 4, which shows a plan view in diagrammatic form. Here it will be seen that the so-called chucking position is at the front and that the table is indexed through 120 degrees at each movement.

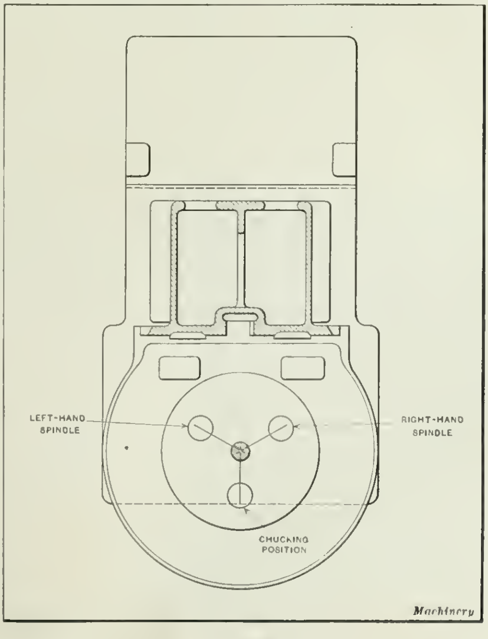


Fig. 4. Diagrammatic Plan View of Machine showing Arrangement of the Chucking and Operating Positions

After a piece of work is set up in the chuck, it is indexed to a position under the left-hand spindle, which is furnished with a tool to provide for performing the first operation. At the next indexing movement, this piece of work will be advanced to a position under the right-hand spindle, where another operation will be performed. With a machine of this type, drilling and reaming or similar sequences of operations can be performed successively, and in cases where a number of holes are required in the work, multiple-spindle auxiliary heads can be utilized to afford increased efficiency. The advantage of a machine of this type over one which is not furnished with the indexing table is that the operator can be kept constantly employed in removing finished pieces of work and setting up fresh castings while the machine is working on castings held in the two operating positions. As a result, the only non-productive time is that period during which the table is being indexed from one position to another.

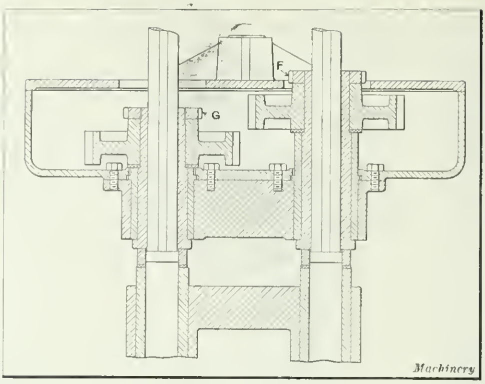


Fig. 5. Arrangement of Independent Spindle Drives which enable Suitable Speeds to be employed for Successive Operations

Improved Features Incorporated in the Design of this Machine

Most readers of Machinery are familiar with the No. 217 heavy-duty drilling machine built by the Baker Bros.; the general outline of the present machine is quite similar. Consequently, the present article will concern itself only with those features which have been added to provide for practically continuous operation. A description of the tools and methods used in handling several typical jobs on this machine will also be presented.

Arrangement of the Indexing Table

As the provision of an indexing table to obtain continuous production is the outstanding feature of this new drilling machine, it is natural to start the description at this point. The reader is cautioned not to infer from the illustrations that feeding of the work to the tools is accomplished by elevating the table. Such a conclusion would be more or less natural in view of the large screw *A* which will be seen in Figs. 1 to 3, passing through the center of the table. This is for the purpose of bringing the table exactly perpendicular to the spindles and also to afford a convenient means of setting the table in the desired vertical position. When the proper setting has been obtained, the two lock-nuts *B* above the table are tightened down and then crank-handle *C* is turned, which results in raising a binding collar into contact with the under side of the table, thus forcing the finished upper face of the table into contact with the finished under side of the lock-nut and accurately aligning the table with the spindles. The binding collar is threaded in its bore to fit screw *A*, and has teeth cut in its periphery to mesh with a worm that is turned by crank *C*. A chain *D* will be seen rising from the back of the table to make connection with a counterweight inside the column, that facilitates raising and lowering the table; and the lever *E* which withdraws the index-pin is located at the left-hand side. In indexing, the method of procedure is to loosen the binding collar by turning crank *C*, then withdraw the index-pin and push the table around until it has passed through 120 degrees, at which time the index-pin snaps into the hardened bushing that locates the table in the next position.

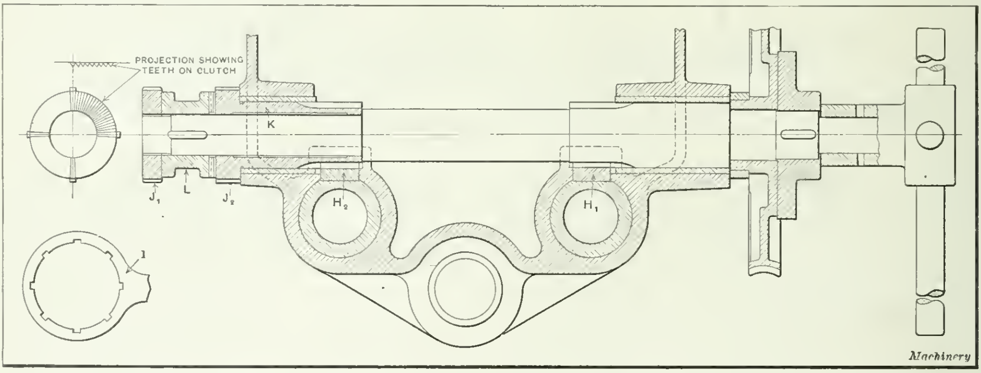


Fig. 6. Sectional View illustrating Arrangement of Means for obtaining Independent Vertical Adjustment of the Two Spindles

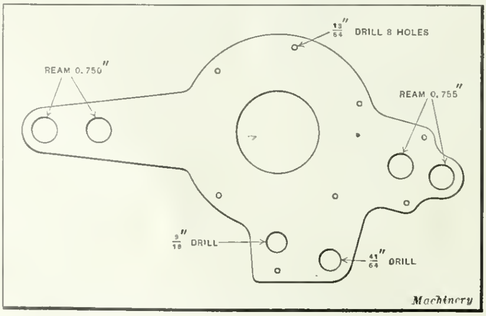


Fig. 7. Motor Car Brake Spider which is drilled and reamed on the Machine shown in Fig. 10

Spindle Construction and Auxiliary Mechanism

General features of the driving and feed mechanisms for the spindles are similar to those on the No. 217 Baker drilling machine, but to adapt this duplex continuous drilling machine for the peculiar requirements of its work a number of modifications were found necessary. It has already been explained that on machines of this type it is the usual practice to perform successive operations under the two spindles; and it may happen that there is a very considerable difference in size between the drills carried by the left-hand and by the right-hand spindles. Such being the case, it will become apparent at once that in order for both tools to work efficiently there must be a considerable difference in the speeds of rotation at which the spindles are driven.

At this point attention should be called to the fact that these are essentially production machines which are built especially to meet the requirements of a single class of work, and the spindle driving gears are designed to give the proper speeds of rotation for this particular job. The arrangement is quite clearly shown by Fig. 5 where it will be seen that there are individual

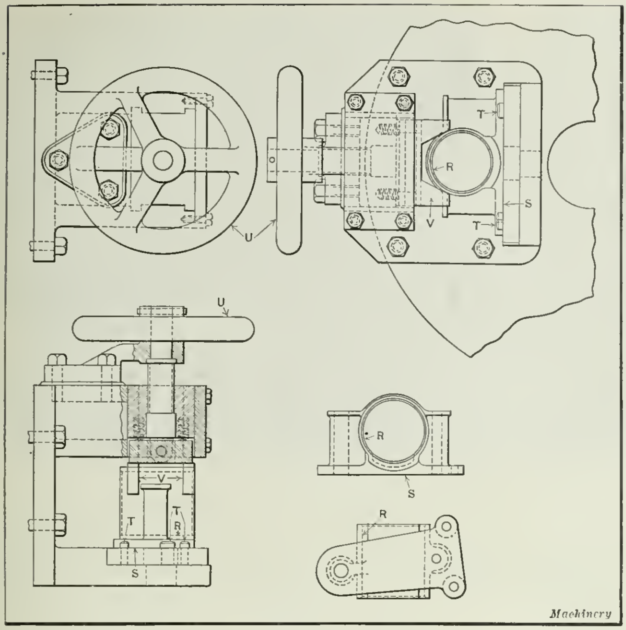


Fig. 8. Motor Car Spring Seat to be bored and reamed at R, and Work-holding Fixture for performing this Operation

spur gears which are splined to the spindles and held in the desired positions by means of threaded collars F and G that clamp the gears up against shoulders provided on the spindle quills for that purpose. It should be explained that the pinions which mesh with the spindle driving gears are located at the back, so that they do not show in this illustration.

The feed-works are the same as on previous Baker drilling machines, power feed being provided by gears contained in a case at the left-hand side, while hand feed and rapid traverse of the spindles are accomplished by the small handwheel and capstan wheel at the right-hand side. The available range of feeds is from 0.003 to 0.145 inch per revolution, and spindle speeds are available from 47 to 585 revolutions per minute. With a duplex machine of this type, it is necessary to supplement the feed movements with provision for independently regulating the vertical positions of the two spindles relative to each other. This result is accomplished by the mechanism shown in Fig. 6. Here it will be seen that steel racks H_1 and H_2 are inset into the spindles, and these racks mesh with pinions that may be turned independently of each other to provide individual adjustments for the spindles.

The way in which this result is accomplished is as follows: A wrench I may be engaged with either of the nuts J_1 or J_2. Nut J_1 is keyed directly to the end of the cross-shaft, and when this nut is turned it rotates the pinion that meshes with rack H_1, thus raising or lowering the spindle by which this rack is carried, according to the direction of rotation. Similarly, nut J_2 is formed at the left-hand end of sleeve K which has cut in its right-hand end the teeth of the pinion that meshes with rack H_2. Sleeve K turns freely on the cross-shaft, thus allowing rack H_2 and the spindle by which it is carried to be raised or lowered through turning nut J_2. It will be evident that wrench I is designed so that it may be slipped right over nut J_1 to bring it into engagement with nut J_2. By engaging clutch L connection is made between the cross-shaft and sleeve K, so that by turning either nut J_1 or J_2 with wrench I, the two spindles may be raised or lowered in unison.

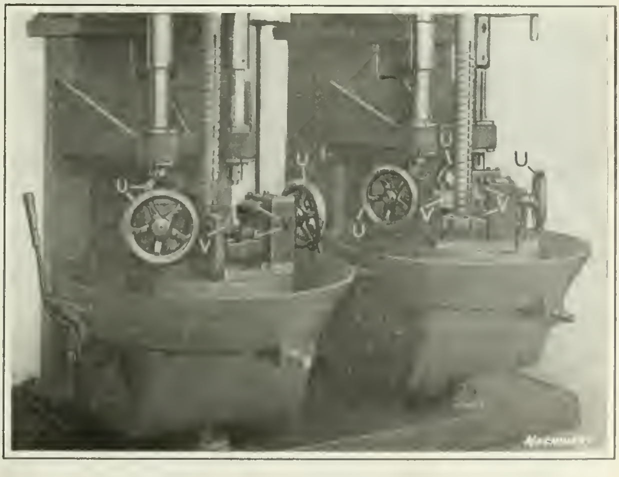


Fig. 9. Gang Type of Baker Continuous Drilling Machine equipped for boring and reaming Motor Car Spring Seats

Drilling and Reaming Motor Car Brake Spiders

Fig. 7 illustrates a malleable iron motor car brake spider in which there are fourteen holes to be drilled. After they have been drilled, four of these holes have to be reamed. This job is handled on one of the Baker continuous drilling machines, the method of procedure being to drill thirteen holes at the first station with a multiple-spindle auxiliary head; and the table is then indexed to the next station, to ream four holes and drill one with a multiple head carried by the second spindle. These pieces are made in pairs consisting of one right-hand and one left-hand spider, and to facilitate production it is the practice to make the drilling jigs, as shown in Fig. 10, with provision for placing a right-hand spider on the top of plate M and a left-hand spider below this plate. Then it is possible to have the same drills and reamers pass through the first piece of work and through guide bushings carried by plate M, to drill or ream the corresponding holes in the second piece of work that is bolted against the under side of the jig.

It would be difficult to maintain the required degree of accuracy if an attempt were made to drill the holes through both pieces of work, guiding the tools from bushings carried in the jig plate N located above the upper casting O. Before finishing a hole in the lower piece, a drill so guided would be likely to show a tendency to run out of line. It is to avoid trouble of this kind, that the upper jig plate N is made to come down on top of the work, and the plate M between the two castings is equipped with a duplicate set of jig bushings to guide the drills through the second casting. Only one casting O is shown in place in this fixture. The holes drilled by the first multiple head are as follows: Two 0.755-inch holes; two 0.750-inch holes; one 41/64-inch hole; one 9/16-inch hole; seven 13/64-inch holes. The work performed by the second head is as follows: Ream two 0.755-inch holes; ream two 0.750-inch holes; drill one 13/64-inch hole.

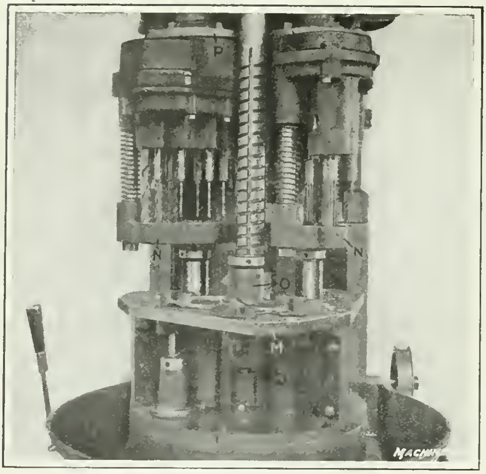


Fig. 10. Close-up View of Tools used for drilling and reaming Motor Car Brake Spiders

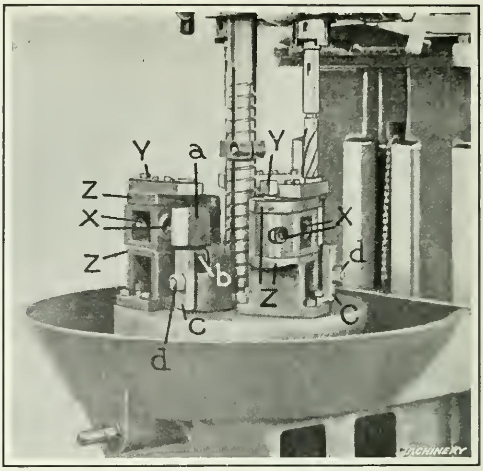


Fig. 11. Baker Continuous Drilling Machine equipped for counterboring and reaming Motor Car Steering Knuckles

Figs. 1 to 3 and Fig. 10 clearly illustrate a feature of this Baker Bros. drilling machine, namely, the provision of a flanged end *P* on each spindle to provide a convenient means of securing an auxiliary multiple-spindle drill head in place. Projecting beneath the flange there is an extension of the spindle which enters the main driving gear of the auxiliary head, thus enabling the head to be secured to the spindle in a manner that makes it as nearly as possible an integral part of the drilling machine. There is an independent clamping bolt *Q* to secure the piece of work in place on the under side of the jig plate *M;* and preparatory to drilling, the castings are disk-ground on their under side. Location is accomplished by swinging the casting about the center pivot, over which it is placed on the fixture, until it comes into engagement with a pin provided for that purpose.

In the lower right-hand corner of Fig. 8 there is illustrated a motor car spring seat made of malleable iron, in which it is required to drill and ream hole *R;* and the remainder of this illustration shows three views of the fixture used for handling the job. The best illustration of the way that the casting is held for boring and reaming is shown in the upper right-hand view, where it will be seen that the flat face *S*, which has previously been disk-ground, is placed against the fixture in which there are two pins *T* that enter holes in the casting to provide for its accurate location. After this preliminary setting has been secured, the piece is clamped in place by turning handwheel *U* that forces a V-block *V* into contact with the cylindrical portion of the casting at its upper and lower ends, thus holding the work firmly in place. By referring to Fig. 9, the reader will obtain a better idea of the way in which these fixtures are constructed. As in the previous case, there are three fixtures distributed around each drilling machine table, so that the operator can busy himself in loading and unloading the fixture in the idle position while the boring and reaming operations are progressing at the other two stations.

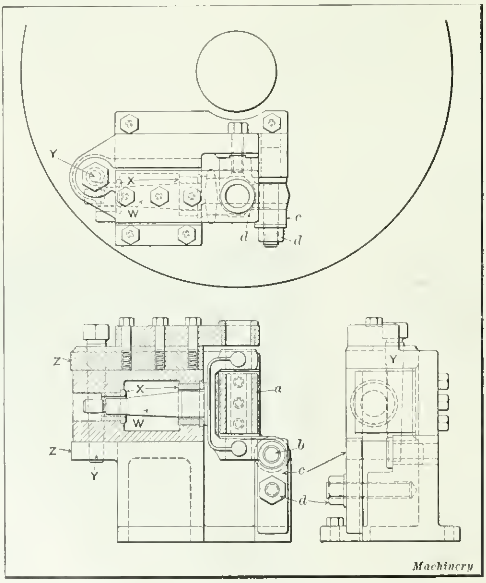


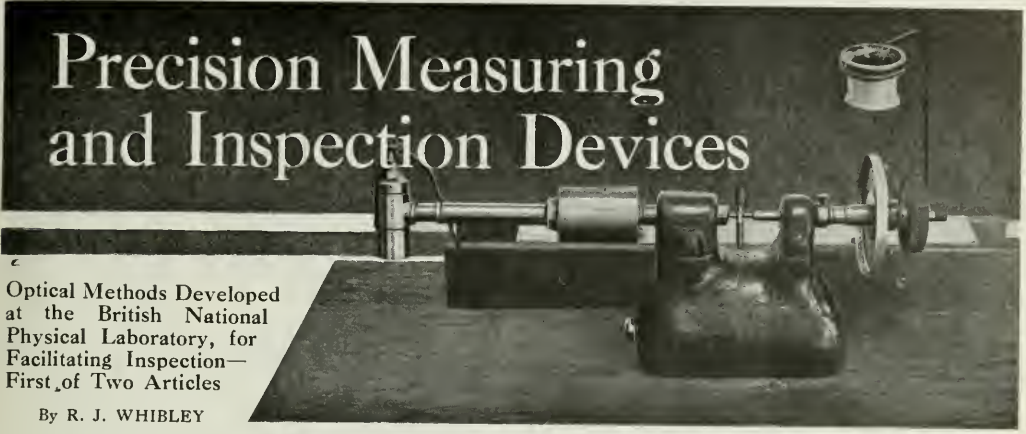
Fig. 12. Work-holding Fixture used on Machine shown in Fig. 11 for counterboring and reaming Motor Car Steering Knuckles

Boring and Reaming Motor Car Steering Knuckles

In Figs. 11 and 12 there are shown one of the new Baker Bros. drilling machines equipped for the performance of counterboring and reaming operations in forged motor car steering knuckles, and the jig used for holding the work while these operations are performed. As they come to the machine, these pieces have had the tapered shank *W* turned and the hole drilled in the lower boss on the forging, which is in a plane at right angles to the boss containing the hole to be counterbored and reamed on the present machine. Referring first to Fig. 12, it will be seen that the tapered shank *W* of the work is pushed into two hardened bushings *X*, the inside diameters of which are of the proper sizes to grip the large and small ends of the shank. These bushings are carried by a block that is mounted on a pivot *Y* so that the block is free to swing outward from its normal position between the upper and lower members of the jig body.

The counterbore and reamer used for the performance of the required operations on this piece are both piloted to maintain the desired alignment, and these pilots run in a hardened bushing *a*. It is necessary to have the block that carries bushings *X* swing outward, as previously described, in order to clear bushing *a* and allow the taper shank *W* to enter bushing *X*. The forging clears bushing *a* as it is swung into the drilling position; and the drilled hole in the lower arm of the forging pilots on a pin *b*. Clamping is accomplished by a strap *c* and bolt *d*.

Precision Measuring and Inspection Devices



Optical Methods Developed at the British National Physical Laboratory, for Facilitating Inspection—First of Two Articles

By R. J. WHIBLEY

A MEASURING machine of the Newall type uses a spring-controlled, movable anvil provided with means for indicating a definite amount of pressure. This provision is of great importance since it makes the machine practically independent of the operator. The Newall measuring machine indicates this pressure by magnifying the movement of the anvil by an amplifier that carries a specially constructed fluid level. With this device the micrometer head can be brought, in a single movement, to the measuring position and the location of the bubble in the level can be constantly seen, thus indicating the extent and direction of the required movement. But difficulty arises when rapid work is attempted with this machine, because the viscosity of the liquid in the level tube causes a lag in the movement of the bubble. This condition was very noticeable when many small wires, such as used in screw thread inspection, were measured at the National Physical Laboratory. If the wires were placed in the machine and rotated, the bubble in the level was slow to show variations in diameter of 0.00005 inch.

The arrangement now used at the laboratory is shown in Fig. 1. *A* is the ordinary level tube of a Newall measuring machine, and *B* is a clip carrying a mirror *C* on which is mounted a small plano-convex lens. A Nernst lamp illuminates a thin cross-wire against the plano-convex or half lens. This lens, since it is mounted on a mirror surface, functions as a complete double convex lens and brings the image of the cross-wire to a focus on the scale *E* after reflection from a mirror above. The mirror carrying the lens must be held in its frame as lightly as possible, as any distinct gripping deforms the lens system sufficiently to prevent an image being formed. On the scale, 0.35 inch represents a movement of the anvil of 0.0001 inch, so that the total magnification of the machine with this arrangement is 3500. The device shows by a dead beat indication a variation from roundness of 0.00001 inch in the small gage wires previously mentioned.

It is worth while noting here that in general the measuring machines used at the laboratory are not used for absolute measurements, but for comparisons. A gage, whose dimensions are known to a high degree of accuracy, is set up in the machine and the cross-wire image brought to zero. Other gages, which are the same nominal size as that of the standard used, are inserted and the image of the cross-wire brought to zero on the scale. The same range of measuring screw is in use, and all other conditions being identical at each measurements, truly comparative readings are obtained.

Another attachment that has proved extremely useful on a smaller measuring machine of the bench micrometer type is shown in Fig. 2. The interesting part of the attachment is the optical amplifier, two small mirrors being used facing one another. One of the mirrors *A* is fixed, and the other *B* is secured to a thin steel strip *C* two or three thousandths of an inch in thickness, which is deflected by the travel of the moving anvil *D*. A beam of light strikes the moving mirror, is reflected on to the fixed mirror, to be again reflected to the moving mirror which ultimately reflects the beam to a vertical scale. The emerging beam of light has been deflected through an angle four times that of the mirror movement, and this, together with the bending of the steel strip, gives an image movement on the vertical scale of 0.1 inch for a travel of 0.0001 inch of the anvil.

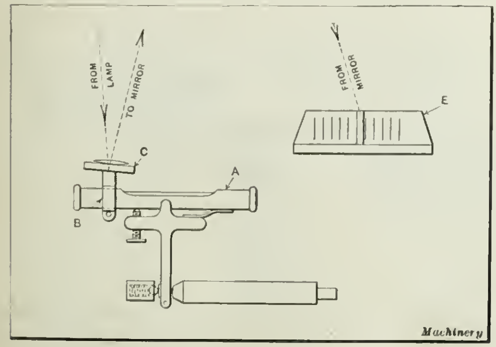


Fig. 1. Optical Attachment for Standard Type Measuring Machine

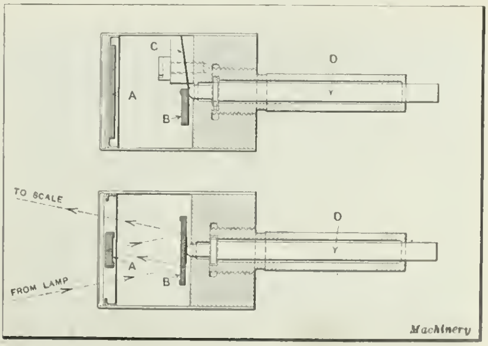


Fig. 2. Optical System used on Machine of the Bench Micrometer Type

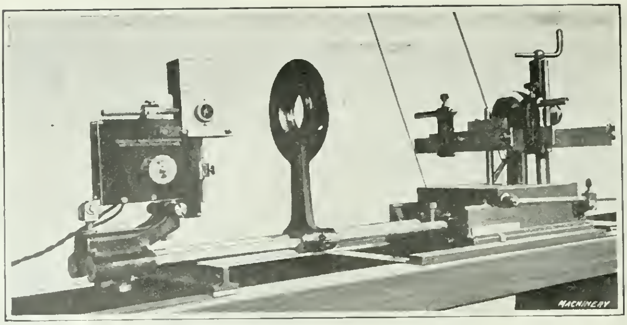


Fig. 3. Horizontal Projector for examining the Form of Screw Threads

In one application of this arrangement the light is not passed directly from the mirror system to a scale, but passes vertically downward through a slot in the bench and thence to a mirror at the floor level, which reflects the image of a pea lamp filament on a horizontal translucent scale located immediately behind the machine. This arrangement gives a still greater magnification, and the position of the scale renders observation less tiring. In the machines described the scale can be moved to bring the zero reading in coincidence with the cross-wire or filament image when a standard gage is inserted.

Projection Apparatus

A most striking innovation in the methods employed at the National Physical Laboratory consists of projecting a form silhouette on a screen of any gage that requires inspection. In this way a considerably magnified image is obtained on a plane surface so that it is easy to compare it with a line drawing of the correct form which is enlarged to the same degree. The simplicity of the projection apparatus arrangement is notable and has proved invaluable in the examination of screw-thread forms. Very definite data exist for the flank angles and shape of the top and bottom of screw threads in many standards, and it was usually considered that carefully made screw gages or screws were fairly accurate in this respect. The projector has shown that this was not the case, screw gages believed to be accurate by the makers showing extraordinary irregularities of form when magnified 50 diameters on the projection apparatus. It is now realized that screw gages may pass gages for root, pitch, and outside diameters, but still be far from accurate in form, and this fact has no doubt accounted in the past for many inexplicable breakdowns. The same difficulty occurs with formed tools of all kinds. To make the dimensions and form clear, the draftsman usually makes an enlarged view. A toolmaker, therefore, cannot be expected to make the actual size piece accurately in all respects without some means of magnifying his work. The great advantage of the projection method is that it not only shows when the form is correct or incorrect, but in the latter case shows the exact direction and magnitude of the inaccuracy. In the case of press tool work, blanking tool tables may give the proper clearances to allow for different materials and thicknesses, but there is no doubt, in the case of an intricate form of punch and die, that regularity of clearance throughout the perimeter of the punch and die cannot be obtained by ordinary inspection methods. With a projector, sections of the perimeter of the punch and die can be examined during the making, and perfect fitting obtained in a much shorter time than is possible when working practically in the dark. The projection instrument has been developed in two forms, one projecting the image horizontally on a vertical screen, and the other projecting vertically on a horizontal mirror, which reflects the image downward on a table immediately under the eyes of the machine operator.

The Horizontal Projector

The horizontal projector is shown in Fig. 3. These instruments are made to National Physical Laboratory design by George Cussons, Ltd., Broughton, Manchester, England, and consist of a special arc lamp seen at the left of the bed, a condenser, and the carriage at the forward end of the bed which carries on a support the compound projection lens. Also mounted on the forward carriage is a table which supports the work to be examined either between the adjustable centers, which can be seen, or on a small table clamped in any desired position. The work-table can be moved to and fro along the carriage for a short distance for the purpose of putting the object into or out of focus on the screen. The arm which conveys this movement carries a small block which allows the mean position of the work being examined to be varied. A small eccentric passes through the block and is mounted on a transverse shaft which is rocked by cords operated by the inspector at the screen.

The question of projection lenses is one that has caused considerable difficulty. The practice is to use a high-grade wide-aperture photographic lens and mount it with a field lens. By careful pairing it has been found possible to practically eliminate distortion of the projected image. The screen is seen in Fig. 4 with the projected image of a profile. The screen board can be moved horizontally or vertically by the operator for the purpose of superimposing the pattern drawing of the profile exactly in position over the image of the piece under examination. The magnification used is 50 diameters, and it is quite easy to see and estimate the extent of even slight divergences from the pattern.

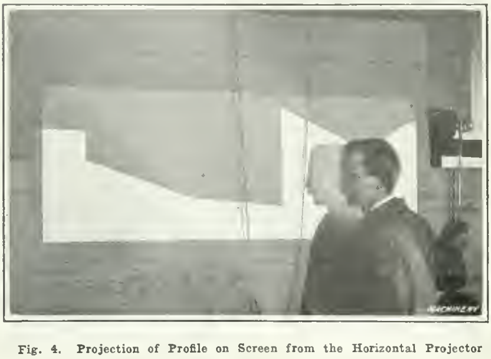


Fig. 4. Projection of Profile on Screen from the Horizontal Projector

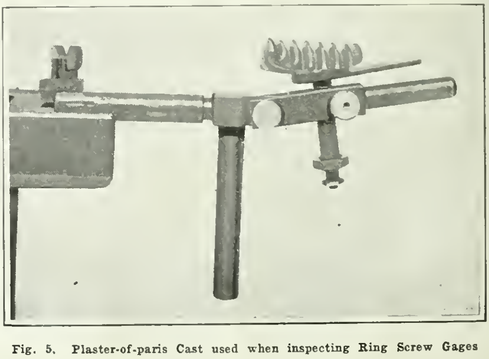


Fig. 5. Plaster-of-paris Cast used when inspecting Ring Screw Gages

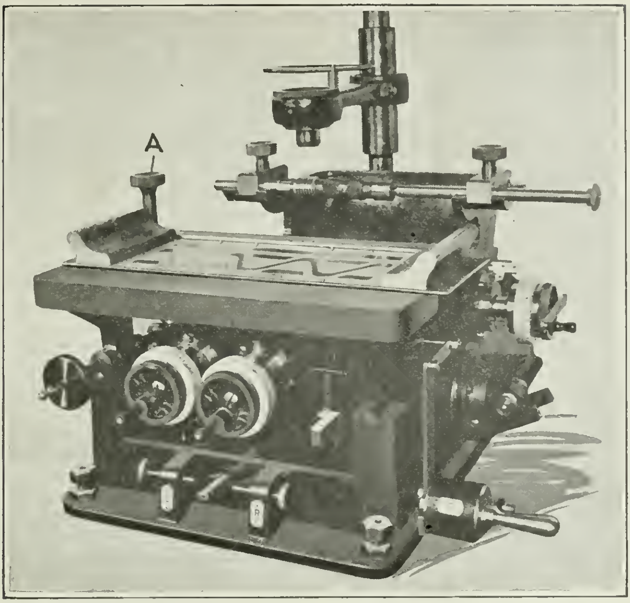


Fig. 6. Vertical Projector for examining the Form of Screw Threads

When examining the screw thread form it is important that the parallel rays from the condenser pass over the threads at an angle from the vertical axial plane and perpendicular to the helix angle of the thread. To secure this result, the rails carrying the arc lamp and the condenser can be swung around independently of the front carriage. The easiest method of setting the apparatus at the correct angle is to throw the screen image slightly out of focus by the arrangement previously described. The image of the thread form will then be bordered by a gray fringe which can quickly be made equal on each flank of the thread by adjusting the rays of the lamp and the condenser. When focus is again obtained, a sharp image of the screw thread is seen. The maximum field of the lenses that can be fitted is 1¾ inches in diameter, which makes it suitable for many profile plate gages as well as for the larger screw gages. In the case of ring screw gages, casts are taken in plaster-of-paris, and Fig. 5 shows such a cast mounted on a carrier which enables the profile of the thread to be brought quickly into the center of the field.

The Vertical Projector

The vertical projector was designed at the National Physical Laboratory especially for screw gage work, and it enables not only the form of the thread to be examined but with gages up to 2 inches in diameter, complete measurements can also be obtained. This machine is also manufactured by George Cussons, Ltd. As the enlarged image is produced on a table, which forms part of the machine, and all the mechanical movements and lighting controls are conveniently located, only one operator is required. Fig. 6 shows a general view of the machine set up for the examination of a screw plug gage, while Fig. 7 shows the optical arrangement. Light rays from an arc lamp are made

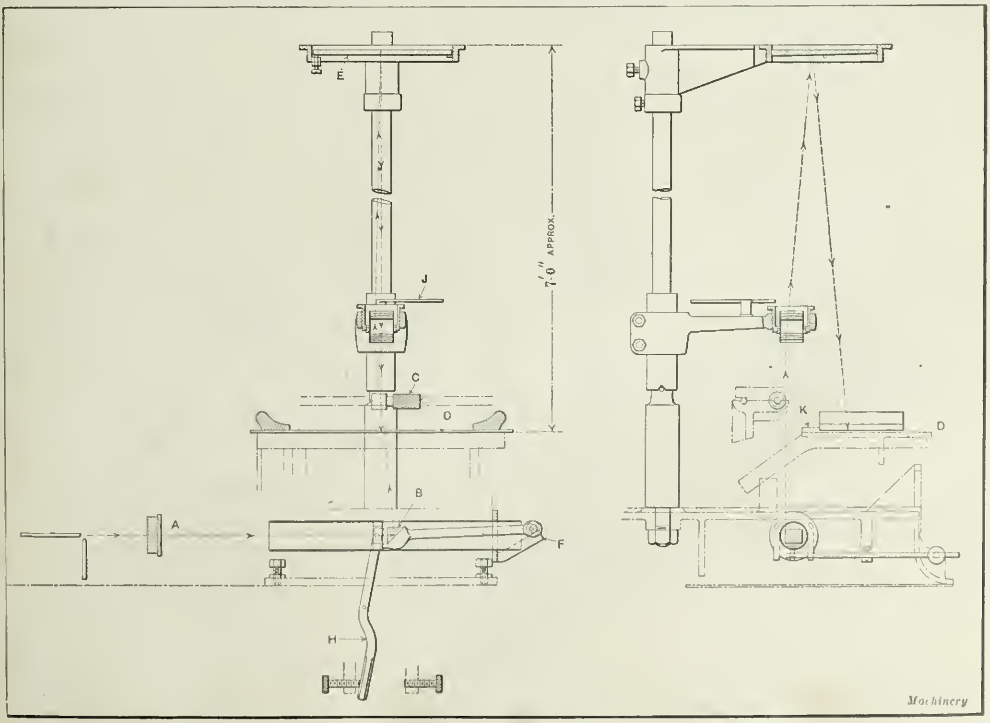


Fig. 7. Diagrammatic Lay-out showing the Optical Arrangement of the Vertical Projector, illustrated in Fig. 6

parallel by passing them through a condenser *A* and then into a tube arranged in the body of the instrument. The light, after passing through a reflecting prism *B*, passes upward, where part of it is interrupted by the thread profile of the gage *C*.

The light passing the profile now passes through a Dallmeyer kinematograph lens, which brings the silhouette image into focus at the desk *D* after reflection in the overhead mirror *E*, which is about 7 feet above the desk and is carried on a vertical pillar securely set in the bed of the machine. It will be seen that the prism *B* is set in such a position that the reflected parallel rays are not vertical, but at an angle corresponding to the helix angle of the thread gage under examination. The prism is carried on the end of a bar, the other end of which carries a roller, which runs up or down an inclined plane *F*. The inclined plane *F* determines the angular disposition of the prism *B*, and the pivoted lever *H*, shown diagrammatically, is moved between adjustable stops and slides the prism bar so that the prism is located at either side of and at the correct angle to the optical axis of the machine according to the direction of the helical angle of the screw gage. This direction varies for right- and left-hand threads and will change according to the side of the gage being examined.

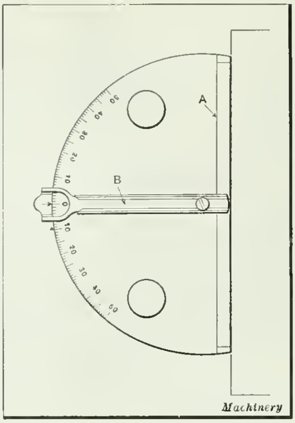


Fig. 8. Shadow Protractor used in Connection with the Vertical Projector

The reflecting overhead mirror *E* is silvered on its upper surface; therefore two images are produced, a strong one being reflected from the silvered surface and a weak or ghost image from the under glass surface. To prevent confusion from the partial overlapping of the two silhouette images formed, the mirror is slightly wedge-shaped, being thinner at the front than at the back. In this way the ghost image is considerably deflected, and does not interfere with the image proper. The correct adjustment for lever *H* is obtained by first throwing the image of the profile slightly out of focus. This is effected by temporarily swinging a frame *J* carrying a set of long-focus lenses so that one of them is brought into the optical path. This allows approximately the correct angle to be obtained. The final setting is made by noting the center of the field on the desk when the object lens is swung out of the way, which may be easily seen since it is the brightest area. After replacing the object lens, the angle of rays is further adjusted in the out-of-focus condition until equal fuzziness on each flank of a thread is obtained at the center of the field. When the frame *J* is swung out of the way, the image is ready for inspection.

All the standard thread forms are printed enlarged fifty times on zinc plates, one of which may be seen in Fig. 6, from which it will be apparent that the diagram of the thread form is not a line but a band. This band is of equal width, ½ inch throughout in a diametral direction. Parallel bands ½ inch wide also appear, the upper and lower edges of which are in line with the crests and roots of the thread form, as indicated by the inner and outer edges of the wavy band. The bands on the diagram plate are dark gray instead of black and are approximately of the same shade as the silhouette of the image. The reason for this is that when the image of one part of the gage is fitted to a corresponding part of the thread band of the diagram, any excess metal in the gage at any point will cause an overlap of the image on the gray band and will give a deeper shaded area by superimposition. This condition would not occur, however, if the

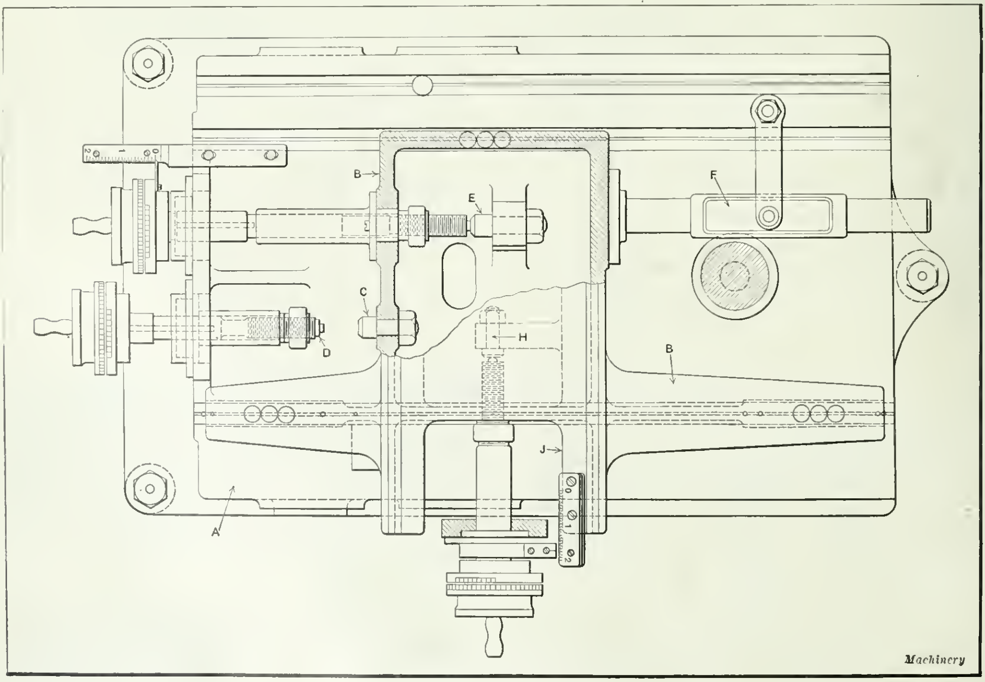


Fig. 9. View of Gaging Machine with Desk removed, showing Traveling Carriages and Micrometers used on Vertical Projector

band were black. Any insufficiency of metal at any part of the form is shown by a light streak or patch.

The angles of the thread are measured by means of the shadow protractor shown in Fig. 8. Referring again to Fig. 7, a bar *K* will be seen on the desk upon which the diagram plate bears. This bar extends the entire length at the rear of the desk and is pivoted at the right-hand end. At the left-hand end a hole in the bar fits an eccentric mounted on an upright, provided with a knurled knob which can be seen at *A*, Fig. 6. By rotating this knob the bar is rocked around its pivot to enable the diagram plate to be set so that the crests or roots of the silhouette image line up with the edge of the shadow of the bar *A*, Fig. 8, when the protractor is used. The gage carriage is then moved slightly in a diametral direction so that the image is cleared from the shadow of the straightedge *A*, Fig. 8. The radius bar *B* is then moved and the protractor slid along until the radius bar is parallel with one flank of the thread image, leaving a narrow slit of white between, so that readings can be taken in the regular manner.

The arrangements for moving the gage carriage axially and at right angles across the axes are shown in Fig. 9 which is a view of the gaging machine with the desk removed. The bedplate *A* is supplied with three leveling screws and carries an intermediate carriage *B* which is supported on three sets of three balls. These balls run in two V-grooves running at each side from the front to the back of the machine. On the long bearing side the intermediate carriage has an inverted V-groove which engages the two sets of balls, and the short bearing side has a flat under surface that engages the single set of balls. The intermediate carriage is thus mounted on a three-point support which allows it to travel in a straight line without restraint. Upon the intermediate carriage a sub-carriage is mounted similarly, but with a travel at right angles to that of the under carriage, and it is upon this sub-carriage that the centers for carrying the gages are mounted. The carriages, therefore, give true straight line motions to the gage in two directions at right angles in the same horizontal plane. The forward travel of the end carriage is limited by a stop *C*, which contacts with the head *D* of a micrometer screw whose nut is secured to the bed. The micrometer head projects conveniently at the front of the machine. The rearward travel of the carriage is limited by a stop *E* fixed to the bed. This stop contacts with the head of a micrometer screw whose nut is secured to the moving carriage, but whose spindle is carried freely through the front of the bed so that the graduated micrometer disk and handle are beside the other micrometer disk.

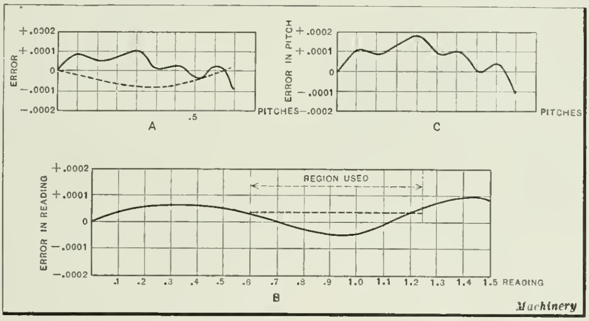


Fig. 10. Correction Curves for Thread Gage and Micrometer Screw

A weighted lever that can be seen on the right-hand side of the machine in Fig. 6, traverses the carriage between the limiting stops, the rapidity of movement being controlled by an oil dashpot *F*, Fig. 9. By operating the weighted handle, the gage is placed so that either its front or rear thread profile is projected on the desk. The axial travel of the gage carriage is limited by a stop *H* secured to the under carriage, and this stop contacts with the head of a micrometer screw whose nut is secured to the sub-carriage *J*. The sub-carriage is kept against the stop by a cord passing over a pulley and a weight.

To measure the pitch of a screw gage, the images of successive threads are brought into the same relative position on the same thread space of the diagram, the advancement required in each case being read off on the micrometer to 0.0001 inch. The means of two series of readings along the gage are taken, and the results plotted as shown at *A*, Fig. 10, in which the wavy line shows the errors either side of standard along the gage. If the micrometer screw of the machine were perfect this wavy curve would represent the corrections for the gage being examined, but usually the micrometer screw correction curve requires to be incorporated to obtain the true divergencies. Thus at *B* the complete correction curve for the pitch of the micrometer screw is shown, the region in use being transferred to the chart *A*. At *C* the combination of the two curves is shown.

To measure the outside and root diameters of a screw gage it is necessary first to mount on the machine a plain standard plug gage. The image of each edge of this plug gage is then brought successively, by means of the two micrometers in front of the machine, into coincidence with the edges of the bands on the diagram board of the screw which is to be tested, and the readings noted. The plug is now replaced by the screw gage and the crests of each side and then the roots of each side brought into coincidence with the bands as in the case of the plug gage. The micrometer readings, taken in conjunction with those obtained with the plug gage, give the dimensions for root and outside diameters. To facilitate the measurement of the pitch diameter a mark is made half way down the flanks of the threads in the magnified diagrams. These are useful if the flanks of the gage thread image do not lie parallel to the diagram, as then the flanks can be made to intersect half way down at the marks, and by rocking the carriage to view each side of the gage successively, the pitch diameter can be measured by the micrometer, the result being equivalent to measuring with wires in the thread vees with the exception that the reading in this case is obtained directly. All three inspection diameters can be measured to 0.0001 inch.

The next installment of this article, which will appear in the November number of MACHINERY, will describe the minimeter and the gage comparator used by the National Physical Laboratory for inspecting precision gage-blocks, by means of which readings to an accuracy of one-millionth inch can be made.

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PATENTS ISSUED BY VARIOUS COUNTRIES

The table below gives the total number of patents that have been issued by the leading industrial countries up to the end of 1915. There are no statistics covering completely the number of patents issued since that date in some of the countries that were involved in the war:

	Patents
Austria-Hungary	156,975
Belgium	242,267
Canada	166,199
France	404,514
Germany	296,514
Great Britain	450,440
Italy	129,428
Norway	27,520
Russia	30,844
Spain	54,390
Sweden	41,588
Switzerland	72,275
United States	1,055,802
Total	3,128,756

Dies for Automobile Service Brake Covers

By J. BINGHAM, President, The B. J. Stamping Co., Toledo, Ohio

SIX punch press operations are required in the manufacture of a service brake cover for a certain type of automobile, which is of such shape that it seemed at first to be very difficult to produce. While four of the operations are performed on machines equipped with punches and dies of standard construction, such as have been described by the writer in previous numbers of MACHINERY, the remaining two require punches and dies of such an unusual design that a description of them will prove interesting. The appearance of the shell after the performance of each operation is shown in Figs. 1 and 2, in which the reference letters indicate the procedure of the successive operations. These illustrations give the dimensions of those portions of the shell that are changed in any of the operations, while the drawing of the completed shell, shown at *F*, Fig. 2, is fully dimensioned. The blank required for the production of this part is cut from cold-rolled stock 0.065 inch thick, and is 8¾ inches in diameter.

Blanking, Drawing, and Trimming Operations

The first operation consists of cutting the blank to the diameter stated, and then drawing it to the shape and dimensions shown at *A*, Fig. 1. The machine used for this operation is equipped with a combination blanking and drawing die. In the second operation, the dome of the shell is redrawn to a smaller diameter and the flange is bent back as shown at *B*. This shaping is accomplished by means of a drawing die, the punch and die being cut away suitably to permit the flange to be bent. The third operation is performed on a press equipped with a trimming die, and consists of cutting the edge of the flange to the diameter indicated at *C*.

Forming Punch and Die

The fourth operation consists of forming the shell to a conical shape, edging up the flange, and making a further reduction in the diameter of the small end. The appearance of the shell at the completion of this operation is shown at *D*, Fig. 2. It will be noted that the flange, conical portion, and diameter of the cylindrical portion at the small end, reach their final stage in this operation and remain unchanged during the succeeding ones. The punch and die used in forming the shell as mentioned may be seen in Fig. 3, in which the punch is shown in the position it holds at the completion of the downward stroke of the press ram.

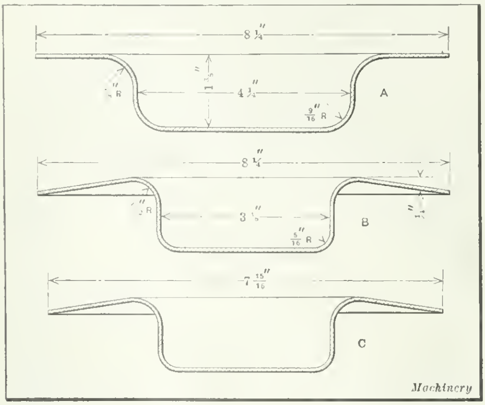


Fig. 1. Appearance of Shell after Blanking and Drawing, Redrawing, and Trimming Operations

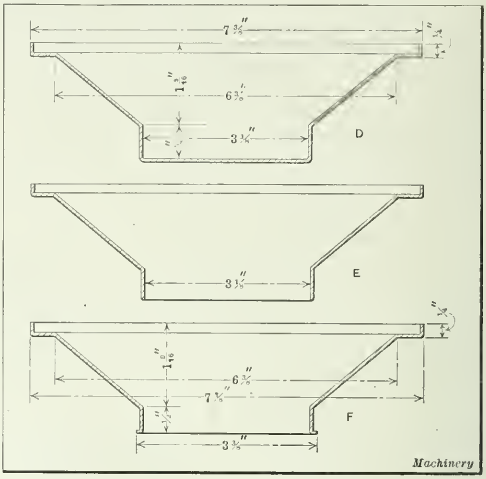


Fig. 2. Shell after Forming, Blanking and Edging Operations have been performed

When the punch is withdrawn from the die, on the return stroke of the ram, rings *A* and *B* and part *C* are raised by springs, thus causing the finished shell to be ejected from the die. Rings *A* and *B* are then used in locating another unfinished shell in the die, preparatory to the next descent of the punch. Ring *B* is raised until a shoulder on the ring comes in contact with the under side of ring *D*, by means of coil springs placed in holes in base *E* which are arranged in a circle beneath ring *B*. Ring *A* and part *C* are raised through the medium of coil spring *F* which raises part *C* until a shoulder on the latter comes in contact with the lower surface of ring *A*, after which the two parts are raised together until the shoulder on ring *G* prevents ring *A* from rising further.

The shell is forced from the punch on the return stroke of the press ram by means of a mechanism which lowers ring *H* on punch *J* until the shoulders on the ring and the punch come in contact with each other. The mechanism that actuates ring *H* consists of knock-out rod *K* which forces bar *L* and pins *M* downward. The latter are screwed into the upper side of ring *H*. The method of arranging ring *H* on punch *J* insures the maintenance of the proper relation between the two parts. The stationary die rings *D* and *G* are each secured to base *E* by means of six fillister-head screws, while ring *N* is attached to punch-holder *O* in a similar manner. All the rings and contact faces of this punch and die are hardened and ground. It may be thought that this punch and die will not function properly due to the large number of moving parts contained in its construction; however, excellent and consistent results have been obtained through its use.

Final Operations on the Small End of the Shell

In the fifth operation, a hole is cut through the small end of the shell as shown at *E*, Fig. 2, a standard type of blanking die being used for this purpose. The next and final operation on the shell consists of bending back the edge

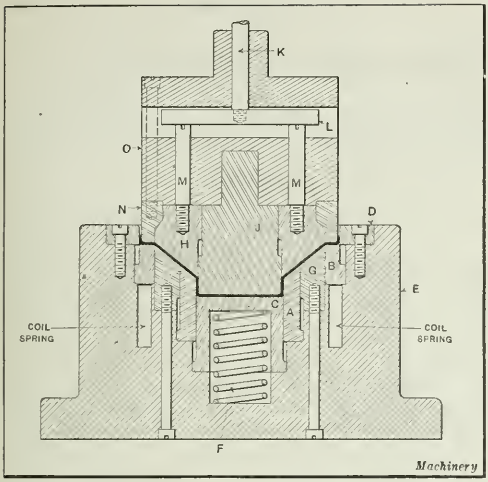


Fig. 3. Construction of Punch and Die employed in forming the Shell as shown at D, Fig. 2

formed by cutting the hole, as indicated at *F*. The punch and die used in performing this sixth operation is illustrated in Fig. 4, in which the punch is shown in its position at the end of the downward stroke. This die is of unusual construction, the part which supports the shell during the operation being made of two sections, one of which is shown at *A*. These sections pivot on pin *B*, and when closed together form an opening of the same size and shape as the outside of the shell after the preceding operation. The purpose of constructing the die in this manner is to permit the removal of the shell from the die after the edge on the small end has been bent back, this removal being readily accomplished after the die sections have been drawn apart. The function of pin *C* is to keep the ends of the die sections tight against plate *E* after they have been closed. The sections are retained in the closed position by suitable means which connect the jaw-like ends.

When the punch is withdrawn from the die, three compression coil springs *F* force plate *E*, and consequently the die sections, upward about 3/16 inch. This is enough to permit the shell to be placed in the closed die sections without the lower edge of the shell touching the bending groove on the die part *D*. The pressure of the springs is sufficient to hold the shell close against face *G* of the punch when the punch descends into the die. This insures that the shape of the body of the shell will remain unchanged as the shell is pushed down on part *D* and the edge is bent back. Part *D* is tapered slightly to allow the shell to be easily removed after the die sections are opened. Plate *E*, die-block *H*, and punch-holder *I* are made of cast iron, all the remaining parts being made of tool steel.

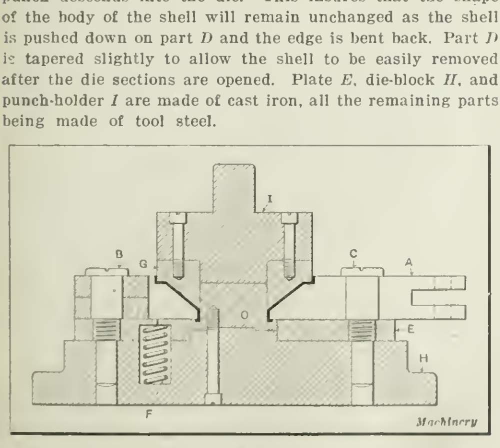


Fig. 4. Die provided with Two Members that can be swung aside to permit the Removal of the Shell

STANDARD TAPERS FOR LATHE AND GRINDING MACHINE CENTERS

Since making the discovery, in our own practice, of the remarkable results obtained by using high-speed steel for lathe and grinding machine centers and deciding to put them on the market with our line of lathe tools and machine dogs, we have found that one of the things that seemed to cause a great deal of trouble is the variety of tapers used for centers.

In general practice, it is customary to use Morse tapers for drilling machines, but when it comes to grinding machines and lathes, there seems to be a big diversity of opinion as to which is the best. Of ten large grinding machine manufacturers three use Brown & Sharpe tapers, three use Morse, and four use Jarno. In the case of lathes, out of thirty-three large concerns, twenty use Morse, one Brown & Sharpe, five Jarno, two Reed (which is a short Jarno), two modified Morse (longer than the standard Morse but the same taper), and three use tapers entirely of their own design.

We planned first to carry Brown & Sharpe and Morse tapers in stock. Later we found that we would also have to carry the Jarno taper, and now we find that we must also have the modified Morse taper, as this is used by the Hendey Machine Co. of Torrington, Conn. We also found that we had to carry the short Jarno taper, which is used by the Reed-Prentice Co. of Worcester, Mass. In addition to this, we find that there are a great many concerns who make centers for themselves from carbon steel, that do not seem to conform to any standard whatever.

It would seem to the writer that when anyone must use a taper center he should use one of the three standards, Brown & Sharpe, Morse, or Jarno. The last seems preferable, because its dimensions are easily remembered, and it has a standard taper throughout all sizes. The number of the taper indicates its length in half inches, the diameter at the large end in eighths of an inch, and the diameter at the small end in tenths of an inch. Take, for example, a No. 10 Jarno taper. The length is ten half inches, or five inches. The diameter at the large end is ten eighths or 1¼ inches, and the diameter at the small end is ten tenths or one inch. The taper is 0.600 to the foot and is the same for every number.

In the case of the Morse taper there are six different tapers per foot, every taper except Nos. 2 and 3 being different. The Brown & Sharpe tapers are all one-half inch per foot, except No. 10, which is 0.5161 inch per foot. Another difficulty about the Brown & Sharpe tapers is that there are more than two lengths of shanks for the same number in many instances.

It would seem that reference to these conditions may be of service to those who are considering establishing a taper of their own. It does not seem possible for all to adopt one standard at this time, as it would be too expensive for the larger manufacturers to make a change, but certainly, when anyone is designing a new lathe or deciding to use a taper shank of any kind, they should adopt some well-known standard.

Bridgeport, Conn. THOMAS FISH, President,
The Ready Tool Co.

* * *

An extended research on the subject of automobile steels has been carried out by the research committee of the Institution of Automobile Engineers of Great Britain. A report covering the investigation will be published and will contain a vast amount of information in regard to the physical properties of the ten automobile standard steels of which the specifications are given in the British Engineering Standards Association Report No. 75. The report may be obtained from the offices of the Institute of Automobile Engineers, 28 Victoria St., London, S.W., 1, England.

Manufacturing for Selective Assembly

Comparison of Interchangeable and Selective Assembly Manufacturing Methods—Dimensions and Tolerances on Drawings for Manufacturing on a Selective Assembly Basis

By EARLE BUCKINGHAM, Engineer, Pratt & Whitney Co., Hartford, Conn.

Selective assembly manufacturing is a method of manufacturing which is similar in many of its details to interchangeable manufacturing. In the selective assembly, the component parts are sorted and mated according to size, and assembled or interchanged with little or no machining. Because of their similarity, the two methods are often confused, and this has led to misapprehensions in regard to the principles of interchangeable manufacturing. The production of many commodities involves both methods of manufacture and this has led to even greater confusion. The general principles of both of these methods are compared in this article for the purpose of explaining the principles involved.

THE chief purpose of manufacturing, by selective assembly or interchangeable methods, is the production of large quantities of duplicate parts as economically as possible, within such limits that they may be assembled without further machining. In order to achieve this, close attention must be paid to the basic principles governing production, including the design of the mechanism and the process of manufacture.

The general principles of design are identical for manufacturing on an interchangeable basis and on a selective assembly basis. The functional design must first be made and tested, then the manufacturing design developed. This modifies the inventive design so that the product may be manufactured on a large scale in an economical manner. This subject of design was previously discussed in the September, 1919, number of MACHINERY. One point, however, should be kept constantly in mind. It is seldom that every part of a mechanism is to be made for selective assembly. Usually a very small percentage of the parts are so made.

A model mechanism is the representation of the design in metal. Thus, as with the design, the general principles and purposes of the model are identical for both interchangeable and selective assembly manufacturing. The purposes of models were discussed in the October, 1919 number.

Clearances and Tolerances in Selective Assembly Manufacturing

The matter of clearances and tolerances is quite different when manufacturing on an interchangeable basis from when manufacturing on the basis of selective assembly. In interchangeable manufacturing, the minimum clearances should be as small as the assembling of the parts and their proper operation under service conditions will allow. The maximum clearances should be as great as the functioning of the mechanism permits. The difference between the maximum and minimum clearances establishes the sum of the tolerances on the companion surfaces.

However, when this allowable difference is smaller than normal manufacturing conditions will permit, parts cannot be economically manufactured on an interchangeable basis. In such cases one of two courses is open. First, excess metal may be left on one part which is fitted at assembly—this usually proves an expensive process; or second, tolerances can be established which enable the parts to be manufactured economically and then sorted and assembled according to their size. This second method is known as selective assembly manufacturing. There are several methods of attaining this end. In general, the usual method consists of treating the more intricate companion parts like interchangeable parts; that is, making the basic dimensions on one part represent the maximum metal conditions, and having the tolerances define the minimum metal conditions. The extent of the tolerances, however, will be determined by the extent of the normal manufacturing variations. The basic dimensions of the companion part would represent the minimum metal condition—not the maximum metal sizes as in interchangeable manufacturing—and the direction and extent of the tolerance would be identical with the first piece.

The practice, which is correct for selective assembly, of making the tolerances represent the normal variation of the manufacturing process employed, is often mistakenly used when manufacturing on an interchangeable basis. If such a practice adds nothing to the expense of production, there is no harm in employing it; but too often it imposes unnecessary refinement in manufacture, as in almost every case, the closer the tolerances, the more exacting and expensive will be the manufacturing processes. With selective assembly manufacturing, on the other hand, the closer the tolerances, the fewer the subdivisions in size that will be required, and the smaller the stock of parts it is necessary to carry. This introduces a factor in selective assembly manufacturing which is not present in interchangeable manufacturing. The economical balance between the increased cost of manufacturing to closer tolerances and the decreased cost of investment represented by a smaller stock of different sized parts establishes the proper course to follow when manufacturing on the basis of selective assembly. Ultimate economy here, as elsewhere, is the main end sought.

Dimensions and Tolerances on Component Drawings

Many of the general principles in regard to component drawings for parts made for selective assembly are the same as for interchangeable parts. Several details vary, however, due to the differences in treating the clearances and tolerances. In both cases the effort should be made to so give the dimensions and necessary tolerances on the drawings that it will be possible to lay out one, and only one, representation of the maximum metal condition and one, and only one, minimum metal condition. In addition to this, for selective assembly, some notation must be made to indicate the proper grading and classification according to size. Thus, in selective assembly manufacturing, there will be a double set of limits, the first being the manufacturing limits, and the second the assembling limits.

Take, for example, the stud and hole shown in Fig. 1, which give the proper assembling conditions. The minimum clearance is 0.0000 inch while the maximum clearance is 0.0004 inch. Assume that the normal manufacturing variation on each part will be 0.0010 inch. Fig. 2 gives one method of notating both sets of limits. Any studs in Group A, for example, will assemble in any hole in Group A, but the studs in one group will not assemble properly in the holes in another group. The above example shows one method of grading parts when both of the companion parts are to be sorted before assembly. Many times in actual practice, when one of the parts is complicated, and the majority of its surfaces are interchangeable ones, the minor part only is sorted according to size. In such cases, instead of defining grades for the major part, a note to the following effect is substituted, "Select stud to suit at assembly."

In many cases, two separate drawings are made of a part which is to be graded before assembly. One shows the manufacturing tolerances only, so as not to confuse the machine operator, while the other gives the proper grading information. In an article entitled "Component Drawings for Interchangeable Manufacture," published in the November number, five laws of dimensioning were given for interchangeable parts. All of them, except the third, apply equally to parts which are selectively assembled. The laws which apply to this method of manufacture will be given again.

Laws of Dimensioning when Manufacturing for Selective Assembly

1. In manufacturing, there is only one dimension (or group of dimensions) in the same straight line which can be controlled within fixed tolerances. This is the distance between the cutting surface of the tool and the locating or registering surface of the part being machined. Therefore, it is incorrect to locate any point or surface with tolerances from more than one point in the same straight line.

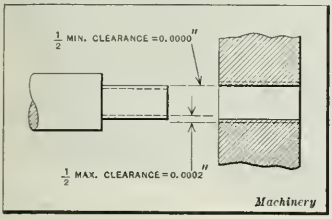


Fig. 1. Proper Assembling Conditions in Selective Assembly

2. Dimensions should be given between those points which it is essential to hold in a specific relation to each other. The majority of dimensions, however, are relatively unimportant in this respect. It is good practice to establish common location points in each plane, and to give, as far as possible, all such dimensions from these common location points.

3. This law relates to the proper basic dimension to be given on the component drawing. In selective assembly the conditions which must be met are so different, that no general rule in this respect can safely be given. Each case requires special consideration.

4. Dimensions must not be duplicated between the same points. The duplication of dimensions causes much needless trouble, due to changes being made in one place and not in the others. It causes less trouble to search a drawing to find a dimension than it does to have them duplicated and more readily found but inconsistent.

5. As far as possible, the dimensions on companion parts should be given from the same relative locations. Such a procedure assists in detecting interferences and other improper conditions.

Similarity of Specifications, Equipment, Gages, and Inspection Methods

The general principles of specifications for interchangeable manufacture, which were given in the March number, hold true for manufacturing on a selective assembly basis. Particular care should be taken to specify clearly the parts to be so manufactured and the method of grading to be followed. If the component drawings are properly made, there is no difference in the actual productive operations between manufacturing on an interchangeable and on a selective assembly basis. In both cases, the task is to produce parts within specified tolerances. Therefore, the conditions governing the design of the manufacturing equipment are constant.

The working and shop inspection gages for either interchangeable parts or those made for selective assembly are similar. Additional gages for the purpose of grading, however, are required for the final inspection. Often these are indicator gages, which promote the rapid sorting of the product. In other cases, gages with successive steps or with slightly tapered measuring surfaces are used.

The detailed shop inspection differs in no particular from that employed in interchangeable manufacturing. The only difference is the addition of the selection and grading of the parts after completion. Sometimes the actual selection takes place at the assembly itself. If the first part tried is too large or too small, another is chosen which assembles properly. If the rate of production is relatively low, this procedure is often satisfactory. In fact, it is often observed in the assembly of parts which are supposed to be interchangeable. But if the production is high, too much time will be lost by the assembler to make the practice economical.

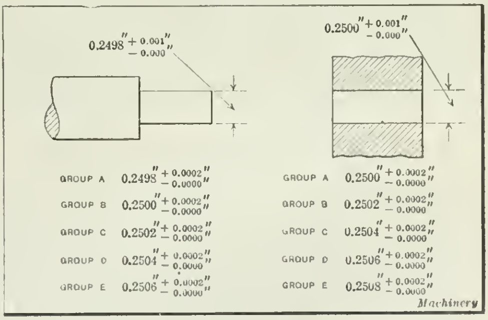
In general, manufacturing on an interchangeable basis will be found more economical than manufacturing on a selective assembly basis, provided the design permits sufficient clearances to allow reasonable manufacturing tolerances. In the first place, a larger stock of parts is required for selective assembly to insure that companion parts of suitable sizes will always be available. In the second place, the additional expense of sorting, whether done by an inspector or by the assembler, is involved in this method of manufacture. In its actual operation, the main difference between selective assembly and interchangeable manufacturing is that overlapping tolerances are required in selective assembly while such tolerances are absolutely wrong in interchangeable manufacturing.

* * *

BRITISH MACHINE TOOL IMPORTS AND EXPORTS

The imports of machine tools into Great Britain during the first six months of this year had a value of nearly £1,600,000 or at present exchange, about $6,000,000. For the corresponding six months in 1919 the value was £2,250,000 or over $8,000,000. In 1914, during the corresponding six months, which was previous to the war, the imports amounted to only £215,000, or at the exchange value at that time, about $1,050,000. The exports of machine tools from Great Britain during the first six months of 1920 had a value of £1,200,000, or about $4,500,000. This is an increase of 50 per cent over the exports for a similar period in 1919.

Generally speaking, the imports today are three times the imports previous to the war on the basis of quantity, and seven times the imports on the basis of value. The exports are slightly larger than the pre-war exports in quantity, and about two and one-half times as large as the pre-war exports in value. It is significant that the exports are steadily growing, while the imports are decreasing.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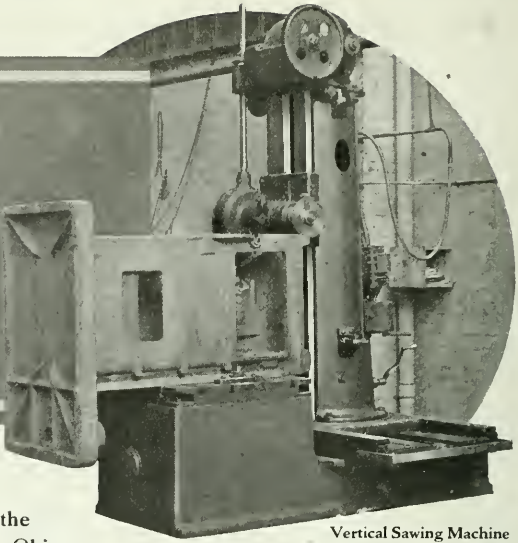
0.2500" + 0.001" − 0.000"
GROUP A 0.2498" + 0.0002" − 0.0000"
GROUP B 0.2500" + 0.0002" − 0.0000"
GROUP C 0.2502" + 0.0002" − 0.0000"
GROUP D 0.2504" + 0.0002" − 0.0000"
GROUP E 0.2506" + 0.0002" − 0.0000"
GROUP A 0.2500" + 0.0002" − 0.0000"
GROUP B 0.2502" + 0.0002" − 0.0000"
GROUP C 0.2504" + 0.0002" − 0.0000"
GROUP D 0.2506" + 0.0002" − 0.0000"
GROUP E 0.2508" + 0.0002" − 0.0000"
Machinery

Fig. 2. Information placed on Drawings used in Selective Assembly Manufacturing to facilitate the Grading of Parts

During the month of June the imports of machine tools from all countries into Great Britain amounted to £340,000, at present exchange equal to about $1,300,000. The exports of machine tools from Great Britain amounted to about £265,000 or about $1,000,000. The largest item in the exports is represented by lathes, the value of the exports being about $400,000. The largest imports were drilling machines valued at about $360,000.

Special-Purpose Machines in the LeBlond Plant



Vertical Sawing Machine for Milling Machine Columns

Design and Construction of Machines Employed for Special Purposes in the Shops of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio

FREQUENTLY a special-purpose machine proves itself superior to a standard type of machine tool for some unusual operation. Sometimes there is no machine on the market that is particularly adapted for handling a certain class of work; again, the general design of a standard machine may be suitable, but the size of the work to be done may be such that a special machine is preferable. If there is enough work to be done of a special nature, a special machine, then, will prove a valuable addition to the shop equipment. It is not always necessary, however, to construct an entirely new machine, because a standard machine can frequently be modified by the use of attachments to perform special operations. The present article deals with several special machines used by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, that have either been entirely built by the company, or modified by means of attachments and reconstruction to meet special conditions in the LeBlond plant. The reason for building these machines was that there were no standard machines on the market specifically suited for the class of work for which these machines are used.

Vertical Sawing Machine Built for Operation Customarily Performed on Radial Drilling Machines

The machine shown in the heading illustration and also in Fig. 1 is a vertical sawing machine designed for splitting the support provided on the top of milling machine columns for the overhanging arm. Ordinarily this operation is performed on a radial drilling machine, the slitting saw being attached in a horizontal position to the drill spindle and fed the length of the overhanging arm support by moving the spindle head outward along the radial arm of the machine. However, this is a class of service for which a machine of this type was never intended and for which it is not suited on account of the side strains to which the spindle is subjected. There being no other machine on the market better adapted for performing this operation, the special machine described was built.

Reference to the heading illustration will make clear the manner of mounting the work on the table of the machine, the slitting operation being performed by feeding the cutter-head downward. A five-horsepower variable-speed motor mounted on the top of the column furnishes the power for driving the cutter-spindle and for feeding or reversing the cutter-head. An automatic control manufactured by the Electric Controller & Mfg. Co. is supplied for the motor. By referring to section *X-X*, Fig. 1, it will be seen that a pinion mounted on the motor shaft drives a large spur gear on one end of the shaft *A*. At the opposite end of shaft *A* is mounted a bevel pinion which engages with a gear mounted on sleeve *E*, section *Y–Y*, to which the worm-shaft *B* is keyed, but through which it is permitted to slide as the cutter-head *D* is raised or lowered. A bevel pinion keyed to the lower end of shaft *B* drives the large gear shown at the left-hand end of the cutter-spindle *C*, section *Z-Z*. The slitting saw is attached to the right end of this spindle.

Arrangement for Feeding and Reversing the Cutter-head

The lowering and raising of the cutter-head *D* is effected through worm threads cut on the sleeve *E* previously referred to, which drive worm-wheel *F*. On the same shaft with this worm-wheel is mounted a small spur gear *G* which drives a large gear *H* keyed on the left end of shaft *I*. This shaft drives shaft *J* by means of a sleeve to which both shafts are keyed but in which the left end of shaft *J* is a sliding fit. Two bevel pinions *K*, one for feeding and one for reversing the cutter-head, are mounted on shaft *J*, either one of which can be meshed with the gear on the upper end of the feed-screw *L*. The feed-screw is provided with left-hand threads for almost its entire length, which pass through the nut *M* attached to the back of the cutter-head *D*. This arrangement permits the cutter-head to be raised or lowered as desired, depending upon which pinion *K* is placed in mesh with the bevel gear on the top of the feed-screw.

Gears *G* and *H* have 18 and 51 teeth, respectively, and when arranged as shown, the feed of the cutter-head is 0.015 inch per revolution of the cutter-spindle. When they are reversed, the feed is 0.125 inch per revolution of the spindle. Through the use of another set of change-gears having 29 and 40 teeth, respectively, feeds of 0.031 and 0.062 inch per revolution of the spindle can be obtained. The sidewise operation of shaft *J* is accomplished by means of the mechanism shown at *N*. The handle on this device is provided with a locking spring pin which may be inserted in one of three holes in the bracket which supports the device. These holes are located so as to permit either of pinions *K* to be locked in mesh with the gear on the feed-screw, or to hold them both in a neutral position. The heading illustration shows a modification in this feature of the machine. In this illustration the control of the mechanism is placed near the bottom of the column so that it will be convenient for the operator, and it is connected by means of a long rod with a lever on shaft *O*, Fig. 1.

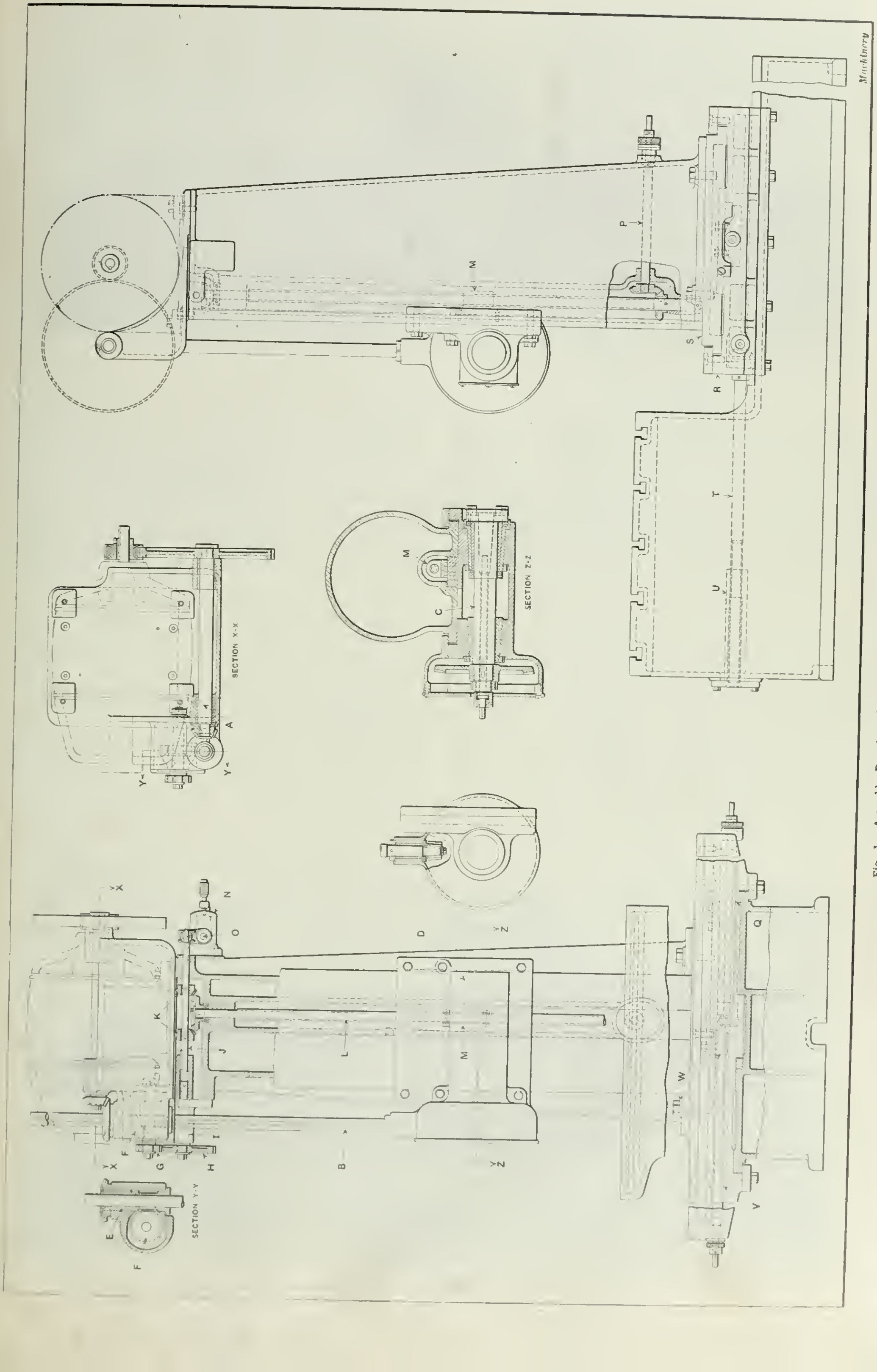


Fig. 1. Assembly Drawing of Sawing Machine shown in Heading Illustration

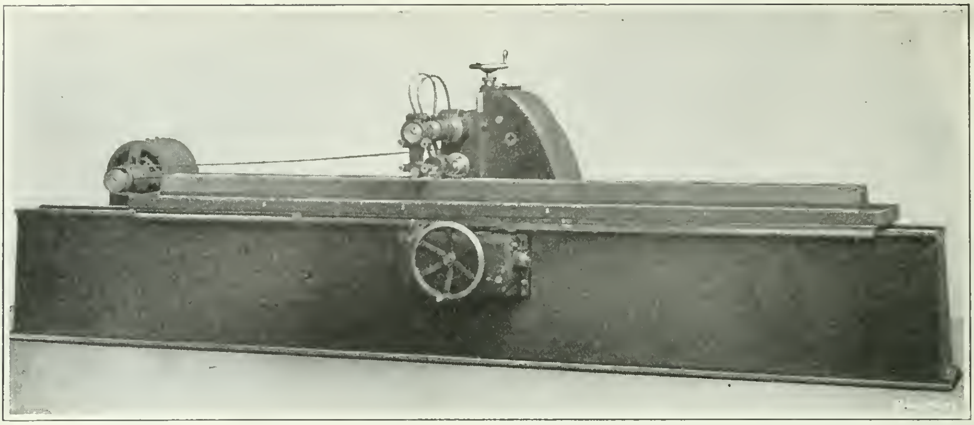


Fig. 2. Machine built for milling Keyways in Long Shafts

The cutter-head can also be fed or raised by hand when pinions *K* are in a neutral position, through revolving shaft *P* in the lower portion of the column, by means of a crank-handle placed on the square end of this shaft. It is obvious that the bevel gear at the opposite end of the same shaft drives the gear near the bottom of the feed-screw, thus rotating the feed-screw, which causes the cutter-head to be operated in the manner previously described. It will be noted that a ball bearing is placed beneath the bevel gear on the upper end of the feed-screw.

Lateral and Transverse Adjustments of the Column

A comparison between the heading illustration and Fig. 1 will show a slight difference in the construction of the table. In the heading illustration a special casting having a series of T-slots on its upper side running at right angles to each other, is bolted to the built-up portion of the base. No special casting is shown in Fig. 1 and the T-slots run only in a lateral direction. The discrepancy between the two illustrations is due to the drawing not having been changed to suit the machine as finally built. Provisions have been made for adjusting the column of the machine by hand in both transverse and lateral directions to suit the work. The transverse adjustment is obtained by rotating shaft *Q* which is supported in bearings in lugs cast on base *R*, through the medium of a crank-handle placed on the square end of the shaft which projects beyond the side of base *R*. At the opposite end of this shaft is a miter gear that meshes with a similar gear on shaft *T*. This shaft is attached to base *R* at right angles to shaft *Q* and extends forward into the built-up portion of the base. The front end of the shaft is provided with threads that engage with nut *U* bolted to the front end of the base. Thus as shafts *Q* and *T* are revolved, shaft *T* is either advanced into nut *U* or expelled from it, at the same time imparting a similar movement to the column through bases *R* and *S*.

Lateral adjustment of base *S*, and therefore of the column, is obtained by turning screw *V*, which extends across the entire width of base *R*. This screw is shown broken off near the center of the front view of the machine in order to clearly show the mechanism employed in obtaining the transverse adjustment of the column. The end of screw *V*, which is not shown in this view, is of the same construction as the end shown, so it is apparent that the screw can be turned from either side of the machine through the use of a crank-handle. The screw passes through a nut *W* bolted on the under side of base *S*, near the center, and as the threads of the screw engage with those of the nut when the screw is rotated, base *S* and the column are adjusted laterally. Attention is called to the flat bar guard shown in the heading

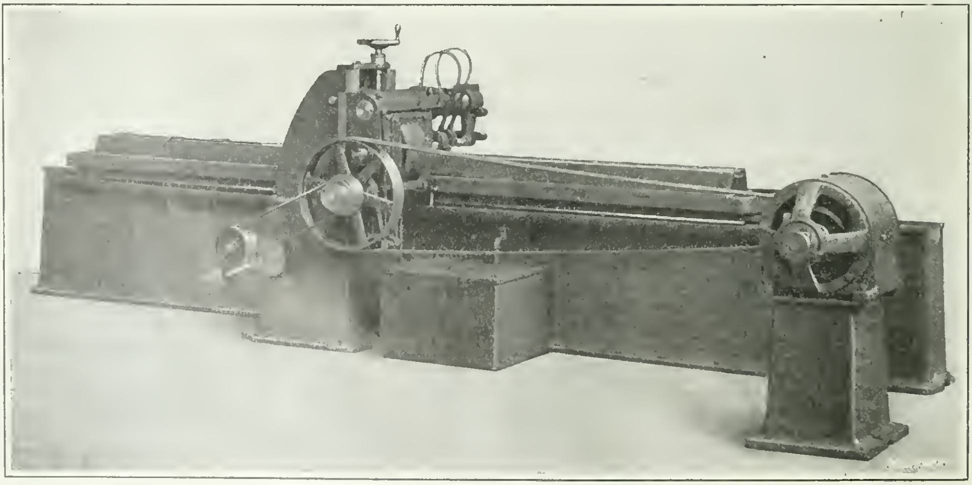


Fig. 3. Rear View of Special Keyseating Machine shown in Fig. 2

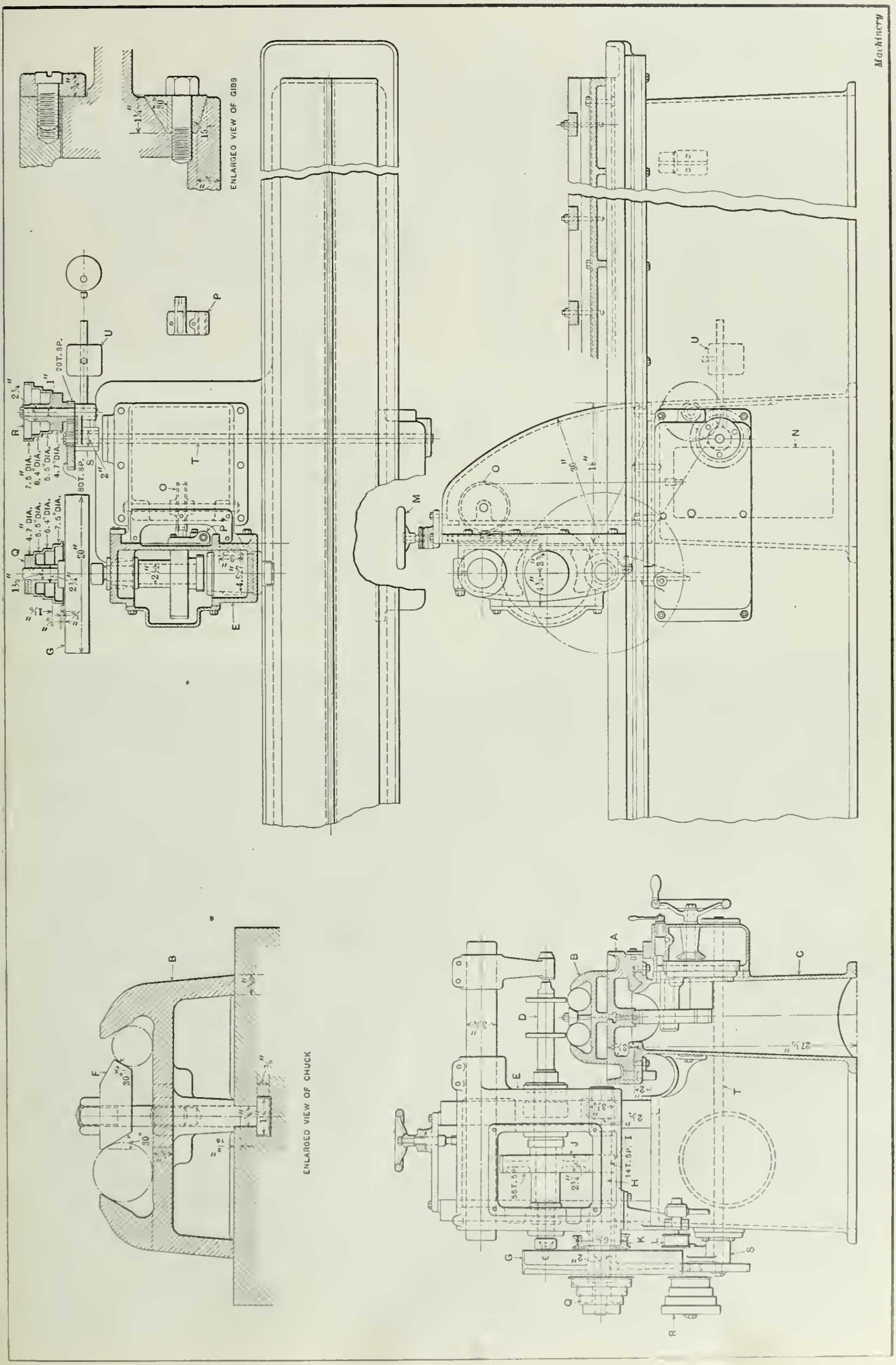


Fig. 4. Construction and Important Details of Keyway Milling Machine shown in Figs. 2 and 3

illustration, which was provided to protect the ends of shaft *Q* and screw *V* from injury. This guard is raised when an adjustment of the column is necessary so that a crank-handle can be placed on either the shaft or screw to accomplish this purpose.

While the machine was designed especially for the work previously mentioned, it can be employed for operations that are slightly different. Arrangements could be made to modify the bottom of the column and base *S* to permit the column to be swiveled on the base. This would allow the cutter to be applied in an angular relation to the work.

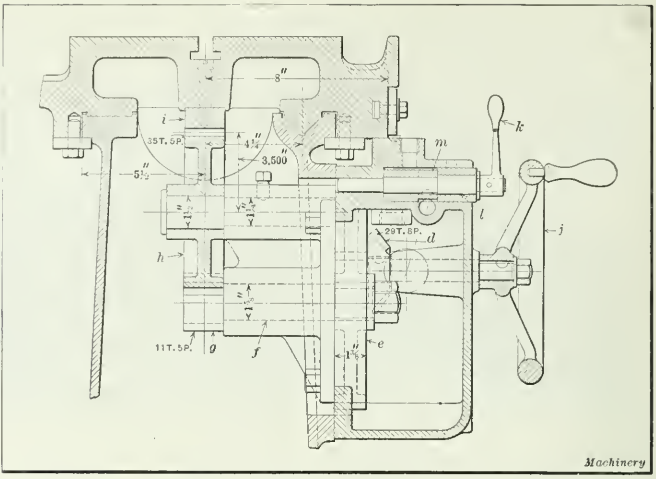


Fig. 5. Sectional View through Feed Control Box, and Portion of Gearing employed in driving the Table of Keyway Milling Machine

Special Keyseater for Long Shafts

Figs. 2 and 3 show the front and rear views of a planer type of milling machine which was designed for milling keyways in long shafts from ¾ to 3 inches in diameter, without necessitating resetting the work. One or two shafts are milled at a time, although the machine could be arranged for milling a larger number simultaneously. When two shafts are being machined, gang cutters are used. In this case there was a machine on the market that could have been utilized for the work, but it was especially suited for larger work and would have been more expensive than the special machine here described.

The construction and operation of the keyseater will be more readily understood by referring to Figs. 4, 5, and 6. In Fig. 4 it will be seen that a table *A* on which is mounted a chuck *B* for holding the work, is supported on a long bed casting *C*. A mechanism is provided for traversing the table and chuck past the cutters mounted on arbor *D* which is held in cutter-head *E*. The outer end of arbor *D* is supported by an overhanging arm, which also extends from the cutter-head. The latter is attached to a column cast integral with the bed near its center, on which the cutter-head can be raised or lowered in order to bring the cutters into contact with the work. The gibs used for holding the cutter-head to the column are shown in detail in the upper right-hand corner of the illustration.

Chuck *B* is of the same length as the planed upper surface of table *A*. The width of the chuck varies with the diameter of the work for which it is adapted. Thus the chuck suitable for holding work from ¾ to 1⅛ inches in diameter is 6½ inches wide, the chuck for work from 1¼ to 1⅞ inches in diameter is 9 inches wide, and the chuck for work from 2 to 3 inches in diameter is 12 inches wide. Means for clamping the work are provided at regular intervals along the length of the chuck. An enlarged sectional view of the chuck suitable for work from 1¼ to 1⅞ inches in diameter is shown in the upper left-hand corner of the illustration. This view also shows the method employed in securing the chuck to the table and the clamping arrangement provided for holding the work. It will be apparent that clamp *F* must be changed whenever work of a different size is to be machined. The chuck could readily be modified to permit the milling of more than two shafts at a time, by increasing its width and providing several rows of clamps and clamping bolts. In such a case, a sufficient number of cutters would need to be provided on the arbor of the machine to suit the number of shafts in the chuck.

Cutter Drive and Method of Feeding Cutter-head

The machine is driven by a variable-speed motor mounted on a base placed a certain distance away from the bed (see Fig. 3) in order to bring the motor pulley in line with pulley *G* of the machine, Fig. 4, which is mounted on shaft *H*. This shaft is provided with gear teeth at *I* which mesh with gear *J* on the cutter-spindle. The maximum spindle speed obtainable by means of the motor furnished is 130 revolutions per minute, the minimum speed being 43 1/3 revolutions per minute. Pulley *K* on shaft *H* is connected by a belt to the pump pulley *L*. The pump is fastened to a bracket bolted to the under side of the cutter-head, and is raised or lowered with the cutter-head so that the proper distance between the two pulleys is maintained. The tank which contains the lubricant is placed at the rear of the machine as shown in Fig. 3, in which the piping to the pump and cutters can also be seen.

The feeding of the cutters into the work or their removal from the work is obtained by altering the position of cutter-head *E* on the face of the column. This is accomplished by revolving handwheel *M*, which is keyed on a screw that passes through a tapped hole in a bracket *P* bolted to the back of the cutter-head. The counterweight *N*, which is contained inside the column, is provided to balance the cutter-head, being connected to the latter by a chain that passes over pulley *O* and is attached to bracket *P*.

Table Driving Mechanism

The power for driving the table is transmitted from the driving shaft *H* by a belt running between cone pulleys *Q* and *R*. As cone pulley *Q* is raised or lowered when the position of the cutter-head is altered, it is obvious that it is necessary to furnish means for permitting cone pulley *R* to adjust its position to suit the position of pulley *Q*. This is accomplished by placing pulley *R* on a fixed stud held in the arm of bracket *S*, which is mounted on the end of shaft *T* and on which it is permitted to swivel. On the inner end of pulley *R* is a small spur pinion which drives shaft *T* by meshing with a gear on this shaft. Thus, when the cutter-head and pulley *Q* are raised, the pull of the belt between the cone pulleys causes the small gear on pulley *R* to advance on the gear in shaft *T* so that the proper distance between the two pulleys is maintained. Bracket *S* is also provided with a lug in which is screwed a rod for supporting weight *U*. This weight is heavy enough to hold pulley *R* tight against the belt and also causes the small pinion on this pulley to recede on the gear on shaft *T* when pulley *Q* is lowered.

The arrangement employed for transmitting motion from shaft *T* to the table can be understood by referring to the front and sectional views of the feed control box which are shown in Figs. 5 and 6, where it will be seen that a worm *W*, mounted on the front end of shaft *T*, drives a worm-wheel *Y* keyed on a sleeve which is a loose fit on shaft *a*. One side of the worm-wheel is provided with clutch teeth

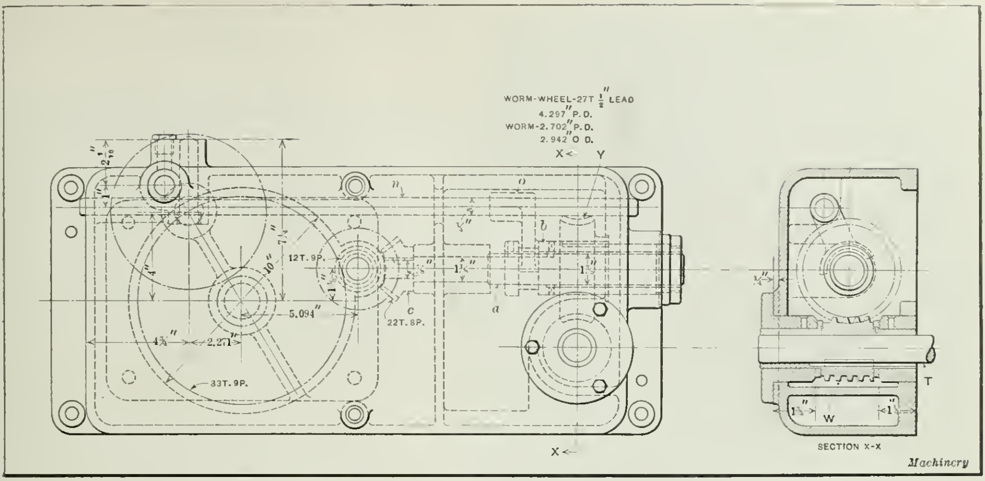


Fig. 6. Elevation and Sectional Views of Feed Control Box containing Part of the Mechanism and Clutch for operating the Table of Keyway Milling Machine

for driving clutch *b* when the teeth of the latter are brought in mesh with those of the worm-wheel. As the clutch is keyed on shaft *a*, the rotation of the shaft is effected when this occurs. Bevel pinion *c*, which is also mounted on shaft *a*, drives gear *d*, Fig. 5. Spur gear teeth are cut on the hub of the latter, and these engage with gear *e* on shaft *f*. The spur gear teeth which are cut on the opposite end of this shaft at *g* drive gear *h* which, in turn, meshes with rack *i* on the lower side of the table and thus accomplishes the feeding of the table. When the cutter-spindle is revolving at its maximum speed, or 130 revolutions per minute, the four feeds of the table obtainable through cone pulleys *Q* and *R*, Fig. 4, are 2.92, 4.11, 5.32, and 7.47 inches per minute. When the cutter-spindle is revolving 43 1/3 revolutions per minute the range of feeds is 0.98, 1.37, 1.77, and 2.49 inches per minute.

The return of the table to its original position after an operation has been performed is obtained by first placing

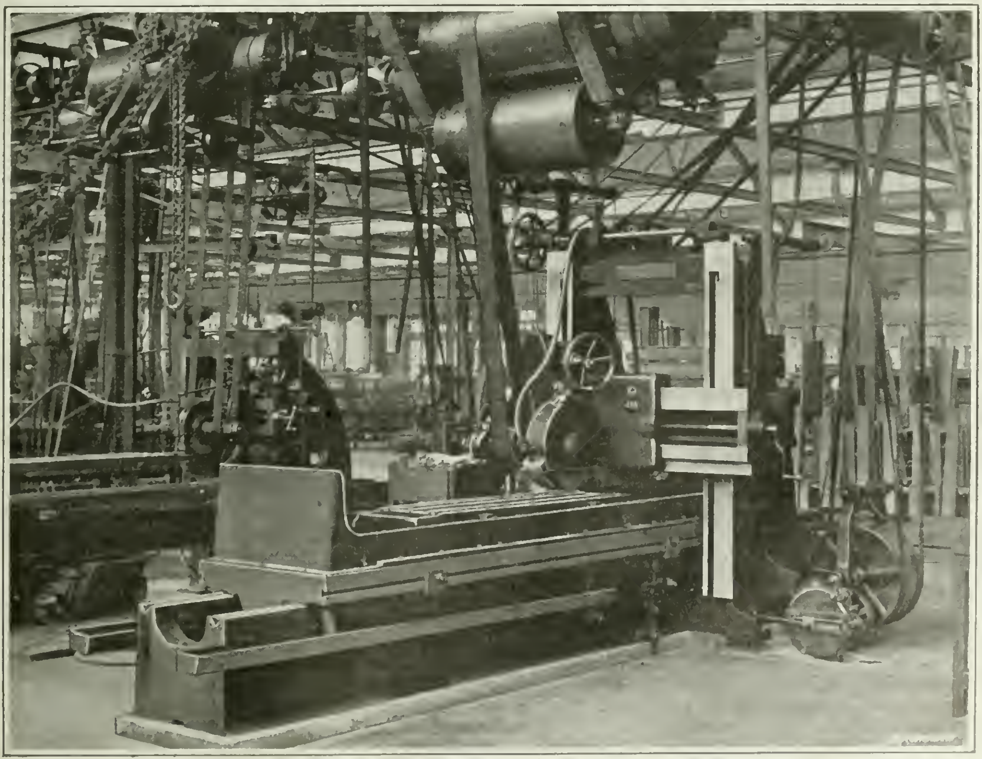


Fig. 7. Planer adapted for grinding Large Flat Surfaces

worm-wheel *Y*, Fig. 6, and clutch *b* out of mesh and then turning handwheel *j*, Fig. 5, in the proper direction. This handwheel is mounted on the same shaft on which bevel gear *d* is keyed, and from this junction the mechanism used in reversing the table is the same as that used in obtaining its feed. The operation of clutch *b* is secured by turning handle *k* which is mounted on shaft *l*. A small spur pinion *m* on this shaft engages with teeth cut on the operating rod *n*, Fig. 6, on which the clutch arm *o* is pinned. Thus rod *n* is carried to and fro when handle *k* is operated.

Medium-sized Planer Equipped for Performing Surface Grinding Operations

Fig. 7 shows a 36- by 36-inch by 14-foot Gray planer rigged up for the grinding of large flat surfaces such as milling machine tables, compound rest parts, vise jaws, etc., in order to eliminate the hand scraping of these surfaces when the parts are being assembled. The special equipment on this planer consists of a grinding wheel head, a special fine-pitch cross-feed screw, special elevating screws, a special countershaft and idler pulley for driving the pulley on the grinding wheel head, equipment for supplying water to the grinding wheel, and a guard bolted to the sides and ends of the table in order to prevent the water that is fed to the grinding wheel from splashing on adjacent parts of the machine and the floor.

The machine reciprocates the work automatically beneath the grinding wheel, the table being operated by the same means as are employed when the planer is used on planing operations, the return of the table being faster than its forward movement. The special cross-feed screw permits the grinding wheel to be fed transversely from a few thousandths inch to nearly the full width of the wheel. The special elevating screws permit vertical adjustment. The countershaft and idler furnished for driving the wheel-head pulley permit the driving belt to move across their faces as the wheel-head is traversed across the work.

* * *

ACTIVITIES IN LOCOMOTIVE BUILDING

During the war a great many locomotives were used until they had to be discarded, and in all countries of the world there is at present a scarcity of locomotives. Germany had to give up a large number of her engines to Belgium and France, and with the exception of Russia, where conditions are not known, it is likely that Germany is in greater need of locomotives than any other country. France is also in great need of locomotives, and on the French railways many German, as well as English and American, engines are now in use. Both in England and the United States there is a need for more engines, which in both of these countries will be supplied through their own locomotive works. Japan now builds some of her own locomotives, and Holland during the war engaged in this line of endeavor also. For a long time to come France will be unable to fill her requirements for locomotives through her own shops, and must obtain large numbers from England and America. Belgium has ordered about four hundred engines in England, and Italy has an order for an equal number in this country. America also controls the Spanish market for locomotives entirely; but previous to the war, Spain had most of her engines built in Germany. Portugal has placed orders for engines in Switzerland, while Poland has made arrangements for ordering 150 locomotives in the United States. The railways of Brazil and Argentina are mainly constructed by British capital, and hence the orders from these roads go mainly to England. Chile, formerly a customer of Germany, has during the war turned to the United States.

Previous to the war the three main locomotive building nations were the United States, England, and Germany. As Germany will be unable to supply her own demand for a long time, let alone competing with other nations, the locomotive building of the world will be in the hands of American and English builders for many years to come.

AN ENGLISH OPINION ON THE METRIC SYSTEM

By H. F. HEMMINGS, Works Manager,
Willans Works of the English Electric Co., Ltd., Rugby, England

In reading the article in the August number of MACHINERY relative to the experience of the De Laval Separator Co., Poughkeepsie, N. Y., the most important point that strikes one is that the De Laval Separator Co. manufactures a specialty under a condition approximating mass production. Many years ago the Willans Works in Rugby were entirely engaged in the manufacture of a specialty—the Willans central valve engine—and at that time adopted the metric system in the engineering and manufacturing departments. The conditions governing the nature of their product have long since changed, and they are now engaged in the manufacture of general engineering products.

As a result, the question as to the advisability of retaining the metric system has had to be considered, and a committee of those responsible for production in this company have given the question of English versus metric measurements as applied to the various works of the English Electric Co., Ltd., full consideration. In considering this matter, the committee had before them at the time a summary of the report of the Committee on Commercial and Industrial Policy after the War, which committee reported against the use of the metric system. The committee of the English Electric Co. issued a report on the use of the metric system at the various works within the combination, which are five in number; after full consideration, the situation was summarized as follows:

1. All public committees whose composition and standing make their reports worthy of consideration have decided against the metric system as a practical proposition for manufacturers in this country.

2. It is not possible to use the metric system in this country to the exclusion of the inch system. Even at Rugby, where a determined effort has been made to make the metric system a commercial success, it has been found quite impossible to eliminate the inch; consequently both systems exist side by side, and a double stock of precision and other tools has to be carried at considerable expense. Our experience at Preston and Stafford is the same.

3. There are therefore two alternatives to choose from, either (a) the inch system by itself; or (b) a dual system consisting of inch and millimeter.

4. The question arises whether each works can settle the question for itself, or whether a uniform system of measurement should be used by all works within the combine. Since the matter is almost entirely one of works production, and in view of the importance of interchangeable manufacture, it would appear a matter of prime importance to use the same system of measurement in all works.

5. While the designer might prefer to retain the millimeter, the shops, without doubt, prefer the inch. The question before the committee, therefore, is: Can we get back to the inch as a unit of measurement, or is it better to retain the present dual system of millimeter and inch?

It was considered that it was not a commercial or practical proposition to work with both systems, and of the two systems the committee was of the opinion that the English was the preferable one, so far as the products of the various works of this company were concerned.

* * *

There are indications from various sources that the Japanese manufacturers who secured a considerable amount of foreign trade during the war are not finding it easy to maintain their hold on the foreign markets. In the machine tool field Japan secured a large share of the trade in China and Siberia, partly by selling machines manufactured in Japan, and partly by re-exporting machinery imported mainly from America. Now both America and England can handle this foreign trade more effectively.

Continuous Versus Station Milling

Comparison of Results that are Obtained by Both Methods of Milling on Identical Work when Using Similar Machines in Interchangeable Manufacture

By GEORGE M. MEYNCKE
Sales Manager and Mechanical Engineer
The Oesterlein Machine Co., Cincinnati, O.

THE fundamental differences between continuous and station milling as conducted on the Ohio tilted rotary milling machines manufactured by the Oesterlein Machine Co., Cincinnati, Ohio, are the method in which the cutters are applied to the work and the manner in which the table is rotated. In the case of continuous milling, the work is spaced compactly around the periphery of the table, and the successive parts are milled as they are fed past the revolving cutters when the table is rotated. In station milling, a number of pieces are grouped at regular intervals around the table and the revolving cutters are first fed toward the center of the table until all parts in the particular station that happens to be in the path of the cutter have been machined, the table being stationary during this step of the operation. The cutters are then returned rapidly to their starting position, after which the table is indexed a portion of a revolution in order to bring the next station into the path traversed by the cutters. The reciprocatory movements of the cutters are obtained by having the vertical cutter-spindle on this machine mounted on a ram which is quite similar to the ram of a shaper. The number of stations on a table depends to some extent upon the time required to unload and load a station, which must be accomplished while the work held in another station is being machined. When a milling machine is set for indexing 180 degrees between the reciprocations of the cutters, one fixture that is provided with a station at each end is frequently employed. It is the purpose of the present article to examine in some detail the conditions that exist when either of the two methods referred to are used and to compare the advantages of each method under different conditions. In doing so, some of the present conceptions as to the relative merits of the two methods are challenged.

Station Milling Permits Higher Rates of Production than Continuous Milling

Both of the milling methods being considered are employed by manufacturers in the present-day attempts to secure maximum rates of production; however, mistaken ideas concerning the relative merits of the two processes are prevalent. It has been the experience of the Oesterlein Machine Co. that much higher rates of production are secured by station milling than when the same work is machined on a similar machine by continuous milling methods. This result is due to the fact that in station milling, the cutters are fed a much less distance than the table must be fed in continuous milling in order to machine a like number of pieces. The return of the cutters to their original position and the indexing of the table in station milling are accomplished at such speeds that the greater portion of the gain over continuous milling methods, secured by the cutters, is maintained. In the following, several examples will be given of cases where both milling methods are used in machining identical parts, for the purpose of permitting comparisons to be made of the results obtained and an opinion to be formed as to the advantages of each method.

Example Showing Advantage of Station Milling Method

The machining of a small part consisting of a shank having a circular boss at one end which is straddle-milled flat on both sides will be considered first. The method of arranging the work on the machine for continuous milling is shown diagrammatically in Fig. 1, there being thirty-eight work-holding units on the fixture attached to the table for holding the work in place. The diameter of the boss on each part is 2 inches, and the distance between the bosses of two adjacent pieces, as mounted on the fixture, is ½ inch. It is apparent that the cutters and table revolve constantly, the operator loading and unloading work at the front of the machine while the cutters mill pieces held diametrically opposite on the fixture. In using this method there is a certain amount of idle time due to the spaces between the parts. Fig. 2 shows the set-up of the work on the machine used in station milling and the direction and distance that the cutters reciprocate. It will be noted that four parts are so grouped that they are milled simultaneously by the cutter, the travel of the cutter in each movement being only slightly more than the diameter of the boss on the work. The idle time in this method consists of the time required for the cutter to return after being fed across the work, which is three seconds, and the four seconds consumed in indexing the table to the next station, this making a total of seven seconds. The rates of production obtained by the two methods will now be compared.

The rate at which the cutters are fed in the station milling method and the rate of table feed in the continuous milling method are both 6 inches per minute. Thus, the time required to feed the cutters across the four pieces held in one station in Fig. 2 is approximately 28 seconds. By adding to this quantity, the 7 seconds of idle time previously mentioned, a total of 35 seconds is obtained which is the time required to finish four parts by this method. By referring

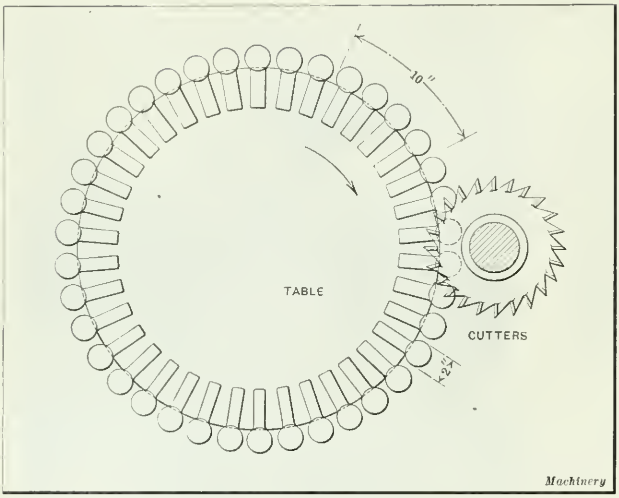


Fig. 1. Diagram illustrating the Relation of the Table and the Work in a Continuous Milling Operation

to Fig. 1 it will be seen that as the diameter of each boss is 2 inches, and the distance between them ½ inch, the table of the machine used in continuous milling must travel 10 inches in order to machine the same number of parts. This requires 1 minute 40 seconds, or 1 minute 5 seconds more than is necessary in machining the same number of parts on the machine adapted for station milling. Thus, the latter method permits a rate of production almost three times that obtained by continuous milling. Besides this great advantage another point in favor of station milling is the fact that the cost of a fixture for this method is considerably less, this being due to the smaller number of work-holding units necessary. It will be noted that in milling the four parts by the continuous method, the idle travel is 2 inches, this being the sum of the spaces between the bosses that the cutters are required to pass.

Milling Automobile Brake Rod Clevises by Both Methods

A machine equipped with a fixture adapting it for the continuous milling of automobile brake rod clevises is shown in Fig. 3. This fixture has forty-eight work-holding units. Three cutters are mounted on the machine spindle for this operation, which consists of straddle-milling the two inside and the two outside surfaces of the jaw on each part. The illustration shows the cutters in the working position. Attention is called to the fact that the ends of the work on which the operation is performed are placed toward the center of the fixture rather than toward the outside as in the case previously cited. The object in doing this is to reduce the space between each part as much as possible and so cause a reduction in the idle travel of the cutters.

A general view of a similar machine provided with a set-up for machining the clevises by station milling, is shown in the heading illustration. Fig. 4 shows a close-up view of the same machine. The fixture on this machine has four stations, each of which contains three work-holding units. The three pieces of work in each station are equalized and clamped by a single movement of the lever connected to that particular station. The operation of this machine is, of course, entirely automatic so that the attention of the operator is fully devoted to the work of loading and unloading the stations as they are indexed from the cutter to the front of the machine. It will be seen by referring to the illustration that the jaws that are to be machined in this instance are placed toward the outside of the milling fixture.

As in the example previously considered, the results obtained in this case by both methods indicate that station milling is the most suitable for work of this nature. The table of the machine equipped for continuous milling is fed at the rate of 10 inches per minute, which results in an output of 350 pieces per hour, representing an average cutting time of 10.3 seconds per piece. The hourly output on the station milling machine by feeding the cutters at the reduced rate of 7.5 inches per minute, is 612 pieces, the average cutting time per piece being about 5.9 seconds. These results show that the rate of production by station milling is 177 per cent of the production obtained by continuous milling. The cutters on both machines are operated at a speed of 60 feet per minute.

Other Advantages of Station over Continuous Milling

The reason for making the feed of the cutters on the station milling machine less than the feed of the table on the continuous milling machine is to reduce the production so as to enable one man to perform the loading and unloading of the work in a station in the time required for the parts in another station to be milled. It is apparent that if the feed of the cutters in station milling was the same as that of the table in continuous milling, the results would be still more in favor of station milling. The reduced rate of feed results in a higher grade of finish being obtained on the parts milled by station milling, and the life of the cutters is also longer. The practice is to change the cutters on both machines daily, and the wear of the cutters used in continuous milling is usually the greater. While the high output obtained by station milling makes this method desirable for quantity production, perhaps the greatest advantage of this method of milling over the continuous method is the possibility of securing a higher quality of finish in the manner previously described.

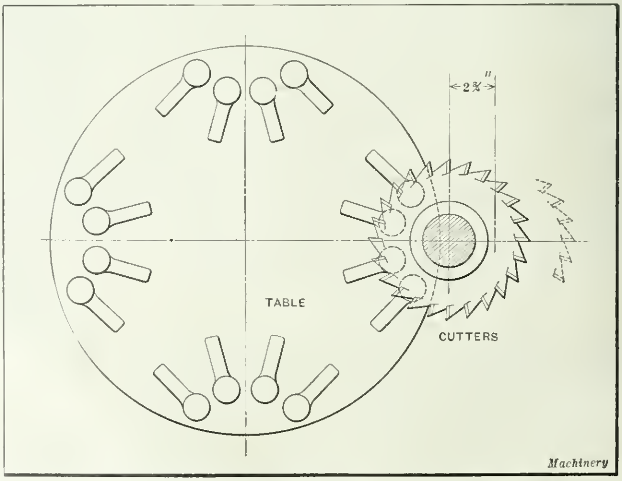


Fig. 2. Set-up of Work on Table, and Feeding Movement of Cutters in Station Milling on an Ohio Tilted Rotary Milling Machine

Another important advantage that station milling has over continuous milling is that, on account of the cutters being fed radially into the work, it is possible to mill circular surfaces having radii corresponding to those of the cutters. This is, of course, impossible in continuous milling, because in this case the surfaces are always milled to a radius equal to the distance from the surface being machined to the center of the revolving table. By designing the fixture on the station milling machine to suit, a number of parts can be mounted on top of each other in such a manner that surfaces of the type mentioned can be finished on each part by straddle-milling. In conclusion, it may be said that while continuous milling may be applied efficiently only to parts that can be placed compactly around the periphery of the table, this does not hold true for station milling. In the latter method, a small surface on a comparatively large piece can be milled with little idle time due to the method of feeding the cutter and indexing the table as has been explained in detail in the foregoing.

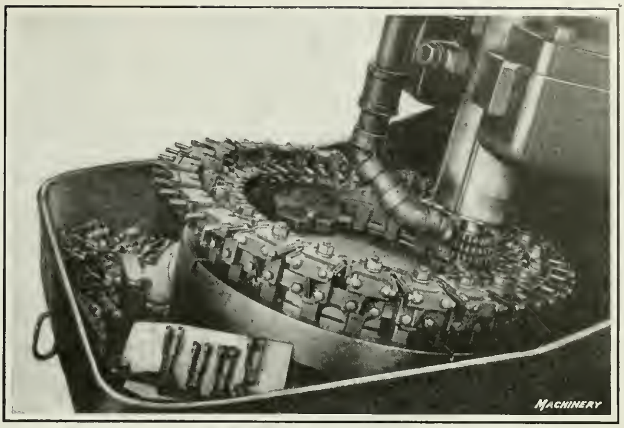


Fig. 3. Continuous Milling Fixture for holding Forty-eight Brake Rod Clevises, and Method of applying Cutters to Work

* * *

NEED FOR USING COAL ECONOMICALLY

If the present rate of steel exports is maintained the total exports for the year will be 4,600,000 gross tons. In the production of this steel, 20,000,000 net tons of coal are consumed. It has been proposed that the exports of coal to foreign countries should be stopped, or at least greatly curtailed, because of the shortage of coal in this country. It has been pointed out that the exports of steel really represent exports of coal; but surely no one would want to interfere with the normal trade channels in regard to the products of the industries of the United States, even with a view to saving coal. It is doubtful if it would be any wiser to interfere with the normal trade channels in regard to coal itself. If the boiler plants in the United States were operated with greater efficiency than they are, the amount of coal exported could easily be saved several times over without curtailing either the production of power or the use of coal for any other purposes than those for which it is now used. In this connection it may be of interest to mention that in the making of paper, the mills in the United States use more than twice the amount of coal per pound of paper that is used in some of the European paper mills.

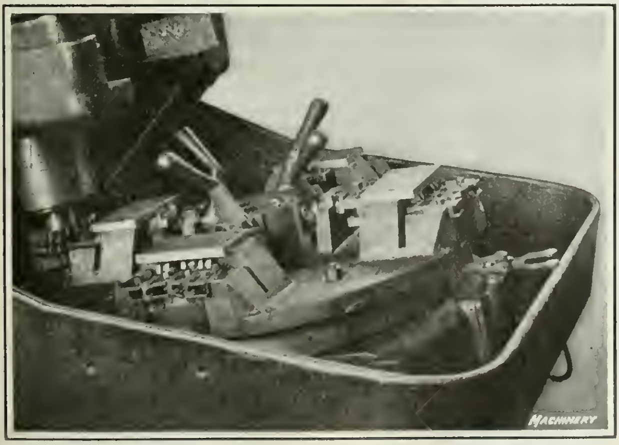


Fig. 4. Machine equipped with Four-station Fixture for holding Clevises when station-milling them

IMPROVED RAILWAY FREIGHT SERVICE

The Association of Railway Executives, in its effort to improve the freight situation of the country, is urging the cooperation of manufacturers to attain, as a definite aim, an average minimum movement of freight cars of not less than thirty miles per day, and an average loading of thirty tons per car. In addition, the association will work for a reduction of the bad-order cars to a maximum of 4 per cent of the total number of cars in use, and an early and substantial reduction in the number of locomotives now unfit for service. It has been pointed out that an increase in the average freight car movement of only one mile a day is equivalent to the enlarging of the available supply of freight cars by 100,000.

Manufacturers using freight cars can aid a great deal in making it possible for the railway executives to adhere to the program laid out. According to reliable calculations, it has been determined that the average freight car is in a train moving between one terminal and another actually only 2.6 hours out of 24; but it is in the service of the shipper or receiver 8 hours out of every 24. The average freight car movement in 1916 was 26.9 miles per day. If this is increased to 30 miles per day, it is equivalent to the building of 300,000 freight cars. By intelligent operation of the railways and real cooperation on the part of every individual shipper, this can be done. Under the stress of war in May, 1917, an average movement of 29 miles per car per day was reached, and there is no reason why this average, or slightly greater, cannot be attained in times of peace.

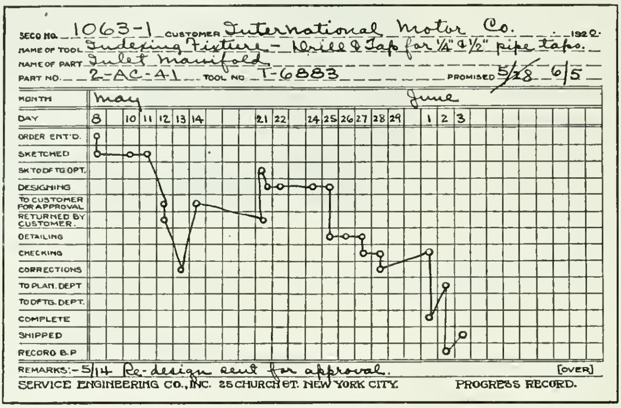
Summing up the matter briefly, it is important that shippers should load cars as quickly as possible after they are received, and the shipper should then furnish prompt and definite billing instructions, which should take the car, if possible, to its ultimate destination. Special billing causes delay, and the practice of billing cars subject to order or reconsignment in transit prevents good freight service. It retards the movements of cars, and should be discouraged, because it is injurious to the whole transportation system, and when practiced by a few, amounts to a special privilege which, owing to the delay in transportation, causes an added expense and inconvenience to other shippers.

As to the loading of cars, one additional ton per each loaded car would be equal to 80,000 new freight cars.

DRAFTING-ROOM PROGRESS RECORDS

By ALBERT A. DOWD

In a drafting-room containing fifty or more men, so many drawings are being made that it is difficult to carry the work through without an adequate system for keeping track of the various jobs. This is especially true in the case of a concern preparing drawings for an outside customer. It is not particularly hard to get a drawing completed, but to have it approved, checked, and delivered when desired is another matter. Drawings for jigs and fixtures are often wanted in a hurry, and yet when a great number of them are in process at the same time, the drawings for several fixtures for some particular part may be held up for various reasons so that they are not completed at the same time as the drawings for the remainder of the tools. This is often the cause of a considerable delay in the ultimate production of the tools.



SECO No. 1063-1 CUSTOMER International Motor Co. 1920

NAME OF TOOL Indexing Fixture – Drill & Tap for 1/4" & 1/2" pipe taps.

NAME OF PART Inlet Manifold

PART NO. 2-AC-41 TOOL NO. T-6883 PROMISED ~~5/28~~ 6/5

REMARKS:– 5/14 Re-design sent for approval. [OVER]

SERVICE ENGINEERING CO., INC. 25 CHURCH ST. NEW YORK CITY. PROGRESS RECORD.

Fig. 1. Progress Card which shows graphically the Progress of a Job through the Drafting-room

A method commonly used to follow drawings of this kind is to check off the various tools on the operation sheet of the part as fast as the drawings are completed. It frequently happens, however, that these drawings go to a tool checker who has a number of other drawings waiting to be checked, and are greatly delayed there on account of other work being checked first. In our organization, work is frequently in progress for a dozen or more firms at the same time, and it was found absolutely necessary to devise a system whereby it would be certain that a drawing would be completed at approximately the right time.

It is obvious that a system of this kind must be self-checking and simple enough to be taken care of by a man who is not necessarily connected with the drafting-room itself. It must also be remembered that various customers have different ideas in regard to the handling of their work. For example, one customer may wish to see a rough sketch of the proposed jig or fixture before authorizing the completion of the tool. Another customer may leave the matter of design to the judgment of the firm making the drawings, and may not require that the drawings be sent for approval. In the first case, the record of progress of any jig or fixture drawings must show that the sketches were made and approved before any designing takes place. Hence, it is apparent that the record card must be so arranged as to take care of these varying conditions, and when completed must form a record of the progress of the work from start to finish. The system that was installed for the purposes outlined is described in the following.

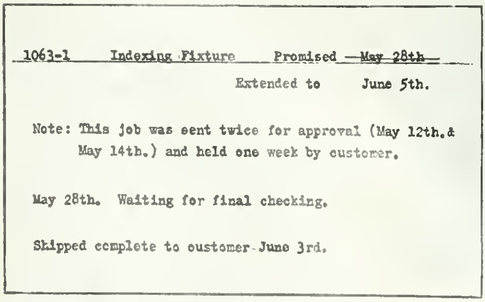
Description of Graphic Progress Cards

Fig. 1 shows a progress card filled out to show the record of the drawings for an indexing fixture for an automobile inlet manifold. The card shows that the order was received on May 8, and that a rough sketch was completed on the 11th, and sent to the customer for approval on the 12th. On the same day the sketch was returned by the customer with suggested changes, which were made on the 13th, and the rough sketch was once more sent for approval on the 14th. After a delay of a week, it was returned by the customer approved, and was then sent to the drafting department with an order to proceed with the work. The record shows that the designing was completed on May 25, and that the detailing started on the same date. The detailing was completed on the 27th, and the checker received the drawings on the same day, completing the checking on the 28th. After the corrections had been made, the drawings were returned to the checker for final inspection on June 1. They were later blueprinted and finally shipped to the customer on the 3rd.

It will be noted that the promised date on this card was originally May 28, but, due to the delay of a week in approving the sketch, this date was changed to June 5. However, the work was completed on June 3, which was two days in advance of the promised date. This card record is made out directly from the time cards which the men turn in each day.

Follow-up Card

In connection with the progress card, a simple follow-up system has been devised in which use is made of the card shown in Fig. 2 This card is intended to be used as a "tickler," and is placed in a card file which has an index tab for each day of the month. It will be seen by referring to the illustration that the card contains the order number, type of fixture, and the promised date of delivery.



1063-1 Indexing Fixture Promised ~~May 28th~~

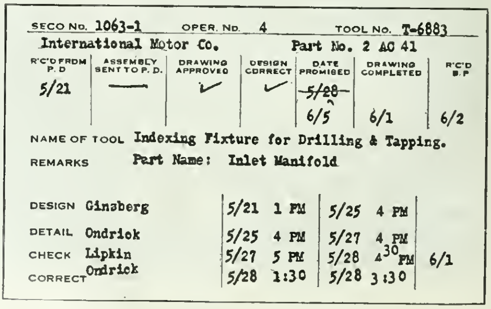
Extended to June 5th.

Note: This job was sent twice for approval (May 12th. & May 14th.) and held one week by customer.

May 28th. Waiting for final checking.

Shipped complete to customer- June 3rd.

Fig. 2. "Tickler" Card used to follow up the Progress of a Job



SECO No. 1063-1 OPER. No. 4 TOOL No. T-6883

International Motor Co. Part No. 2 AC 41

R'C'D FROM P. D	ASSEMBLY SENT TO P. D.	DRAWING APPROVED	DESIGN CORRECT	DATE PROMISED	DRAWING COMPLETED	R'C'D B.P
5/21	—	✓	✓	~~5/28~~ 6/5	6/1	6/2

NAME OF TOOL Indexing Fixture for Drilling & Tapping.

REMARKS Part Name: Inlet Manifold

DESIGN	Ginsberg	5/21 1 PM	5/25 4 PM	
DETAIL	Ondrick	5/25 4 PM	5/27 4 PM	
CHECK	Lipkin	5/27 5 PM	5/28 4^30 PM	6/1
CORRECT	Ondrick	5/28 1:30	5/28 3:30	

Fig. 3. Card for recording Time spent by Men on a Job

In use, this card is placed in the "tickler" file under a date about a week in advance of the time when the work is promised. By referring to this file each day, and by transferring the card from one position in the file to another, it is evident that a constant check can be kept on the work as it progresses. When used in this way, there is a constant reminder of any job that is to be completed at a certain time and there is no chance for the work to be sidetracked, provided the system is followed up carefully as intended. Notes containing information concerning the job can be placed on the card as shown.

Draftsman's Record Card

In connection with the "tickler" file, use is made of another card, which is shown in Fig. 3. The purpose of this card is apparent, and it will be noted that the designer, detailer, and checker are all considered. A record is kept of the date and hour that each man began to work on the job and when he completed it. Thus, in connection with the other cards, a complete record of any particular job is kept. In all probability, this system can be simplified for use in ordinary drafting-rooms, but under the conditions mentioned, the system as outlined has worked excellently.

* * *

WHAT IS A MACHINE TOOL?

A definition of the term "machine tool" that will satisfy all requirements has yet to be proposed. L. L. Thwing, of Boston, Mass., in an interesting article in the August number of *Mechanical Engineering*—the journal of the American Society of Mechanical Engineers—goes into the history of the various proposed definitions of machine tools and the uses of the term. He mentions that at a meeting of the American Society of Mechanical Engineers in 1885 one of the subjects for discussion was the power requirements for machine tools. In the course of this discussion one of the speakers, complaining about the indefiniteness of the question, said, "What a machine tool is, is slightly in doubt," and this question has been with us ever since. The dictionaries define it as a machine that uses tools, and the Custom House officials have accepted this and include woodworking machines under this classification. Users, dealers, and manufacturers, however, do not accept the definition, and the whole subject is as far from being settled as it was in 1885.

Early Uses of the Term "Machine Tools"

Edward H. Knight in his mechanical dictionary, published in 1872, gives the following definitions: "*Machine*: An instrument of lower grade than an engine, its motor being separate. It is distinct from a tool, as it contains within itself its own guide for operation. *Machine Tool*: A machine in which the tool is directed by guides and automatic appliances. Among tools of this class for metals are lathes, punches, and shears. Machine tools for wood are sawing machines, planing machines, etc."

It is the habit of dictionary makers to copy each other, and it is not improbable that our present-day dictionary interpretation of the word is derived from the above. It must also be said that to define a machine tool as a tool-using machine is very natural. There is some doubt, however, if the original and common use of the words is as indicated above.

Cameron Knight, author of "The Mechanician and Constructor," published in 1869, in the course of a very complete definition of shop terms, includes the following: "Tools include every implement small and large, simple or complex, which is used to produce or operate upon the work in the course of progress. A center-punch in a turner's pocket is a tool, and the lathe before him is a tool."

It is an easily verified fact that in the text and advertising columns of the early mechanical papers such as the *Scientific American* (1846), the *Mechanics' Magazine* (1836), and the *American Artizan* (1862), the term "machine tools" is used but seldom, and then exclusively by editorial writers. The first observed use was in 1862. "Tools" is the word that was in universal use during the Civil War period to indicate what we now call machine tools. Advertisements for the sale of the after-war surplus were either under this caption or under the heading "machinist's tools." This use of the word persists into the eighties. In fact, in the discussion referred to in the opening paragraph, the word "tools" was not infrequently used. There can be no reasonable doubt, therefore, that although the expression "machine tools" was at least recognized as far back as 1860, "tools" was the word in common and everyday use until the eighties. In 1879, Frederic B. Miles formed a company with the name "Machine Tool Works." This is the first noted instance of the use of this term by a shop man. The above company advertised the manufacture of steam hammers, planing machines, and lathes.

Suggested Definitions of Machine Tool

On first thought we may be inclined to define a machinist as a machine-using workman, and a machine shop as a machine-using shop, but this definition will admit weavers and textile mills to these classifications. It is evident that a machinist is a machine-*building* workman, and a machine shop is a shop that *builds* machinery. By an analogous reasoning a machine tool is not a tool-using machine, but a machine-building tool; that is, a tool or machine for building machinery. This definition conforms to the best modern definition of the term, namely, "Machine tools are machines which, when taken as a group, will reproduce themselves." This excellent definition has the disadvantage of being general rather than specific, and as a secondary definition the following might be suggested: "A machine tool is any metal-working tool the waste from which is in the form of chips." This is specific and can be easily applied to any particular machine. It is not necessary to define a metal "chip," but it may be advisable to recall that the sparks from a grinding machine are chips, very small chips to be sure, but chips. This definition excludes sheet-metal working machinery and metal-forming and forging machines, but these are probably not classed as machine tools by the majority of shop men, and in any case it is necessary to draw the line somewhere, and this seems to be the best place. This classification includes all metal-cutting machinery the action of which is a progressive cutting away of surplus stock—a gradual reduction in size until the finished dimensions are reached.

A press, when used for piercing sheet metal, has very little in common with a lathe, a milling machine or a planer. They are all metal-cutting machines, and here the similarity ceases. The metal is not in the same form, and the cutting tools have nothing in common with other metal-cutting tools as to construction or cutting angles. When a press is used for forming it has nothing in common with lathes, etc., other than the fact that they are all metal-*working* machines, as are also power hammers, bulldozers, swaging machines, etc.

* * *

THERMOSTATIC METAL

An interesting metal known as "thermostatic" metal is manufactured by the British Thomson-Houston Co., Ltd. This metal, which is homogeneous in appearance, is formed, according to *Engineering*, of two metal strips having widely different coefficients of expansion. The two metals are welded together along their entire length and are quite inseparable under normal working conditions. When the duplex strip is subjected to change of temperature, one half will expand more quickly than the other, causing the strip to bend. A single degree of temperature change is said to affect its curvature to a measurable extent, and practically instantaneously. In bending, it exerts a force sufficient for the direct operation of levers, the opening and closing of ventilators, etc. The metal can be cut, stamped or machined. It is supplied in various thicknesses from 0.015 to 0.250 inch.

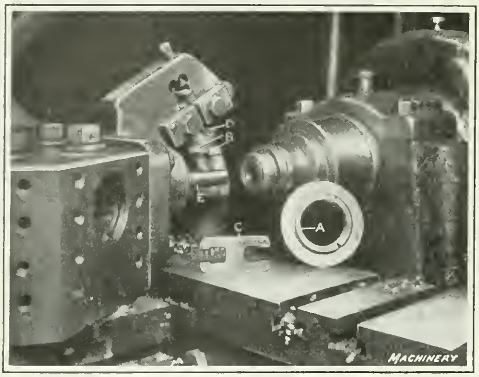


Fig. 1. Bardons & Oliver No. 4 Turret Lathe equipped for turning and facing Clutch Flange Nuts of the Type shown in Fig. 3.

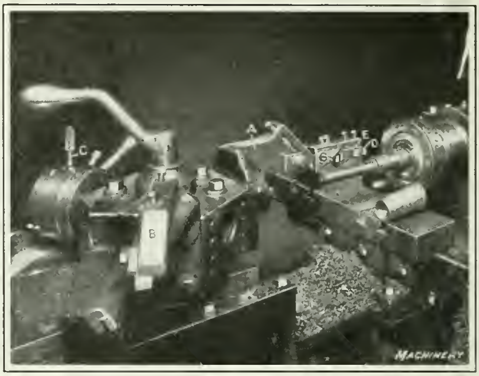


Fig. 2. Close View of the Chuck and Tools on a Bardons & Oliver Turret Lathe used for machining Sleeve shown in Fig. 5

Machining Clutch Parts on Turret Lathes

Tooling Equipment Used in the Plant of the Borg & Beck Co., Chicago, Ill., for Machining Automobile Clutches

AT the Borg & Beck Co.'s plant in Chicago, Ill., the work consists of producing clutches for motor cars, and in the manufacture of this specialized product there are some interesting applications of turret lathes built by the Bardons & Oliver Co. of Cleveland, Ohio. Most of the clutch parts to be machined are of small or medium size, and in handling this work advantageous use is made of automatic screw machines on which the preliminary operations are performed; but in cases where machines of this type are used in combination with turret lathes, the work to be handled is of such a character that the automatic could not complete the machining operations that are required, and Bardons & Oliver machines are used for the performance of a second series of operations. A typical case of this kind is illustrated in Figs. 1, 3, and 4 which show the flange nut for a Borg & Beck clutch (Fig. 3), a No. 4 Bardons & Oliver turret lathe set up for the second sequence of operations on this part (Fig. 1), and the threaded mandrel used for holding the work on the turret lathe (Fig. 4). In Fig. 1 one of the pieces to be machined is shown at *A* and referring to the detail view of this piece, Fig. 3, attention is called to the fact that the automatic is utilized for boring and tapping hole *A* and for finishing surfaces *B*, *C*, and *D*.

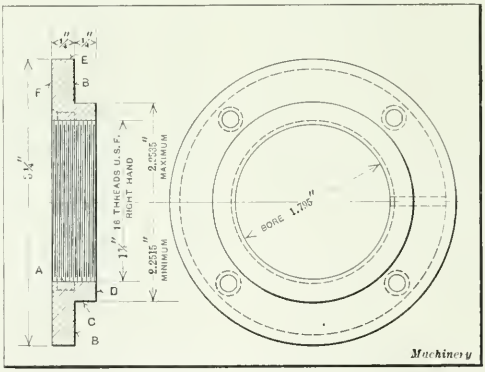


Fig. 3. Clutch Flange Nut on which Turning and Facing Operations are performed on Bardons & Oliver No. 4 Turret Lathes

For the second sequence of operations the tapped hole *A* and face *D* are utilized as the locating points; and in Fig. 4 it will be seen that thread *A* on the mandrel is made of such a diameter that the flange nut to be machined can be readily spun into position by giving it a sharp turn with the finger and thumb, which brings face *D*, Fig. 3, back against sliding collar *B*, Fig. 4, on the mandrel. After this result has been accomplished the draw-back mechanism of the turret lathe is used to pull back the shank of the mandrel so that the work is held firmly against collar *B*, the mandrel sliding through the housing and causing the collar *B* to act like a lock-nut to secure the work in place. In Fig. 3, the surfaces to be machined on the Bardons & Oliver turret lathe are the

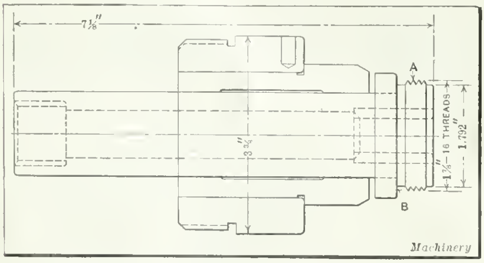


Fig. 4. Special Threaded Mandrel connected with Spindle Draw-in Mechanism for holding Clutch Flange Nuts of the Type shown in Fig. 3

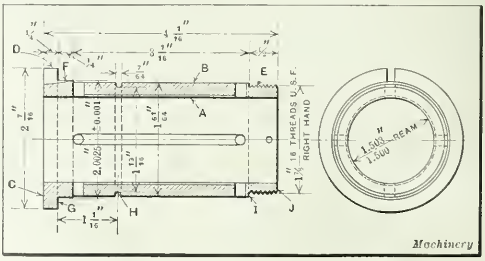


Fig. 5. Clutch Throw-out Sleeve on which Turning, Facing, and Threading Operations are performed on a Bardons & Oliver No. 4 turret lathe

outside diameter *E* and faces *F* and *B*. It is important for faces *F* and *B* to be so finished that the thickness of the flange is exactly ¼ inch.

It will be recalled that surface *B* is rough-turned on the automatic screw machine, but in order to get the required thickness for the work, there are two straddle facing tools held by set-screws shown at *B* in Fig. 1, which are mounted at the front of the cross-slide, one of the tools being set slightly in advance of the other so that this tool feeds right across surface *F*, Fig. 3, while the second tool only feeds down surface *B* until it reaches shoulder *C*. At *C* in Fig. 1 there is shown a "Go" and "Not Go" gage used to test the accuracy of the flange thickness. Turret tool *D* turns the outside diameter of the work, and it will be seen that there is a pilot *E* which enters the hardened steel bushing in the front end of the mandrel to maintain accurate alignment. After the operation has been completed, the draw-back mechanism is released in order to relieve the frictional resistance of the back side of the work against the collar *B* on the threaded mandrel. It is then an easy matter for the operator to screw the work off the mandrel by hand. The flange nuts to be machined by this means are made of malleable iron, and the job is performed at a cutting speed of 80 feet per minute with a feed of 0.020 inch per revolution. The rate of production is 800 to 1000 pieces in a ten-hour day.

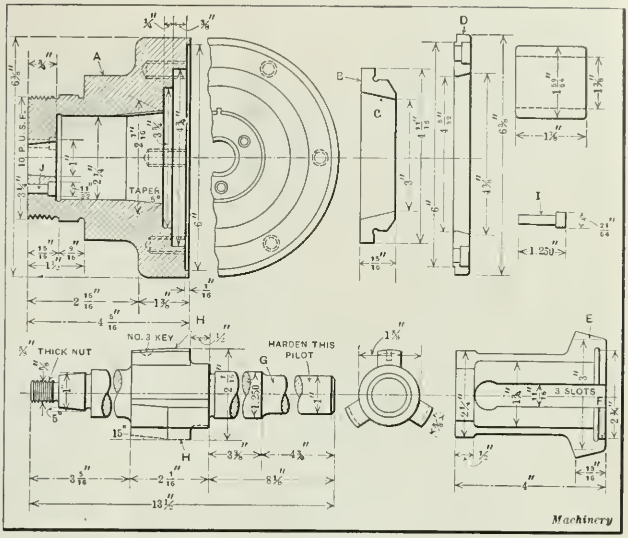


Fig. 6. Parts of the Special Collet Chuck that is used on the Machine shown in Fig. 2 for holding Throw-out Sleeve shown in Fig. 5

Machining Malleable-iron Throw-out Sleeves

In Fig. 5 is shown a malleable-iron throw-out sleeve for a Borg & Beck clutch, which has previously had hole *A* bored and reamed, diameter *B* turned, end *C* faced, and flange *D* turned, so that in some respects the work to be done by the No. 4 Bardons & Oliver machine shown in Fig. 2, that is utilized for the performance of a second sequence of operations, is rather similar to the job which has just been discussed. The machine on which this work is done is equipped with a collet chuck of the type shown in Fig. 6, which grips the work by the outside of flange *D*, Fig. 5. Referring to Fig. 6, attention is called to the fact that chuck body *A* is secured to the draw-back mechanism and has a collar *B* with a tapered bore *C*, this collar being held in place by a ring *D* so that it is a floating fit. Split collet *E* is counterbored at *F* to receive the flange of the work, and extending through the center of this collet there is a pilot *G* that enters bushings in successive faces of the turret to assure accurate alignment. The larger of the two diameters of this pilot fits in the bore of the work and supports the overhanging portion which would otherwise produce too great a strain for the collet to hold securely. It will be seen that the body of the pilot is keyed in the chuck, and the splines *H* enter the spaces between the collet jaws, thus locking the collet to the body of the chuck. As chuck body *A* is moved by the draw-back mechanism, ring *D* draws tapered bore *C* of collar *B* back over the tapered nose of collet *E* and closes this collet in to grip the work. Plunger-pins *I* fit in holes *J* at the back of the chuck body *A* and hold collet *E* against lateral movement, thus causing it to grip the work.

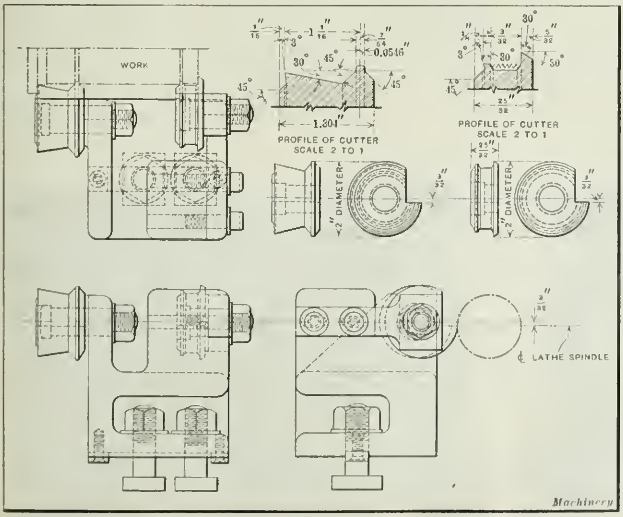


Fig. 7. Design of Circular Forming Tools which will be substituted for Independent Cross-slide Tools on the Machine shown in Fig. 2

Mounted on the first station of the turret there is a turning tool *A*, Fig. 2, having three cutter bits which are so located that they provide for taking an intermediate cut on diameter *B* Fig. 5, and for rough-turning diameters *E* and *F*. At the second station there is a turning tool *B* that provides for taking a finish cut over outside diameter *B* on the work, and at the third station there is a Geometric threading die *C* which cuts thread *E* on the work. Mounted on the front of the cross-slide it will be seen that there are four tools *D*, *E*, *F*, and *G*, which are used, respectively, for facing surface *G*, necking the work at *H*, facing shoulder *I*, and cutting off and chamfering end *J*. At the present time the tool-room of the Borg & Beck Co. is making two circular forming tools which will provide for performing operations on the work at *CH* and at *IJ*, and it is expected that better results will be obtained in this way than those secured with the four separate tools on the cross-slide. Fig. 7 shows the two circular forming tools that have been designed for this purpose. The same rates of speed and feed are employed as for the malleable-iron flange nut shown in Fig. 3, and the rate of production obtained on these throw-out sleeves is 320 pieces in a ten-hour day.

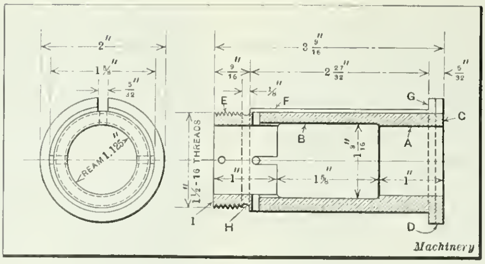


Fig. 8. Clutch Throw-out Sleeve made of Bronze, which is machined on the Bardons & Oliver Turret Lathe shown in Fig. 9

Machining Bronze Throw-out Sleeves

Fig. 8 illustrates a bronze throw-out sleeve for a Borg & Beck clutch on which the method of machining is similar to that employed for making malleable-iron sleeves of the form shown in Fig. 5. There are, however, certain interesting modifications in the method of tooling which will doubtless prove of interest. A No. 4 Bardons & Oliver turret lathe equipped for performing the second sequence of operations on this piece is illustrated in Fig. 9 and when the work comes to this machine, hole *A*, Fig. 8, has been bored, recess *B* cut, surface *C* faced, and flange *D* turned. For the second sequence of operations, the work is held in a collet chuck of similar design to the one which was described in connection with the illustration shown in Fig. 6. Referring to Fig. 9, the sleeve to be machined is shown at *A*. On the turret there is a tool *B* with two cutters which provide for turning the thread diameter *E* and the outside diameter *F*, and on the second station of the turret there is a Geometric die *C* that cuts thread *E* on the work. Carried on the front slide it will be seen that there is a tool bit *D* and a double circular forming tool *E*. Tool *D* faces shoulder *G* on the work, and the circular forming tool necks the work at *H* and cuts off and chamfers at *I*. The rate of production obtained in the performance of this operation is 500 sleeves in a ten-hour working day.

Design of Special Recessing Tool

It will be recalled that on the first sequence of operations performed on the bronze sleeve shown in Fig. 8, it was necessary to cut a recess *B*, and Fig. 12 illustrates quite an interesting type of tool that was designed for this purpose. It is used on the turret of a No. 4 Bardons & Oliver lathe, on which the first sequence of operations is performed, and as the turret tool is fed up to the work sleeve *A* enters the bore, allowing a ball bearing thrust collar *B* to abut against the end of the piece to be machined. With an arrangement of this kind the work is able to continue rotating while in engagement with the fixed tool, without setting up undue frictional resistance. A continuation of the feed movement of the turret slide results in thrust collars *B* and *C* sliding back over sleeve *A*, this movement being accomplished against the resistance of compression spring *E*.

Eccentrically mounted in sleeve *A* there is a tool-bar *F* by which the recessing tool bit *G* is carried; and mounted in thrust collar *C* there is a pin *H* that projects through a slot in sleeve *A* so that its point may enter a cam groove *I* that is cut in the side of tool-bar *F*. Mention has been made of the fact that this tool-bar is eccentrically mounted in sleeve *A*, and it is free to rotate according to the motion imparted through the influence of pin *H* and cam groove *I*, although longitudinal motion is prevented by a pin *J*, that enters an annular groove *K* cut in the rear end of the bar. As the thrust collars *B* and *C* are moved to the left through the forward feeding of the turret slide, pin *H* slides in groove *I* in the cutter-bar, imparting a slight rotary movement to this bar; and owing to the eccentric mounting of the bar *F* in sleeve *A* this rotary movement swings the tool out sufficiently to cut the required recess inside of the work.

Reference to the cross-sectional illustration of the sleeve to be machined, Fig. 8, will show that the recess only extends for a distance of 1 5/8 inches at the center, and that the tool must be advanced 1 inch into the work before starting the recessing operation. This result is accomplished by the form of cam groove *I* which, it will be seen, has a straight section preceding the rise, that causes the tool to move outward radially to cut the recess; then there is a second straight section along which pin *H* slides in order to feed the tool for the required distance to cut a recess of a specified length. The machine stop governs the length of recess that is cut, after which the tool reverses its preceding sequence of operations to return to the starting point. It will be evident from a comparison of Figs. 8 and 12 that the straight portion of the cam groove which precedes the rise is not long enough to allow the tool to be advanced a distance of 1 inch into the work before starting to cut the recess. But as the recessing tool bit has already been entered some distance into the bore of the work before the end of the sleeve engages thrust collar *B*, it will be evident that the form of this cam has been properly developed to give the desired results.

Facing Retractor Collars

Fig. 11 illustrates a malleable-iron retractor collar for a Borg & Beck clutch, and in Fig. 10 there is shown a No. 4 Bardons & Oliver turret lathe set up for facing surface *A* with a single tool mounted on the front slide. Pocket *B* has already been bored and faced, and it is used as the locating point for the second operation. There is really nothing about this job to warrant discussion except the very simple means which has been devised for loading and unloading the work-holding fixture Referring to Fig. 10, two of the

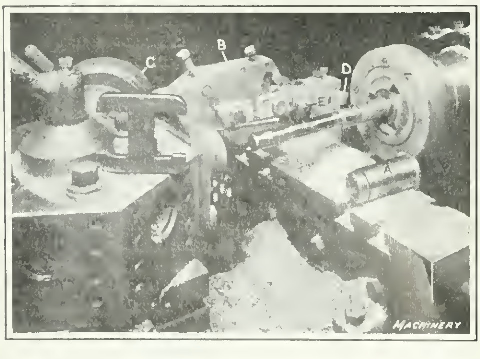


Fig. 9. Cutting Tools and Chuck used on Bardons & Oliver Turret Lathe for machining Bronze Sleeve shown in Fig. 8

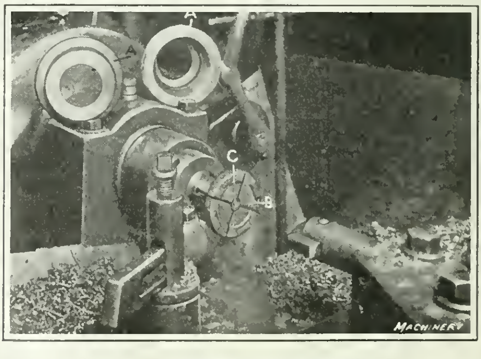


Fig. 10. Close View of the Facing Tool and Expanding Chuck used for holding Retractor Collar shown in Fig. 11

retractor collars are shown at *A*, illustrating opposite sides of the work. At *B* there is illustrated the expanding mandrel on which the work is held. This consists of a simple split mandrel with a flanged end of the proper size to enter pocket *B* in the work. This mandrel is attached to the draw-back mechanism of the turret lathe spindle, and projecting through the inside of it there is a tapered pin *C* that is held against longitudinal movement. By drawing the split mandrel back over this tapered pin, provision is made for expanding the mandrel to provide for gripping the work. Of course, the operation of facing surface *A* on the work is a very simple one, but were it not for the rapidity with which the work can be set up and removed from the mandrel it would be impossible to attain anything like the output of 800 collars in a ten-hour working day that is attained on this job. The work is done at a cutting speed of 80 feet per minute with a feed of 0.020 inch per revolution.

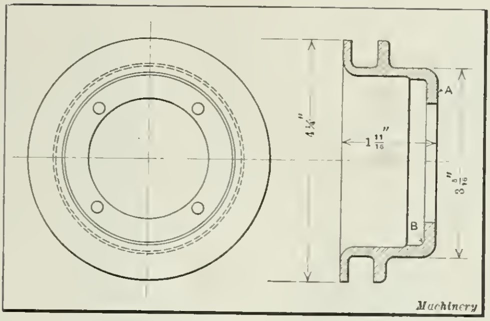


Fig. 11. Retractor Collar which has Surface A faced by a Bardons & Oliver Turret Lathe

* * *

SUBSTITUTES FOR BRONZES

The shortage of many metals in Germany during the war period forced German manufacturers to adopt various substitutes. These are discussed in an article in a recent issue of *Stahl und Eisen*; the results of these German experiments may prove of interest and value in the metal trades everywhere. The following data on the subject have been obtained from a translation made by the *Journal of the American Society of Mechanical Engineers*.

Substitutes in Engine and Pump Manufacture

Crankshaft housings for submarine engines have to be built of a special bronze having very high mechanical qualities, such as high tensile strength and high percentage of elongation. Since the beginning of 1915, due to the shortage of metals, these crankshaft housings were made of cast steel, which did not lead to any particular difficulties and, indeed, with the construction of larger sizes of submarine engines, proved to be an advantage, as it gave to the housing a greater rigidity. On the other hand, the machinability of the material was not as good as that of bronze.

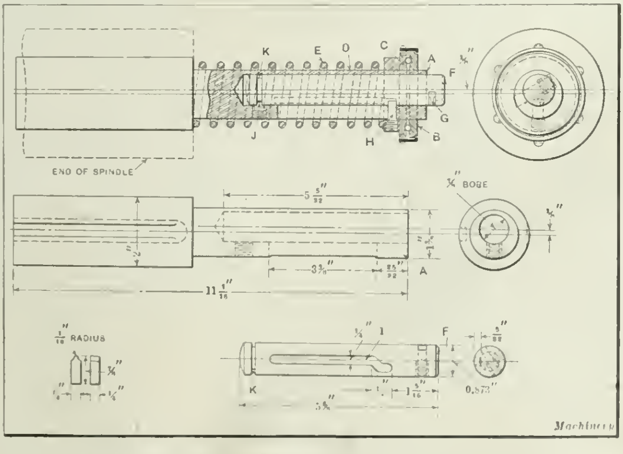


Fig. 12. Tool for cutting Recess in the Bore of Sleeve shown in Fig. 8

All the screws, bushings, etc., which before the war were made of bronze or copper castings, had to be of iron and tin-coated in order to protect them against rust. This was done by the Schoop process. On the other hand, parts which used to be made of aluminum castings were during the war made of thin sheet iron and then galvanized.

Considerable trouble was experienced with piping. The former copper piping was replaced by steel piping, galvanized inside and out. The zinc coating did not prove satisfactory, however, as it was rapidly eaten away by sea water and salty sea air. The pipes then were protected by lead, which, however, did not adhere well to the steel and chipped off easily under mechanical influences. It, therefore, proved necessary to protect the piping by two coats of metal—zinc first and lead afterward. This required great skill in manufacture and a close control of the temperatures at which the metals were applied, and was therefore not wholly successful.

Conservation of Tin

Vigorous efforts were made to conserve tin. Bronze bushings or parts under heavy stress (such as steering gears) used to be made of a bronze with a 15.5 per cent tin content. During the war these bronze bushings were made of an alloy containing about one-third less tin and were not cast in sand, but in a metal mold so as to give them a greater hardness. This was based on investigations made in 1910 by Heyn and Bauer, which indicated that the hardness of a copper-tin alloy is really a matter that may be controlled either by variation in tin content or by the proper control of temperature conditions during cooling, and, in particular, by the velocity of cooling. It should clearly be borne in mind that this hardening by rapid cooling is possible only with bronzes and not with brasses.

Bronze bushings with a tin content of 10 per cent were machined and after having been set in their seats were hardened on their surfaces by having a mandrel driven in under high hydraulic pressure. Parts not subject to heavy stresses were made of zinc castings, and it appears that the strength of such parts was materially affected by the heat-treatment to which they were subjected.

An effort was made to produce a bearing metal containing 42 per cent tin, 42 per cent lead, 2 per cent copper and 14 per cent antimony, but it has not as yet been carried to a successful conclusion.

Metals for Steam and Water Nozzles

Considerable trouble was experienced in attempts to find substitute metals for use in nozzles through which water, steam, gases or acids are discharged under pressure. Here, in addition to other conditions, the tendency to corrosion and erosion had to be met. In particular, in injectors, attempts were made to substitute cast-iron nozzles for bronze, but it was found that the former did not stand up well when used either with steam or hot water. The inner wall of the nozzle was strongly corroded, which interfered with the efficiency of the apparatus.

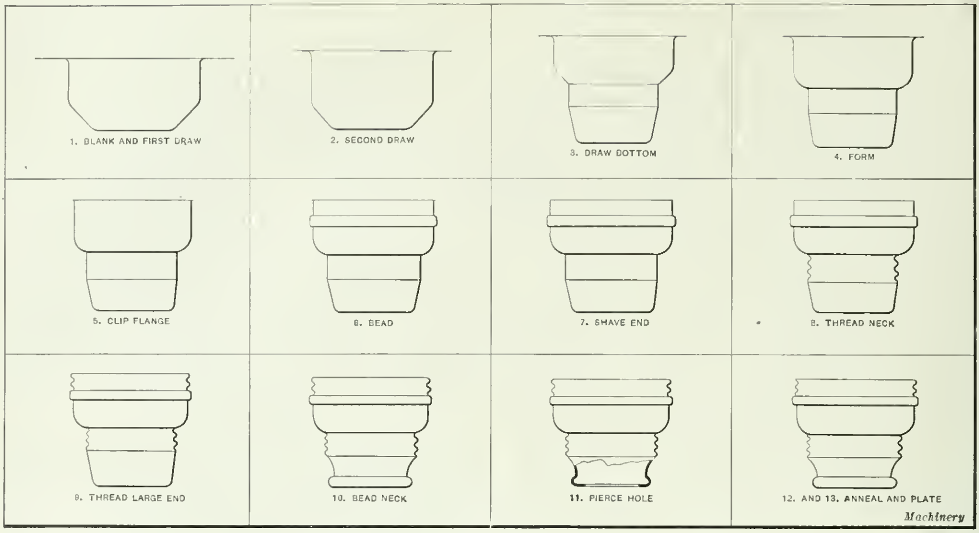


Fig. 1. Operation Sheet, showing Various Steps taken in drawing the Shell

Drawing a Deep Shell of Irregular Shape

Principal Details of Dies Used for Successive Operations in the Drawing and Forming of a Shell of Unusual Form

By CHARLES RUIZ

THE drawing of a deep shell depends upon a number of variable factors, and the rules for calculating the flow of metal are empirical. The formulas that have been developed as the result of experimentation pertain chiefly to shells of regular shape and are given in Volume II of MACHINERY's Encyclopedia, page 411, and in "Diemaking and Die Design;" consequently they need not be presented in this article. When planning the drawing operations, not only must the amount of reduction in diameter permissible in each succeeding drawing operation be considered, but also the amount that the stock is "ironed" or thinned out while being drawn. This is true because the reduction in gage thickness means greater pressure of the punch against the bottom of the shell; consequently the amount that the shell diameter is reduced in each drawing operation must be lessened when a greater amount of ironing is necessary.

In arranging to manufacture an irregularly shaped shell, the rules pertaining to shells of regular shape cannot be applied, except in a general way. In the manufacture of the shell, the operations on which are described in this article, considerable planning was required on account of this fact. Shells of irregular shape must be carefully studied to determine the probable flow of metal, when planning and designing the tools for use in their production. The diameter of the blank was determined by weighing a sample, and then, knowing the weight of the sheet metal per square inch, computing the diameter of a piece which would be equal in weight to the sample. The diameter was then increased a certain amount, in this case, 5 per cent, to allow for trimming after the drawing operations were completed. This is necessary on account of the unevenness in the flow of metal due to irregularities in hardness and inaccuracies in setting the dies in relation to the punch. After the size of the blank was decided on, the process of manufacture and the requisite number of operations were determined. The most dependable factor to consider in this connection is the designer's previous experience, for there is no other way, to the writer's knowledge, to determine what the shapes should be after each successive operation. The planning and tooling are of utmost importance, as many dollars worth of tools can be saved by a little diligent study.

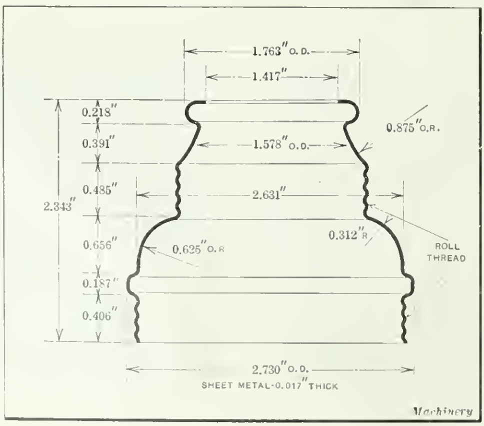


Fig. 2. Fully Dimensioned Illustration of the Finished Shell

Major Forming Operation for Producing the Shell

For convenience in following the various steps required in its evolution, an operation sheet, Fig. 1, and a completely dimensioned drawing of the shell, Fig. 2, may be referred to. The shell is made from sheet metal, 0.017 inch thick, and is blanked and formed to the shape shown by the heavy line in Fig. 3, in one operation.

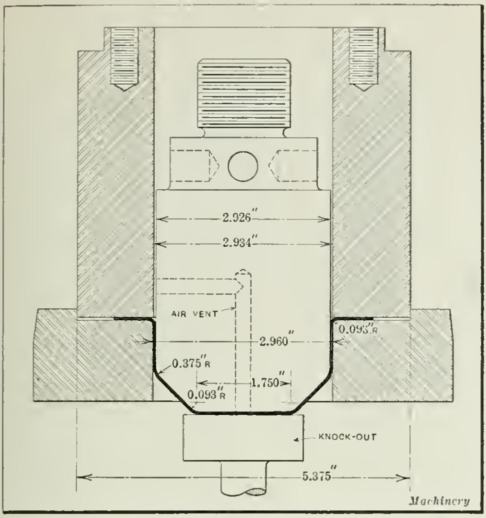


Fig. 3. Punch and Die used in the Blanking and First Drawing Operation

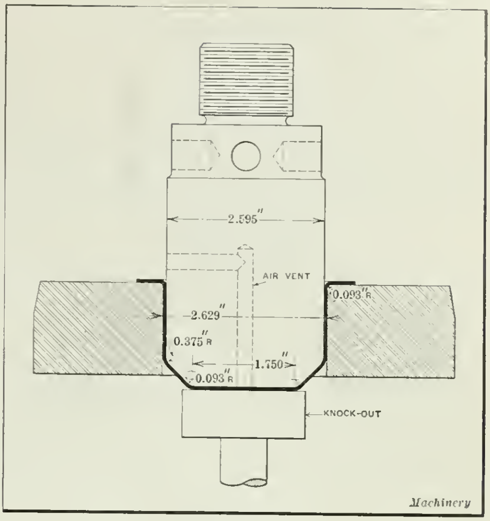


Fig. 4. Single-action Press Equipment for the Second Drawing Operation

The punch and die for this operation is used on a double-action press of standard construction equipped with a knock-out for ejecting the shell from the die. Fig. 4 illustrates the tools used in performing the second operation, which is simply a redrawing operation performed on a single-action press. It will be observed that all dimensions necessary for making the tools that are employed in the forming of the shell are given on the illustrations, and the construction is clearly shown in each case.

Operation 3 is performed with the tools illustrated in Fig. 5, and consists of drawing the bottom of the shell to the shape shown. Attention is called to the fact that the shape of the shell after Operation 2 is such as to enable it to fit the upper portion of the die used in Operation 3, and that sleeve *A* is so shaped as to hold the work while the plunger draws the bottom of the shell and forms the nose. This operation is also performed on a double-action press, the construction of the tools being similar to those used in the preceding operations as regards knock-outs, air vent, etc. Fig. 6 illustrates the tools used for forming the shell to the shape shown; this equipment contains no features to which attention need be drawn, except that the knock-out is made to bottom in a hole in the die-block so that the small end of the shell will be formed perfectly flat. Operation 5 consists of clipping the flange as shown in Fig. 7. This is a plain punch and push-through type of die with a hardened steel die ring *A* seated in the die-block. This operation which, with the exception of the final piercing operation, completes the press work on the shell, is performed on a single-action press.

Beading, Shaving, Threading, and Piercing Operations

The tools used for forming a bead on the large diameter of the shell are shown in Fig. 8. The work can be performed on an ordinary lathe by holding the form roller *A* in the toolpost and the arbor *B* in the headstock. It will be

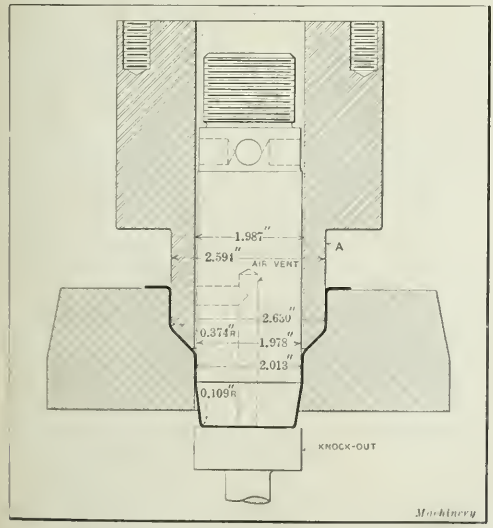


Fig. 5. Third Operation—Drawing the Bottom of the Shell on a Double-action Press

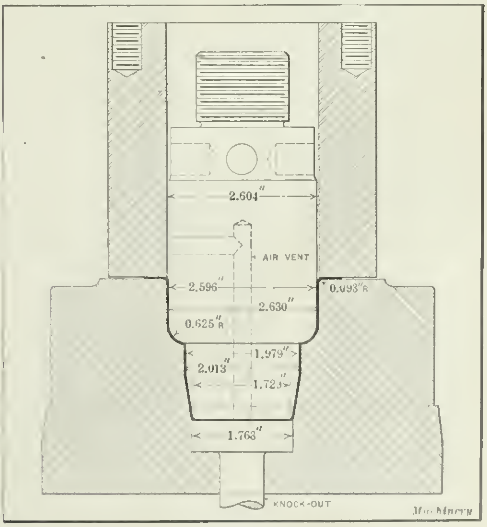


Fig. 6. Forming the Shell to the Shape shown and flattening the Small End

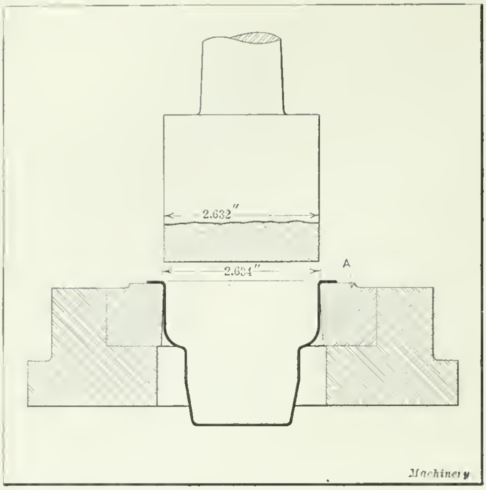


Fig. 7. Clipping the Flange. This Operation is performed on a Plain Push-through Die

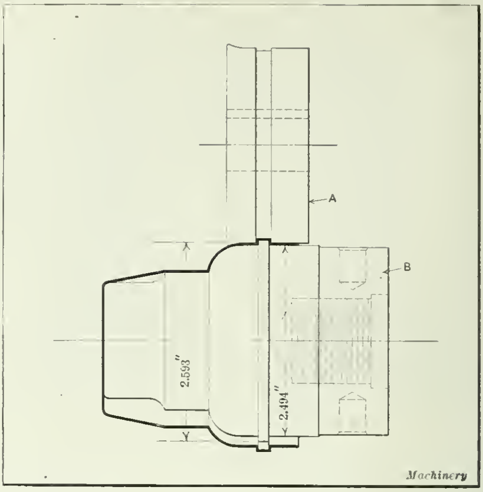


Fig. 8. Forming a Bead on the Large Diametral Surface of the Shell in a Lathe

seen that the important dimensions of the arbor are given—the diameter of the tongue used in forming the bead and the large diameter of the body. The arbor should be small enough in diameter to allow the shell to slip freely over it. Operation 7 consists of shaving the end of the shell, and the tools and arrangement employed are clearly shown in Fig. 9. While this work could be performed in a lathe, the operation can be done more economically on a vertical machine, with provision for locating the tool properly for shaving the shell to the correct length. In the vertical machine in which this operation was performed, the shell is driven by pressure between arbor *A* and sleeve *B*. These two members are mounted on opposed spindles of the machine which are connected to rotate in unison, and the tool is fed to the work automatically.

The rollers employed for threading the neck and large diameter of the shell are illustrated in Fig. 10 and at *A* in Fig. 11, respectively. These rollers are mounted on a special threading and knurling machine, and both the arbor and the rollers rotate by means of a positive gear drive. The shell is loosely mounted on the arbor which is made about 0.005 inch smaller in diameter than the inside diameter of the shell before threading. The arbor is single-threaded, and the threaded roller usually has a diameter of about two or three times that of the arbor, the gearing being such as to rotate the roller one revolution while the arbor is rotating either two or three revolutions, as the case may be. The size of the roller, however, should not be exactly double or triple the diameter of the arbor, because the thickness of the metal from which the shell is made must be taken into consideration. It will be apparent that the surface speed of the arbor and of the outside of the shell cannot be the same under these conditions, and the speeds must be calculated to take care of the increased speed of the outside of the shell, and not with respect to the speed of the arbor. The diameter of the roller should be either two or three times the sum of the outside diameter of the arbor plus twice the thickness of the metal. It follows that when the diameter of the roller is twice that of the outside of the shell on the arbor, the roller should be double-threaded; and when the diameter of the roller is three times that of the revolving shell, the roller should be triple-threaded.

The tenth operation, that of beading the neck of the shell, is performed like the beading operation shown in Fig. 8. The tools and the relation of the form roller to the work are illustrated at *B*, Fig. 11. The last machine operation, No. 11, is shown at *C*, and consists of piercing a hole in the bottom of the shell, the work being performed with simple tools on a single-action punch press. Due to the hardening or ironing that the metal receives during its manufacture, the shell requires annealing several times between the drawing and forming operations; the number required must be found by trial, and must be reduced to a minimum to lessen the cost of the shell. The last two operations do not require special mention.

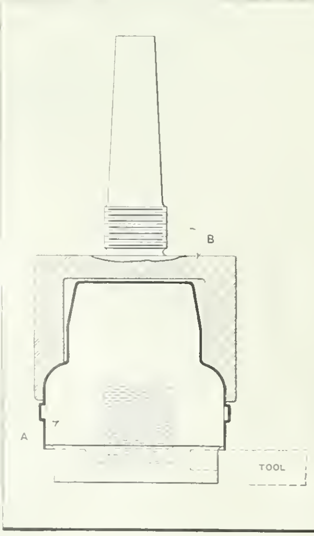


Fig. 9. Shaving End of Shell on Special Vertical Machine

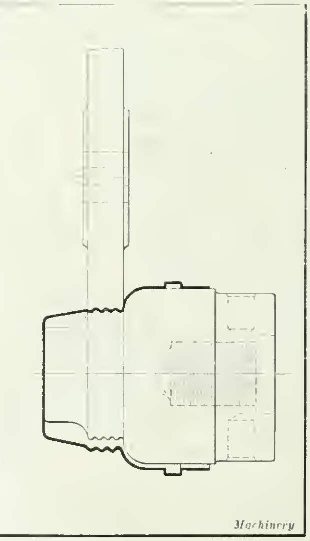


Fig. 10. Rolling a Thread on the Neck of the Shell

INCREASING VOLUME OF FOREIGN TRADE

It is not generally appreciated that the foreign trade of the United States now forms 17 per cent of our total commerce. As a result, foreign trade becomes of importance to everyone engaged in productive work. The workers in the industries of the country should realize that the products on which they work are largely sold abroad and that their continued prosperity and employment in many cases depends on the maintenance and development of foreign trade.

In the electrical industry for example, 25 per cent of the total production in generator sets in 1919 went abroad; and in the case of electric railway locomotives, over 60 per cent of those manufactured were for foreign buyers. In 1919 over 5000 American ships having a total tonnage of 6,665,000 were engaged in foreign trade. The total tonnage of vessels, both American and foreign, that cleared from American ports engaged in foreign trade in 1919 was over 51,000,000 tons, carrying exports valued at nearly $8,000,000,000.

Ten per cent of the total products of the electrical manufacturing industries in the United States during 1919 were exported. The total exports in this industry were valued at $90,000,000. Forty per cent of these exports went to our neighbors in North and South America; 25 per cent to the Far East and Australia; and 25 per cent to Europe, where Great Britain, Norway, France, Italy and Spain were our biggest customers. This high level of electrical exports during 1919 was attained in the face of unfavorable foreign exchange rates. But the demand for electrical products in Europe has been very urgent because of the necessity for utilization of hydro-electrical power for the industrial rehabilitation of Europe.

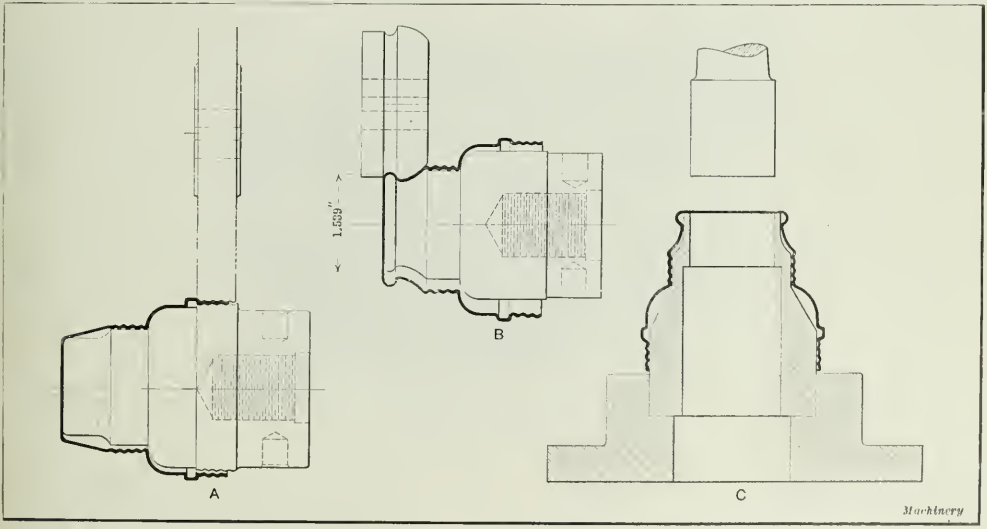


Fig. 11. (A) Threading the Large End. (B) Beading the Neck. (C) Piercing Hole in End of Shell

According to a pamphlet entitled "Sources of Our Exports" published by the National Foreign Trade Council, the National Automobile Chamber of Commerce is now endeavoring to have removed an obstacle that has proved a hindrance to the extension of our export trade of American cars in Europe. The proposal is that the present import duty into the United States, which is now 45 per cent on cars having an import valuation of $2000 and over, be reduced to 30 per cent upon cars of all values. The European countries, in fixing their import duties, have taken our rate as a sample, and have imposed correspondingly high duties upon automobiles imported into their countries. The adoption, by the United States, of a lower rate will, it is believed, induce a material lowering of European import duties on automobiles. It is stated that the entire membership of the Automobile Chamber of Commerce—123 companies—are unanimous in urging the reduction of our import duties on automobiles on the broad ground of general benefit to the automobile industry.

In 1919, 4 per cent of the automobiles manufactured in this country were exported—67,000 passenger cars valued at $74,000,000 and 15,500 trucks valued at $35,000,000. In addition to this, parts were exported to a value of $43,000,000 making a total export of automobiles, trucks, and parts of $152,000,000.

* * *

THE PRESENT POSITION OF THE SHIPBUILDING INDUSTRY

From Lloyd's shipbuilding reports it appears that there were 2195 merchant vessels in the course of construction in all parts of the world on June 30, this year, representing a gross tonnage of about 7,700,000 tons. Of these 941 ships, aggregating 3,580,000 tons, were under construction in the United Kingdom, while a tonnage of 2,106,000 tons was under construction in the United States. The total available tonnage of steel steamers owned in the United Kingdom is 18,110,000, which is about 780,000 tons less than in 1914. The United States at the present time owns a tonnage of 12,400,000 as compared with 2,027,000 tons in 1914. At the outbreak of the war in 1914, the total steel steamship tonnage of the world was 45,400,000. At present this total is nearly 54,000,000 tons, most of this increase having been completed in the last twelve months, in which period 6,000,000 tons have been built.

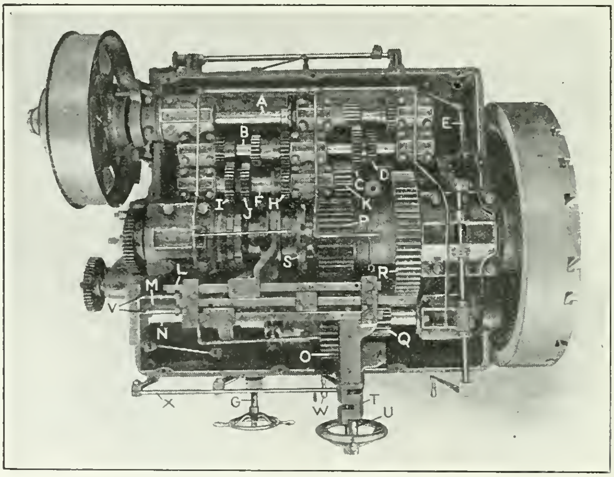
* * *

The state of New York has appropriated $50,000 for establishing scholarships for teachers in industrial training schools. These scholarships amount to $2000 each, and will be given only to men who have at least five years successful experience in some industrial or technical occupation. It is expected in this way to meet the requirements for teachers who know their trade and who would like an opportunity to learn how to teach it. Five years of practical experience and one year of training in the vocational department of an institution for training vocational teachers ought to equip a man for this work, provided he is otherwise fitted for it by temperament and inclination.

Geared-head Transmission for Lathes

WHILE the construction of gear-head drives for lathes is generally understood, a detailed description of such a mechanism will doubtless prove of interest. The design illustrated herewith is the transmission gearing and mechanism contained in the headstock of a 60-inch engine lathe and contains certain unique features of design. The speed changes, of which there are eighteen provided, are of the selective type, and the shifter-bar arrangement is similar to the gear transmission on an automobile.

The initial driving shaft *A* operates at a constant speed and transmits two speeds to the long auxiliary shaft *B*, according to which of the two gears *C* and *D* is in mesh with the driving shaft gear. The friction clutch for the driving pulley (or for the driving gear if the lathe is motor driven), and the brake are operated by handle *W*, the clutch being connected by a long rod to the bell-crank lever *E*, which prevents shifting of gears *C* and *D* except when the friction clutch is disengaged. These gears are operated by the handle shown near the faceplate of the lathe. The movement of the crank-handle to the right disconnects gear *C* and brings gear *D* into mesh with its mating gear. The design of lever *E* is such as to prevent engagement of the friction clutch when the gears are in the neutral position or when they are not fully in mesh. The operation of the friction clutch also controls a speed-change locking mechanism, consisting of fingers *V* which carry pins for engaging slots in the shifters and locking them together in series. The connecting link and the arm attached to bar *X* are plainly seen in the illustration from which it will be apparent that the manipulation of handle *W* simultaneously engages the friction clutch and prevents the shifting of the gears when the driving pulley is connected with the initial driving shaft of the geared head.



Arrangement of Gears and Clutches in Headstock of 60-inch Geared-head Engine Lathe

The two speeds of the long auxiliary shaft *B* furnish six speeds for the short auxiliary shaft *F* which may be obtained in the following manner. There are two racks located under shaft *F* and parallel with it, which may be engaged by a pinion on the end of the operating shaft *G*. One of these racks operates sliding gear *H* by means of a gear-shifting fork which it carries, while the other operates gears *I* and *J* by similar means, to mesh with either of the two smaller gears on shaft *B*. The six speeds which are thus obtainable for gear *K* may transmit eighteen speeds to the faceplate of the lathe by means of two combinations of gears and one sliding clutch. The gear shifters *L*, *M* and *N* are operated by shaft *U* for the purpose of obtaining these three transmission combinations.

When driving through the faceplate pinion (which cannot be seen in the illustration), gear shifters *L* and *N* occupy the left-hand position shown in the illustration, while shifter *M* is moved to the right thus engaging a sliding gear (not visible) with pinion *Q*. The drive is then through the spindle gear *P*, which is an idler, to the faceplate pinion-shaft by means of pinion *Q* and its engaging gear. In the second method of driving the faceplate, shifter *L* remains as before, leaving gear *P* loose on the spindle, and shifter *M* is moved to the left withdrawing the faceplate pinion from mesh with the faceplate gear. Shifter *N* is slid to the right-hand position which results in sliding the faceplate pinion-shaft, so that pinion *Q*, which is fast to it, will be brought into mesh with the fixed spindle gear *R*. The drive is then through gears *P*, *O* and *Q* to spindle gear *R*. The third drive is direct to the lathe spindle. In this case, shifter *N* is moved to the left, to the position shown in the illustration, disengaging pinion *Q* and gear *R*, after which shifter *L* is moved to the right, engaging tooth-clutch *S* with gear *P*. In this case the faceplate pinion-shaft revolves, but is inoperative.

The three shifters *L*, *M*, and *N* are controlled by the operating shaft *U*, which contains a projecting finger that engages slots in the shaft bearing *T* when operating the shifters. This arrangement is provided so that after each shift of gears is made, it becomes necessary to turn the operating shaft in the opposite direction, until the end of the slot is reached, so as to disengage the drive before shifting to the next speed. This prevents the selection of gears having a conflicting ratio and furnishes a stop against which the finger on the shaft *U* must be abutted when the gears or clutch are placed in full engagement. When thus engaged, the positions are locked by the device previously mentioned so that they cannot be changed until the friction driving clutch is disengaged. This same construction for selecting the speed changes is provided for shaft *G* and is a modification of the lever gate or H-plate used in automobile gear-boxes.

The center lines of all gears in this head lie in the same horizontal plane and are lubricated by an oiling system in which the oil is forced through pipes located over the various journal boxes, into each of which a stream of oil is constantly directed. The sprocket wheel for the oiling system, from which the centrifugal pump is driven by means of a chain, may be seen on the initial drive shaft, near the middle bearing. Shafts *A*, *B* and *F* together with their bearings and the ten gears which they carry, constitute an individual unit which is assembled independently of the other gears, shafts, etc. This facilitates the assembling process, since this unit is simply set into the headstock housing and after gears *K* and *P* are brought into mesh, is attached by bolts to the headstock casting. The eighteen speeds of this gear-head range from 1.63 to 115.5 R. P. M. The lathe on which this head is used is manufactured by Manning, Maxwell & Moore, Inc., Putnam Machine Works, Fitchburg, Mass.

Electro-percussive Welding Developments

IN a paper presented before the American Welding Society at Pittsburg, Pa., by Douglas F. Miner, research engineer, Westinghouse Electric & Mfg. Co., recent developments in electro-percussive welding were considered, together with the advantages of the process. This method of welding is particularly suitable for manufacturing large quantities of duplicate parts because one size of machine will handle a large variety of work over a considerable range of size; but on account of the necessity of having different fixtures for various kinds of work, the investment in fixtures is likely to be too great if only a small number of identical parts is to be welded. Thus, it will be apparent that repair work is not its most suitable field. There is a great opportunity for developing automatic machines for utilizing this process inasmuch as the time required for welding is negligible and the only factor limiting production is the time required to feed and grip the work.

A study of the parts of a well-known automobile showed that over fifty of the parts could be produced better by percussive welding than by present methods. The manufacturing costs of many types of tools having a special cutting portion attached to a shank of cheaper material can also be reduced by this process and better results obtained. Besides this, there are numerous hardware articles having unlike metals or unequal sections welded together which can be advantageously produced by electro-percussive welding.

Development of Apparatus Using Electro-magnetic Energy

The underlying principles utilized in percussive welding were discovered in 1905 by L. W. Chubb of the Westinghouse Co., and machines were developed for welding metals in wire form of rather small cross-sections. (A complete description ot the principles of the system was published in MACHINERY June, 1915, and is also published in the book "Electric Welding" by Hamilton and Oberg.) Satisfactory welds were made between wires having widely different physical properties, perfectly ductile welds being made with platinum and lead, tungsten and aluminum, and copper and aluminum. The apparatus consisted essentially of a device producing a percussive engagement of the parts to be welded practically simultaneously with a discharge of electrical energy, this energy being taken from an electrolytic condenser. However, a condenser proved to have decided limitations on account of the small amount of energy capable of being stored in one of convenient size; consequently, a scheme was evolved for utilizing electrical energy stored in a magnetic field, thus substituting electro-magnetic for electro-static energy. An apparatus using electro-magnetic energy has been developed, and very successful welds of the butt type have been made with stock having a cross-sectional area equivalent to that of ½-inch diameter stock.

In order to permit a better understanding of the apparatus a brief description of its operation will be given. Stated in simple terms, when any electrical circuit containing large inductance, such as a coil of many turns, is interrupted, the stored energy tries to prevent the break and causes an arc to be drawn. An electric arc is a source of high intensity heat particularly well suited to welding operations. In the apparatus there is a reactance coil of two windings, a primary coil being connected momentarily to a source of direct current, and a secondary coil being connected to the pieces to be welded. By means of suitable tripping devices the forging hammer causes the primary coil to be disconnected from the source of power, with the secondary coil closed. The transferal of the energy of the collapsing magnetic field to the secondary coil occurs and then a rapid small separation of the parts to be welded causes an intense arc to melt the surfaces of the work. At the proper moment the hammer forges the pieces together, the complete operation requiring only about 0.1 second, so that no time is allowed for oxidation or excessive heating. An oscillogram taken during a weld between copper and steel rods ⅜ inch in diameter indicated a peak of current of 2600 amperes, an arc of 30 volts, a maximum power of 60 kilowatts, an energy of 0.00077 kilowatt-hours, and the welding time as 0.094 second.

Advantages of Electro-percussive Welding

The power necessary for percussive welding is only about one-quarter of that required in welding the same size of stock by the butt-welding process. The operation is so rapid that the time of the actual weld is negligible and so the rate of production depends chiefly on the time consumed in handling the work. A time study of a number of operations employing other methods of welding has shown that the saving in time obtained by the use of percussive welding allows a remarkable increase in production or a reduction in labor costs. The short duration of the fusing arc in the percussive process allows no chance for the heat to travel back into the metal when the two pieces of work are of unequal section. The necessary energy is concentrated in a very small amount of material, utilized where needed, and not dissipated in heating up the rest of the stock. Consequently, welds such as a small rod to a heavy plate or a tube to a block, are possible. No preparation of the surfaces or previous treatment is necessary; this feature opens up a wide field of application permitting the welding of some products formerly impossible, and improving the methods of manufacture on some products now being made by other welding processes.

In many manufactured products it is desirable to join brass or copper parts to parts composed of steel, and percussive welding solves many of these problems without the use of screws, bolts or rivets. Steel alloys can also be welded to cold-rolled steel. Percussive welding permits the welding of parts, the physical structure of which the heating caused by other methods either destroys or changes, such as drawing the temper. Welds can be made after any treatment has been given to the work without changing the condition of the structure, because of the localized heat of the weld. Immediately after the weld is completed the piece can be handled and no appreciable warmth can be felt. This is a feature which is valuable in tool manufacturing. After the proper setting for a given weld is made the character of the weld is always uniform and independent of the skill of the workman, so that the machine may be operated by unskilled labor without danger of poor results. With most other welding processes the judgment of the operator must be relied upon to a large extent and the chance of faulty work is large. The percussive process produces a much smaller fin or flash than butt-welding, thereby decreasing the cost of finishing. In fact, for many purposes, finishing operations are unnecessary.

* * *

The serious post-war problems of Germany are perhaps best exemplified by the inefficiency of German labor in the coal fields. According to *Stahl und Eisen*, there are in the Ruhr coal mines at the present time in round figures 70,000 more men actually employed than immediately preceding the war, yet the total output is only 60 per cent of the output in 1913.

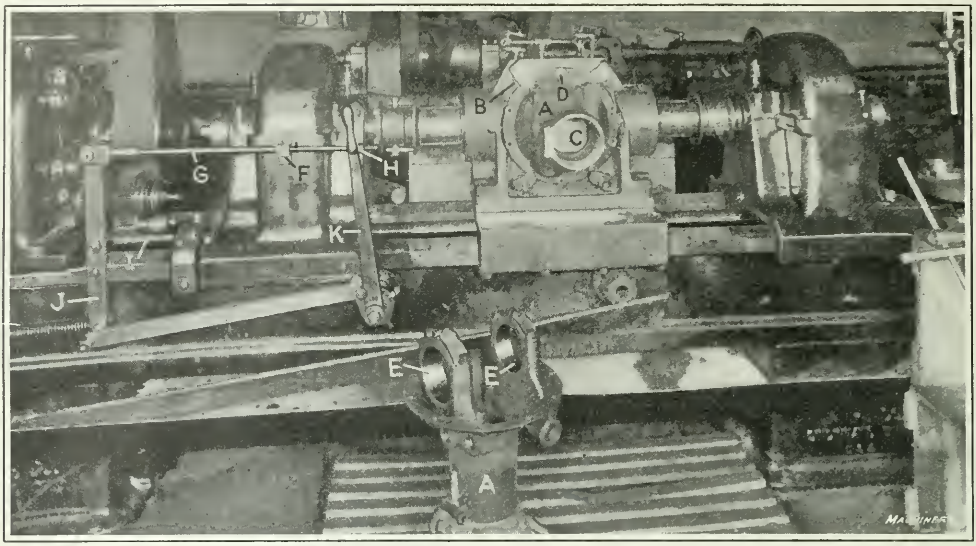


Fig. 1. Special Duplex Boring and Tapping Machine developed for machining Differential Gear Carriers

Shop Practice in an Axle Plant

Methods of Machining and Equipment Employed in the Plant of the Timken-Detroit Axle Co., Detroit, Mich., for Obtaining High Production

MEN who have an opportunity of frequently observing machine shop practice in different industries are usually of the opinion that the methods used in motor car plants and factories engaged in manufacturing automobile parts and accessories are among the most efficient. The reason ascribed for this is that many of these plants were planned and built for a predetermined volume of product and as a result, it was possible to provide many improved methods which are not applicable in plants that have been developed by a gradual process of evolution. Another feature of the average plant in the motor car industry is the care that has been taken in developing the factory organization, making provision for carefully studying the requirements of each new shop operation, with a view to providing a method which will enable the job to be done in an economical manner. Similarly, old methods are not allowed to remain in use after it becomes evident that the work could be done at a lower cost in some other way. Probably it is safe to say that there is no industry in which a greater amount of money is spent on the planning of methods of machining and in the replacement of existing equipment with machines of more efficient types.

Examples of Shop Practice in the Timken-Detroit Axle Plant

At the plant of the Timken-Detroit Axle Co., in Detroit, Mich., the normal daily rate of production is 600 axle sets which are used in Cadillac, Hudson, and other well-known motor cars. There are few plants in which each detail of manufacturing practice is more carefully scrutinized with a view to eliminating every possible source of inefficiency. One method of improving operating conditions is to have an industrial engineer of wide experience come to the plant for one week out of each month and spend his time investigating both the methods of performing machining operations and the details of construction of individual machine tools, the latter part of the work being done with a view to ascertaining their suitability for the particular purposes for which they are used.

Based upon the periodical reports of this expert, and upon the findings of men who are constantly engaged upon similar work at the Timken plant, the design of the machines is constantly being modified to make them more perfectly adapted for the peculiar requirements that must be fulfilled in manufacturing axle parts. For instance, it may be found that by strengthening gears, shafts, or other members of the driving mechanism, coarser feeds and higher speeds can be employed. The making of such changes involves an expenditure of time and money, but the return in increased production far more than offsets this expense. In a plant where such careful attention is paid to every detail one would naturally expect to find interesting and highly efficient methods of performing machining operations. The following examples were selected for discussion in MACHINERY both on account of the interesting means provided for handling the work and the satisfactory rates of production which are obtained, and also because, while these methods are used for machining axle parts, they could be employed with slight modifications for producing many similar classes of work.

Turning the Thread Bearing and Taper on Steering Arms

There are several different types of steering arms used in Timken axles, but in machining all of these parts it is necessary to turn a straight thread bearing at the end of the arm and a tapered fit above the straight cylindrical surface. After using various methods for handling this job, the work was put on engine lathes provided with special equipment of the form shown in Fig. 2 and this has proved capable of giving highly satisfactory results. In this illustration the straight thread bearing is indicated at *A* and the tapered portion at *B*, and it is important for a square shoulder to be formed between surfaces *A* and *B*. Referring to the illustration it will be evident that a cat-head is mounted on the lathe faceplate, with V-blocks on this cat-head for supporting and driving one end of the work, while the opposite end of the forging is supported by a tail-center. For obtaining the required straight and tapered portions of the turned surface,

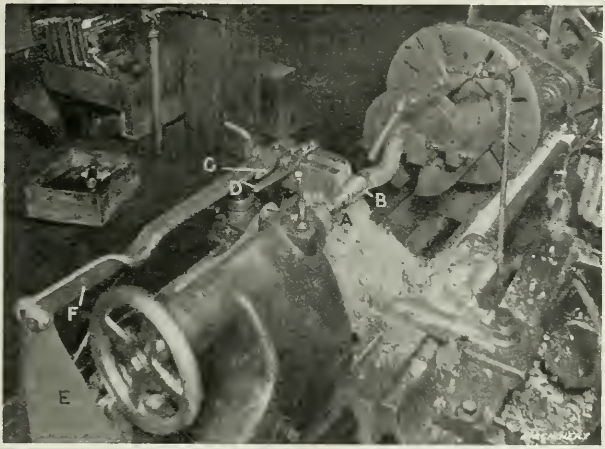


Fig. 2. Engine Lathe equipped with a Special Combination Straight and Taper Turning Attachment

a cam *C* is furnished at the front of the machine which engages a contacting point that is secured to the cross-slide.

As previously stated, it is necessary to have a square shoulder between surfaces *A* and *B*, and this result is obtained by having a similar shoulder between the straight and inclined faces of the cam. The contactor or sliding member that bears against cam *C* is provided with a square corner so that it is able to drop straight down the shoulder of the cam to produce the required form of shoulder on the work. The fixture is provided with a hand-lever *D* which is connected with the "Lo-swing" tool-block used for this job, and the operator holds this lever in his right hand to supplement the action of a spring that holds the contactor in engagement with the cam. By so doing, he insures having the contactor follow the contour of the cam while passing over the shoulder and thus insures an accurate form for the work that is being turned. It will be evident that the purpose of bracket *E* and rod *F* is to hold the support for cam *C* in a stationary position on the lathe bed, while lever *D* and the contactor that runs over cam *C* are mounted on the cross-slide so that these members travel with the carriage. On this job the rate of production obtained is 20 steering arms per hour.

Rough- and Finish-boring and Tapping the Differential Bearing in Differential Gear Carriers

Special duplex lathes were built for the Timken-Detroit Axle Co. by the National Lathe Co., of Cincinnati, Ohio, which make it possible to perform the necessary boring and tapping operations on the differential bearings at both ends of the differential gear carriers without requiring the work to be reset. Referring to Fig. 1 it will be evident that one of these malleable iron castings *A* is shown set up in place on the machine while a second casting will be seen standing in the foreground to give a better idea of the operation to be performed. Between the opposed spindles of the machine used for handling these parts, there is a work-holding fixture provided with a vertical plate *B* against which the work is clamped. Before the castings come to this duplex lathe, the hole has been bored in the sleeve on which the casting is shown standing in the foreground, and this finished bore is used as a locating point by having a pilot *C* secured to the fixture, this pilot being of the proper size to enter the bored hole.

Small holes have also been drilled in the flange of the work, and one of these holes constitutes a locating point by fitting over a pin *D*. With the work set up in this way the operator is ready to start boring and tapping the differential bearing holes *E*. The two opposed spindles of the duplex lathe are furnished with combination rough- and finish-boring bars and collapsible taps which are arranged to operate successively, so that the three operations are finished at a single feed movement of the lathe heads along the bed of the machine. Both the feed and the return movements are automaticaly controlled so that after the work has been set up and the machine started working on one casting, the operator can give his attention to a second machine, while the first one is occupied on the operation upon which it has just been started.

Automatic Control of the Feed Movements

Automatic control of the movements of the lathe heads is obtained in the following manner: Each head moves forward

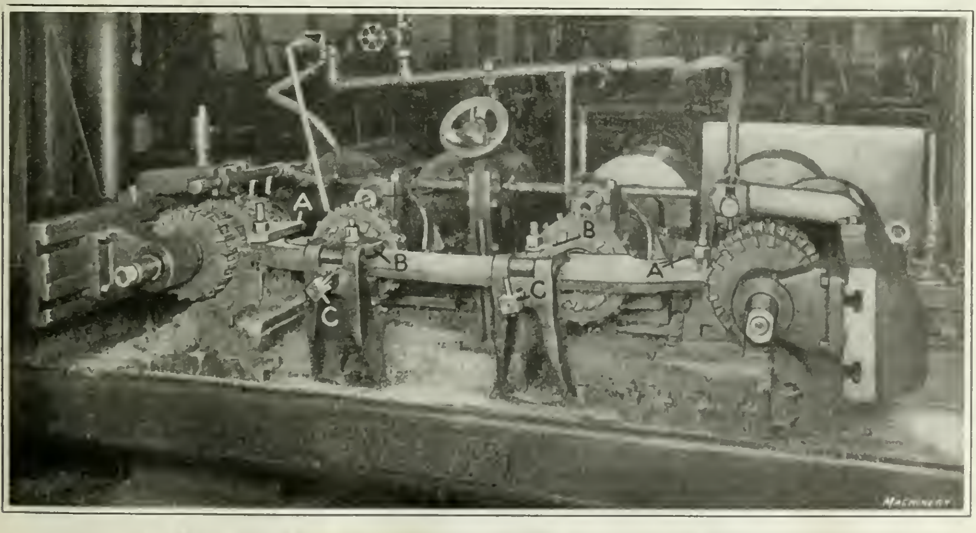


Fig. 3. Special Multiple-spindle Milling Machine built for Use in simultaneously milling Ten Surfaces on Front Axle Forgings

until the rough- and finish-boring tools and the taps have been fed through their respective holes *E* in the work. After this has been accomplished a bracket *F* carried on one of the lathe heads and arranged to slide over horizontal rod *G*, comes into engagement with nut *H*, and further movement of the lathe head results in pulling rod *G* forward to throw the clutch out of engagement with the "forward" feed-gears and into engagement with the "reverse" gears. Then the lathe head returns at high speed until rod *I* secured to the lathe head, comes into contact with lever *J* and throws this lever over to disengage the reverse gears and throw the clutch into a neutral position. Then feed movement of the head stops until such time as the operator has removed the finished piece from the machine and set up a fresh casting in its place. One feed control mechanism suffices for the operation of both heads on the machine because this mechanism imparts a forward or reverse movement to the feed-screw which operates both of the heads. After a fresh piece of work has been set up, the clutch is re-engaged with the forward feed-gears by means of a handle *K*, and when this has been done the operator is ready to give his attention to another machine in the manner previously described. On this job the rate of production obtained is 70 differential gear carriers from each machine in eight and one-half hours.

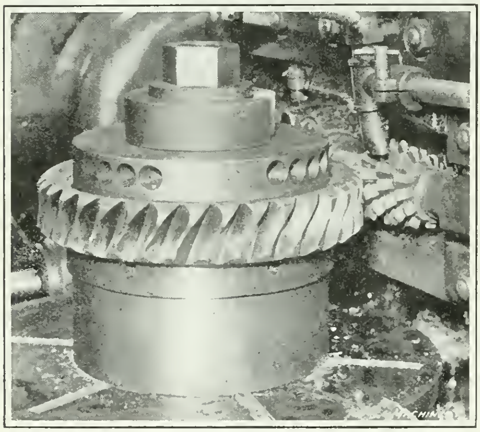


Fig. 4. Gear Generating Machine equipped with a Special Hob that is fed tangentially across the Worm-wheel for roughing and finishing the Teeth

Special Multiple-spindle Milling Machine for Operation on Front Axles

Fig. 3 illustrates a special multiple-spindle milling machine built by the Beaman & Smith Co., of Providence, R. I., to provide for the performance of milling operations on front axles. This machine provides for simultaneously milling two spring pad seats and four faces on each yoke of the axle, making a total of ten faces which are milled on the work at a single setting. On each end of the machine it will be seen that there are two pads or brackets on which the yokes at each end of the axle are held down by straps *A*, while there are two seats near the center against which the work is held by straps *B*. These center clamping members are also furnished with screws *C* which are tightened against the work to help support the pressure of the face-milling cutters. With the forging set up in this manner, it is evident that provision must be made for feeding the cutters across the face of the work, and this result is accomplished by imparting a longitudinal movement to the cutter-heads and holding the work stationary. The two outside heads carry a gang of four cutters each which provide for straddle-milling the upper and lower projections of the yoke on each end of the front axle forging. These cutter-heads are fed in toward the work to give this result. Similarly, a longitudinal movement is imparted to the heads carrying facing cutters that mill the spring pad seats near the center of the forging, but these heads are fed out toward the ends of the work. In operating this machine, manipulation of a single lever provides for simultaneously returning all of the cutter-heads to their starting positions. Owing to the hardness of the forgings to be milled, pipes are arranged to deliver a copious flow of coolant to each of the cutters. On this job the rate of production obtained is 7 axles per hour.

Advanced Practice in Hobbing Worm-wheels

For use in hobbing the various sizes of worm-wheels that are used in rear axles of its manufacture, the Timken-Detroit Axle Co. has adopted the use of the form of hob which has its forward end tapered and provided with a thread of variable lead on the tapered section. Behind this part of the hob there is a cylindrical section with a thread of uniform lead. The lead of the thread on the tapered section of the hob gradually increases until it coincides with the uniform lead on the cylindrical section. The tapered section of the hob is utilized for roughing out the worm-wheel teeth, and the cylindrical section finishes the teeth as the hob is given a tangential feed movement over the worm-wheel by means of suitable mechanism provided on the machine. Fig. 4 illustrates a close-up view of a gear-hobber developed by Gould & Eberhardt of Newark, N. J., for the application of this principle of gear hobbing. This method is the means of effecting a substantial increase in the rate of production, because a roughing and a finishing cut can be taken at a single setting of the work, and the teeth are roughed out by a section of the hob which is utilized exclusively for that purpose, leaving the finishing section to take only a light final cut to assure accuracy. As a result, it is a long time before the hob is worn to an extent which would affect the accuracy of the finished work. A high cutting speed and heavy feed can also be utilized with a hob of this type. On the present job, the hob runs at 120 revolutions per minute and the table at 14 revolutions per minute. The feed per table revolution is 0.052 inch. In the January, 1919, number of MACHINERY a description was published of a special lathe developed by the T. C. M. Mfg. Co. for relieving hobs of this particular design, so that this subject does not call for attention in the present article.

* * *

NEW DIESEL ENGINE

A new two-cycle marine Diesel engine, embodying in its design new features especially adaptable for American operating conditions, has been brought out by the Bethlehem Steel Corporation in conjunction with the Bethlehem Shipbuilding Corporation, Ltd. This engine is intended for stationary use as well as for cargo vessels of any size. One of the engines built in accordance with this design was installed at the power plant of the Bethlehem Steel Corporation, at Bethlehem, Pa., and was operated for ten months for stationary purposes. It was then installed in an ore-carrying vessel which recently completed a voyage to Cuba and back. The ore vessel made the voyage to Cuba and back on one-third the amount of fuel that would otherwise be consumed by an oil-burning cargo vessel of the same size, and it is claimed that the economy was greater than has been achieved by any present type of Diesel engine. Further details on this point, giving specifically the size of engine, size of vessel, speed and oil consumption would, of course, be necessary before any definite judgment can be passed upon the superiority of the new engine over those developed and built in the past.

* * *

A recent commerce report containing a general summary of the economic conditions in Brazil for the past year, states that all of the railway supplies, rolling stock, and equipment obtained for the government-owned railways, as well as for other railways in Brazil have been purchased from American firms.

Chordal Thickness of Tooth and Corrected Pitch Depth of Bevel Gears

By C. W. MAPES

THE tooth profile of a bevel gear is based on the back cone distance, and because of this fact, there has been some confusion regarding the calculations for determining the chordal thickness and "corrected pitch depth" or corrected addendum. The formula for determining the chordal thickness should be based on the pitch radius of the bevel gear, the chordal thickness of a bevel gear tooth being the same as that of a tooth on a spur gear having the same pitch and number of teeth. The formula for corrected pitch depth may be based either on the pitch radius or the back cone radius, as the results in either case are sufficiently accurate for practical purposes. However, the formula based on the pitch radius is somewhat simpler as will be shown later. The chordal thickness will be considered first.

The points P and P_1 (see accompanying illustration) are the points between which the chord is measured. These points lie on the pitch line, and therefore the pitch circle passes through them. Since similar points on all the teeth in the gear also lie on the pitch line, the pitch circle must pass through all the points, forming a complete circle whose diameter is equal to the pitch diameter; therefore, the calculation for length of chord should be based on the pitch diameter.

To more clearly illustrate the case, take, for an example, a gear of 8 teeth, 1 diametral pitch, 60-degree pitch cone angle, with a standard Brown & Sharpe form of tooth. The space between pitch points P_1 and P_2 will be equal to the distance PP_1 or the chordal thickness C. By joining all the pitch points, P, P_1, P_2, etc., with straight lines, a sixteen sided polygon with each side equal in length to the chordal thickness C of the tooth, or 1.5608 inches is formed. As these points lie on the pitch line, the pitch circle circumscribes the polygon. Calculating the chordal thickness with the back cone distance as a basis, gives a length of side of the polygon of 1.5682 inches. A circle circumscribing such a polygon would be 8.0385 inches in diameter; therefore, the points could not lie on a pitch circle of 8 inches diameter.

In the formula for determining the chordal thickness of tooth, the following notation is used:

C = chordal thickness;
R = pitch radius;
T = thickness of tooth on pitch circle.

$$C = 2R \sin \frac{90T}{R\pi}$$

For a Brown & Sharpe standard tooth,

$$C = 2R \sin \frac{90}{N}$$

The corrected pitch depth A is the distance from the end of the tooth to the pitch points P and P_1, measured as indicated in the illustration. The chord being measured on the radius R, F is the height of the arc. The corrected pitch depth A will be equal to the pitch depth H plus B which is one side of a right-angle triangle of which F is the hypotenuse and θ the angle between them. Therefore,

$$B = F \cos \theta \text{ and } F = R - R \cos \omega$$

Then

$$B = \text{Cos}\, \theta\, (R - R \cos \omega) \text{ and } A = H + \cos \theta\, (R - R \cos \omega)$$

$$\omega = \frac{90T}{R\pi}$$

and

$$A = H + \cos \theta \left(R - R \cos \frac{90T}{R\pi} \right)$$

which is the general formula for the corrected pitch depth of bevel gears, based on the pitch radius.

For a Brown & Sharpe standard tooth, the formula for the corrected pitch depth, based on the pitch radius, is:

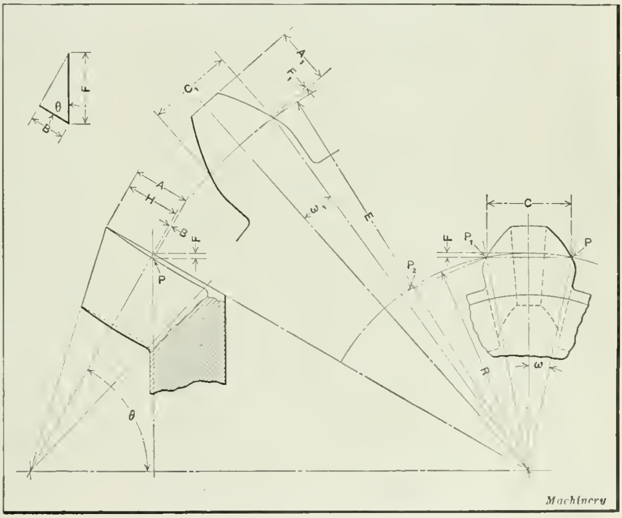


Diagram showing Dimensions and Angles used in determining the Chordal Thickness and Corrected Pitch Depth of Bevel Gear Teeth

$$A = H + \cos \theta \left(R - R \cos \frac{90}{N} \right)$$

The general formula based on the back cone distance is:

$$A_1 = H + E - E \cos \omega_1$$

$$E = \frac{R}{\cos \theta}$$

$$\omega_1 = \frac{90\, T \cos \theta}{R\pi}$$

Therefore,

$$A_1 = H + \frac{R}{\cos \theta} - \frac{R}{\cos \theta} \times \cos \frac{90\, T \cos \theta}{R\pi}$$

$$= H + \frac{R - R \cos \dfrac{90\, T \cos \theta}{R\pi}}{\cos \theta}$$

The formulas for A and A_1 give practically the same results. Substituting the values of the example previously given, in the formula based on the pitch radius,

$$A = 1 + 0.5\ (4 - 4 \times \cos 11 \text{ deg. } 15 \text{ min.}) = 1.0384 \text{ inches}$$

Using the same values in the formula based on the back cone distance,

$$A_1 = 1 + \frac{4 - 4 \times \cos \dfrac{90 \times 1.5708 \times 0.5}{4 \times 3.1416}}{0.5}$$

$$= 1 + \frac{4 - 4 \times \cos 5 \text{ deg. } 37 \text{ min. } 30 \text{ sec.}}{0.5} = 1.0385 \text{ inches}$$

It might be supposed that this slight discrepancy in results is due to not carrying decimal places far enough, but substituting 1 for R and leaving the other quantities as before,

$$A = 1 + 0.5\ (1 - 1 \cos 45 \text{ deg.}) = 1.1464 \text{ inches}$$

$$A_1 = 1 + \frac{1 - \cos 22 \text{ deg. } 30 \text{ min.}}{0.5} = 1.1522 \text{ inches}$$

The difference in results in this case is sufficient to prove that the formulas are mathematically different. As will be seen, the simplest formula to use for calculating the corrected pitch depth of bevel gears is based on the pitch radius.

* * *

STANDARDIZATION OF FIRE-HOSE COUPLINGS AND THREADS

The importance of the standardization of fire-hose coupling threads is easily appreciated. In the past, there have been various so-called standards, many of which have been used only locally in certain large cities or in certain parts of the country. It has always been difficult for the makers of threading tools to provide exactly what has been required unless an actual sample of the hose coupling has been provided. A review of the effort to standardize hose-coupling threads is given in the August number of *Mechanical Engineering*. It is pointed out that failure to recognize the importance of standards in this instance has resulted in enormous fire losses due to lack of uniformity in fire-hose couplings.

The first real movement for standardization may be said to date back to the great Boston fire of 1872. Following this conflagration several of the nearby cities, profiting by the experience, adopted the Roxbury thread coupling which was the Boston standard at that time. Later, New York City adopted a thread which became the local standard through general adoption by most of the New Jersey and New York state municipalities within a radius of from fifty to seventy-five miles. Local standards have been adopted in a number of places which has given a feeling of security and complacency. Experience has shown, however, that such an attitude is not entirely justified because of the fact that outlying towns are little better off than if there were no standards at all.

The first organized effort toward the adoption of a universal standard thread was made by the International Association of Fire Engineers during the period 1873-1883. It was not, however, until a Committee on Hose Couplings and Hydrant Fittings of the National Fire Protection Association was appointed in 1905 that the work was effectively started. Through the efforts of this committee the couplings known as the National Standard promptly received unqualified approval and adoption by all of the leading organizations concerned with fire protection. Coincidentally, the American Society of Mechanical Engineers appointed a sub-committee on fire protection whose report describes the methods by means of which the standards were adopted, the specifications for hose couplings, and the methods for converting non-standard couplings.

In December, 1919, an illustrated pamphlet, "Standardization for Fire Hose Couplings and Fittings," containing an extended treatment of the subject of this standardization, and a complete description of the resizing or standardization tools, was issued by the National Board of Fire Underwriters of New York City. Upward of 12,000 copies of this pamphlet have been distributed. This pamphlet, copies of which are still available, contains a description of a set of tools devised for the purpose of re-forming to standard size, and shows threads which are slightly different from standard.

There are about 8000 cities or towns in the United States and Canada that have fire-hose fittings in service. Statistics show that 15 per cent of them have National Standard thread couplings; 70 per cent have couplings that may be resized and made standard; and the remaining 15 per cent are either using couplings which have six threads to the inch or one of the various types of snap or clutch couplings.

The American Society of Mechanical Engineers has supported this movement from its inception and, as a body, is much interested in the recent strides toward its general adoption. Members who reside in localities where standardization movements have not already been initiated, are urged to take upon themselves the matter of arousing their respective communities to the importance of the subject.

* * *

ANNUAL MEETING OF A. S. M. E.

From the plans at present in process of preparation for the annual meeting of the American Society of Mechanical Engineers to be held in New York City, December 7-10, it may be judged that the meeting will be one of the most successful in the history of the society. The keynote session will deal with transportation, and prominent men in the railroad and water transportation fields will deal with important phases of this subject. Engineers engaged in the motor truck industry as well as those versed in the solution of terminal problems will also be heard. Six of the newly formed professional sections are making plans to hold separate sessions. These are the sections on fuels, management, machine shop, power, railroads, and textiles.

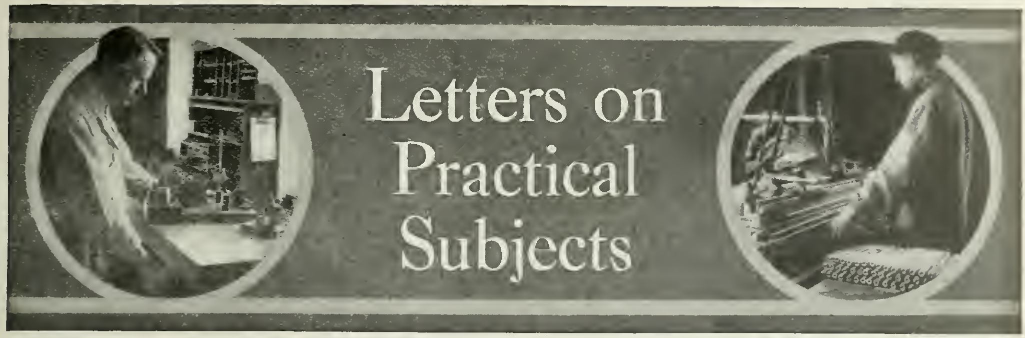
The need for better engineering in the woodworking field has long been recognized, and a sub-committee has been appointed by the committee on meetings and programs to arrange for a session on this subject for the annual meeting. The interest in appraisal and valuation displayed at the two previous meetings of the society has prompted the continuance of the consideration of this subject at the coming meeting. A number of papers that do not fall under any of the previous sub-divisions have also been received by the society, and the best of these will be presented at the general sessions of the society.

* * *

SMALLEST MOTOR IN THE WORLD EXHIBITED AT FOUNDRY CONVENTION

As far as is known, the smallest motor in the world, made by Ivan T. Nedland, Hillsboro, N. D., will be exhibited at the Foundrymen's Convention in Columbus, Ohio, October 4-9. It will be shown in the exhibit space of the Pangborn Corporation, Hagerstown, Md. The length of the motor over-all is 19/64 inch, the height is 11/64 inch, and it weighs complete about 5½ grains. A small flashlight battery is used for supplying it with current.

The commutator has four segments made of gold, each segment being insulated from the others with mica. Fiber is used as insulation between commutator and shaft and between the end pieces and the commutator. The commutator is built up in the same way as those of larger machines, no glue or cement having been used in its construction. The diameter of the commutator is 0.045 inch. The commutator is mounted on a steel shaft, 0.009 inch in diameter. The armature has four poles and is wound with No. 40 silk-covered wire. The diameter of the armature is 0.090 inch. The weight of the shaft, commutator and armature wound complete is 1¼ grains. The motor has two field coils between the armature and yoke. The brushes are made of silver and are 0.012 inch in diameter. The springs for the brushes are 0.004 inch in diameter.



Letters on Practical Subjects

GASKET-CUTTING ATTACHMENT FOR DRILLING MACHINE

A device suitable for mounting on a drilling machine for cutting rubber or fiber gaskets is shown in the illustration. The principal parts are the holder *A*, the cross-bar *B*, the cutter-holders *C* and *D*, and the cutters *E* and *F*. The two cutters are free to revolve on their axes. The shank of holder *A* is tapered to suit the socket in the end of the drilling machine spindle to which the device is attached when in use. When a gasket is to be cut, the holder *A* is secured in the drilling machine spindle, and the cutter-holders *C* and *D* are adjusted along the cross-bar until the cutter *F* is a distance from the center of holder *A* equal to the radius of the size of gasket to be cut, and the distance from cutter *E* to the center of the holder is equal to the radius of the gasket hole. The cutter-holders are then clamped in these positions by means of the set-screws *L*.

The drilling machine head is next lowered until the cutters rest upon the material from which the gasket is to be produced. At this time the pointed end of bolt *G* has entered the material until a certain amount of pressure is exerted on the material by the bearing plate *H* and the coil spring *I*, which is placed between the bearing plate and collar *J*. Then when the machine is started, the device revolves with the spindle and the cutters rotate in circular paths of the same dimensions as the gasket to be cut. The pressure exerted upon the material by plate *H* and spring *I* prevents it from turning during the operation. The cutting of the gasket is accomplished by gradually lowering the drilling machine spindle until the cutters have worked their way through the material.

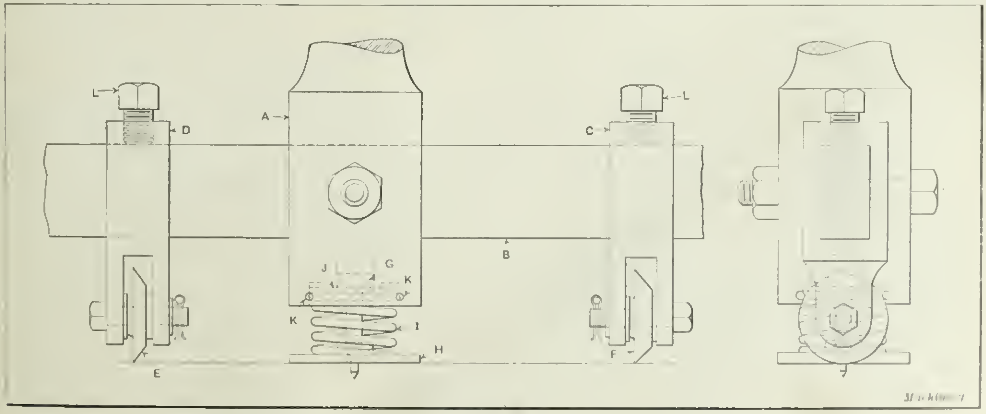
The cutters *F* and *E* should always be used in the same relative positions shown in the illustration, for cutting the periphery of a gasket and the hole, as otherwise the angular side of the cutters will mar the gasket surfaces. Bolt *G*, bearing plate *H*, and spring *I* are secured to holder *A* by means of collar *J* which fits into a recess in the lower end of the holder. The collar is secured in the holder by two pins *K* which engage a groove running around the collar. It is obvious that the size of the largest gasket that can be cut by means of the attachment depends upon the length of the cross-bar *B*. In the device illustrated, this length was 23 inches, and gaskets ranging from 2½ to 22 inches in diameter could readily be produced.

Chicago, Ill. H. A. Pearson

DIES FOR BRASS CURTAIN POLE KNOBS

Several seemingly difficult punch press operations in the manufacture of curtain pole knobs or ends are readily performed on machines equipped with the punches and dies to be described in the following. These knobs are produced from brass blanks 0.026 inch thick and 1 9/16 inches in diameter. The first operation on the shell is performed on a press provided with the combination blanking and drawing die illustrated in Fig. 1, and consists of cutting the blank to the proper size and then drawing it to the shape and dimensions shown in the upper right-hand part of the illustration. The drawing of the shell to this extent in only one operation is helped materially by having the top ball-shaped.

The illustration shows the relation of punch *A* to the die at the end of the downward stroke of the press ram. Prior to the descent of the punch, the blank-holder *B* is raised by means of three pins *C* until the upper surface of the blank-holder coincides with the cutting edge of the blanking die *D*. Pins *C* are actuated by a rubber buffer located beneath the



Drilling Machine Attachment for cutting the Periphery and Hole of Rubber and Fiber Gaskets

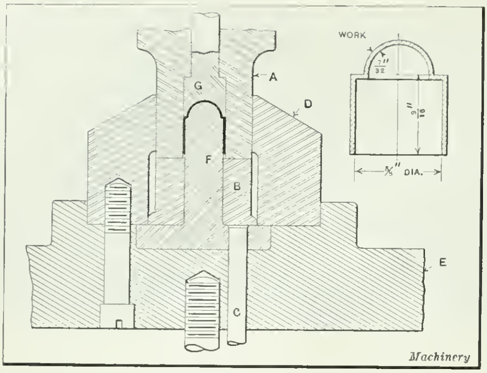


Fig. 1. Combination Blanking and Drawing Punch and Die which produce the Work as shown in One Operation

die-block *E*. Thus, when the punch descends after the brass stock has been laid across the top of the blanking die, the blank is cut as the punch enters the die, and is at the same time held firmly between the faces of the punch and the blank-holder. The latter condition prevents the formation of wrinkles when the blank is drawn upon the drawing die *F*, which occurs as the punch and the blank-holder continue to descend. The shoulder on the upper end of the shell is produced near the end of the stroke by the knock-out *G* in punch *A*. The shell is ejected from the die by the blank-holder as the latter is raised by pins *C* when the punch is withdrawn. In case the shell remains in the punch, it is removed by the knock-out *G* previously referred to.

The next two operations form the neck on the open end and complete the punch press work on the shell. These operations are performed on a machine having two plungers. The punch shown at *A* in Fig. 2 is attached to the end of one plunger, the punch shown at *B* in the same illustration being attached to the end of the other plunger. Only one die is provided on the machine, although one is shown under each punch in the illustration, arrangements being made so that this die can be swung under the second punch after the neck of the shell has been partially formed by the first. As the edge of the open end of the shell is quite regular after the preceding operation, no trimming is necessary on this end preparatory to these final forming operations.

The die is first placed in position beneath the punch shown at *A*, after which the shell is seated in the die part *C*, by means of the ball-shaped end and the shoulder on this end. Then when punch *D* descends, spring pin *E* enters the shell and exerts pressure on the ball-shaped end. As the punch continues to descend, the open end of the shell is closed to the contour of the opening in the punch until the edge of the metal reaches shoulder *F*, the spring pin *E* causing the hole to be made to the proper size. The shell is ejected from the punch on the return stroke by the spring pin, as this pin is momentarily kept from rising with the punch by the coil spring placed above it.

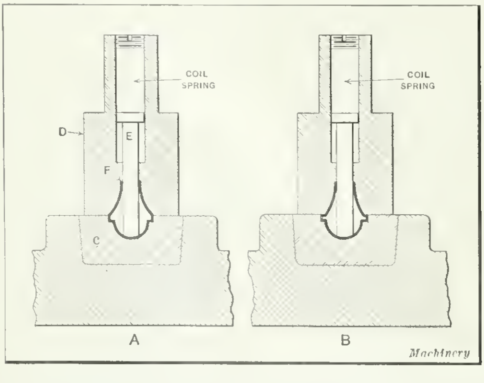


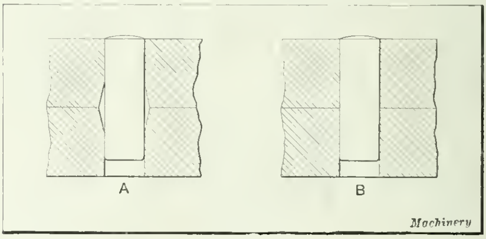
Fig. 2. Punches and Die mounted on Double-plunger Punch Press for forming Neck on Open End of Shell

The next step is to swing the die and shell beneath the punch shown at *B*. In the operation performed by this punch, the diameter of the large portion of the neck is reduced a trifle, so that a shoulder is formed on this side. The operation of this punch is similar to that of the punch shown at *A*. In the design of punches and dies of the type just described, care must be taken to see that the shoulder in the punch which the edge of the shell touches at the end of the operation, is located properly, and that the pin which regulates the size of the hole is of the correct diameter.

Toledo, Ohio J. BINGHAM

INCORRECT AND CORRECT DOWELING

When dowels are used to hold parts of tools or gages in alignment, care should be taken in reaming and lapping the dowel holes to see that they do not become bell-mouthed or tapered. If attention is not given to this point, a condition such as shown exaggerated at *A* in the illustration may be the result. Although this dowel fits tightly at both ends, the fit is such that a knock received during rough usage may be sufficient to cause the dowel to become bent, and thus change the relation between the two members. It is evident that if a short dowel is driven into a hole of this nature, there will be considerable play between the two gage parts, which illustrates the fact that the dowels which fit tightly do not always prove satisfactory, especially when the fit does not extend throughout the length of the pin. The correct way to assemble two parts by means of dowels is to have the holes reamed or lapped straight, so that the dowel will have a bearing its entire length as shown at *B*. In this case, the tendency will be to shear the dowel, rather than to bend it. J. E. L.

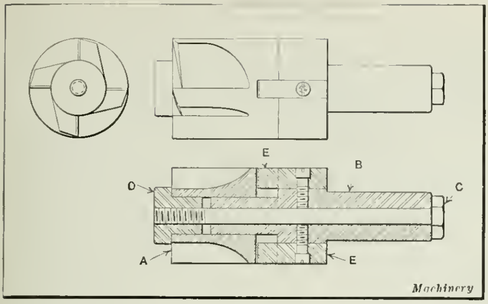


(A) Dowel-pin in Bell-mouthed Hole. (B) Dowel-pin in a Straight Hole

COUNTERBORE WITH DETACHABLE CUTTER AND PILOT

The accompanying illustration shows a counterbore constructed in such a manner that the pilot and cutter can be removed from the shank to facilitate grinding the flutes of the cutter, without spoiling the pilot by having it come into contact with the grinding wheel. The latter is a common occurrence on tools of this kind, which are so designed that the pilot cannot be detached from the cutter for the grinding operation. Another advantage of this counterbore is the fact that a new cutter can be used with the old parts when the existing one must be discarded on account of wear. This obviously results in a great saving of labor and material.

It will be seen that cutter *A* is mounted on one end of the shank *B*, which has a hole running the entire length through the center to accommodate bolt *C*. This bolt is employed to secure the threaded pilot *D* to the unit. It is apparent that the shoulder on the pilot holds the cutter in place. The cutter is driven by two keys *E* which are fitted



Counterbore so designed that the Cutter can be removed for Regrinding or Replacement

in grooves on the enlarged portion of the shank and held to the shank by means of fillister-head machine screws. These keys extend into the groove milled across the adjacent end of the cutter, and thus cause its rotation with the shank. A small amount of end clearance is allowed between the keys and the cutter. Besides the advantages previously mentioned, cutters of various diameters can be used in conjunction with the other parts, the only requirement being that the hole, length, and key groove on the cutter, must be of the proper dimensions. C. D.

INCREASING THREAD DIAMETER TO ALLOW FOR ERROR IN LEAD

It sometimes happens that a screw and nut will not go together, even though the outside, pitch, and root diameters are within the required limits of accuracy, because the lead of the nut does not correspond with the lead of the screw. It is therefore necessary in some cases to increase the size of the nut or to decrease the size of the screw to compensate for the error in lead, so that the two parts can be screwed together. The accompanying diagram illustrates a simple method of calculating the amount that the diameter of a nut must be increased to compensate for a known error in lead. It is required to find the dimension AC which is one-half the amount that the diameter of the nut must be increased over that of the screw in order to permit the two parts to be screwed together when there is an error in the lead of the nut thread of 0.001 inch per inch of thread. In the triangle ABC, side $CB = 0.0005$ inch and angle $CAB = 30$ degrees.

Therefore

$$AC = CB \times \cot CAB$$

$$AC = 0.0005 \times 1.7320 = 0.000866 \text{ inch}$$

As this value is for one side only, the amount which the diameter of the nut must be increased is $2 \times 0.000866 = 0.001732$ inch. Since the only quantities used in this solution are the differences in lead of plus or minus 0.001 inch and the thread angle of 30 degrees, it follows that the quantity 0.001732 may be employed as a constant. For instance if the error in lead should be 0.002 inch instead of 0.001 inch, the dimension AC would equal 2×0.000866, and the amount which the diameter of the nut thread must be increased would be 4×0.000866. B. S.

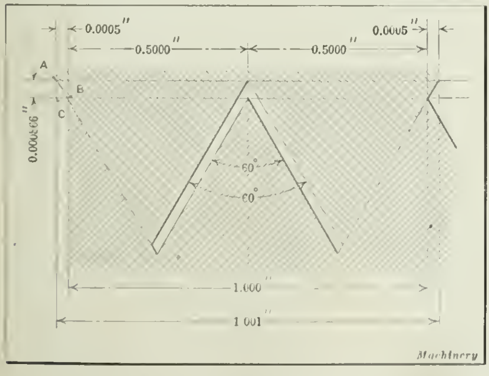


Diagram showing Method of determining Amount Diameter of Nut Thread must be increased to compensate for Error in Lead

PATTERN FOR MOLDING SHEAVES

Many patternmakers are of the opinion that a two-part pattern having the parting line at the center, and intended for use in preparing the mold in green sand without the use of cores, is the most suitable when casting iron rope sheaves. The reason for this belief may be due to the fact that they were so taught when apprentices, and after becoming journeymen, continued to make such patterns in the manner stated, without receiving any criticisms pertaining to the design from foundrymen. However, this type of pattern is really inferior to a solid pattern which makes use of cores to form the ledge around the mold necessary to produce the groove on a sheave. In the following, a description will first be given of the manner in which molds were made by the use of a split pattern for casting twenty-five rope sheaves having an outside diameter of 6 inches. The manner in which a solid pattern could have been used in molding these sheaves will then be described. From these descriptions it will be seen that a better mold would have been made by the solid pattern and with far less labor than was required in making the mold from the split one.

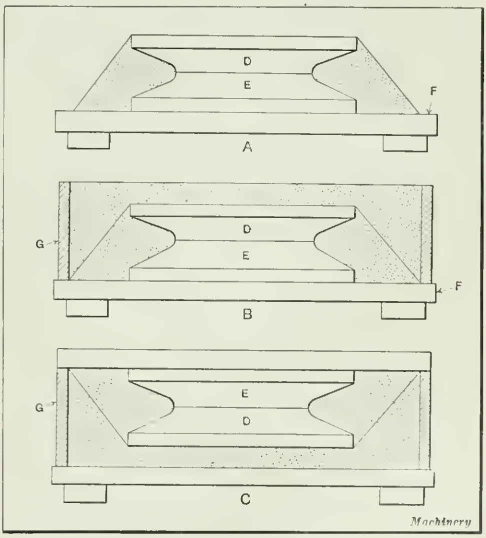


Fig. 1. Method of building Mold when the Pattern is of the Two-part Type which is Inferior to the Solid Type

The procedure followed in building the molds from the split pattern can be readily understood by referring to Fig. 1, a two-part flask being used. The first step in the molding operation is illustrated at A, the pattern halves D and E being first placed upon the molding board, after which sand was built around them as shown in order to form the ledge required in the mold for producing the groove on the sheave. The next step was to place the cope G of the flasks on the molding board, and then ram sand over the pattern and the sand molded in the first step, as at B. After this step was completed another molding board was placed on top of the cope and the entire mold turned over as shown at C. The drag was then placed on the cope and filled with sand, which was next rammed and struck off. The drag was then removed and the pattern section *E* taken from the mold, after which the drag was replaced and again covered with the molding board. The mold was then again turned over so that the drag was underneath, the cope lifted, and the pattern half *D* removed. After this had been done, the cope was replaced and vents and a pouring hole made in the usual way, thus completing the mold. On account of the nature of this mold, it was impossible for it to be made in a large flask containing other molds, and so a 14-inch flask was used for this small job.

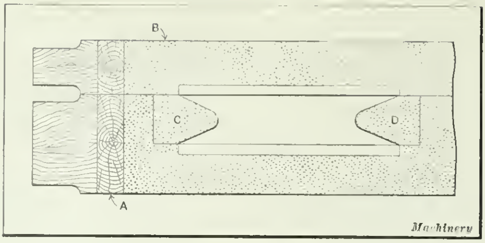


Fig. 2. Sheave Mold made by using a Solid Pattern and Cores

Fig. 2 shows the method followed in making a similar mold from a solid pattern. The drag *A* is first placed on the molding board, then partly filled with sand, and the pattern placed in position. Sand is next rammed around the pattern, after which the cope *B* is placed on the drag and filled with sand, which is also rammed down. The cope is then removed so that the pattern can be taken out, two cores *C* and *D*, each of which run half way around the mold, are placed in the impression formed by the core-prints on the pattern, and the cope is replaced. After vents and a pouring hole have been made, the mold is completed.

Some of the advantages of the solid pattern over the two-part type obtained in molding are that there is much less labor required in making the mold; the mold can be placed in a corner of a large flask containing other molds; and there is much less danger of the delicate ring of sand which forms the groove in the sheave being washed away when the molten metal is poured. Besides these advantages, a solid pattern can be made more quickly than a two-part pattern and can be used for years, whereas, the split pattern will soon become warped and worthless.

Kenosha, Wis. M. E. Duggan

THE TREACHEROUS SHARP CORNER

The writer has read with much interest the editorial in the August number calling attention to the treacherous sharp corner and mentioning how a machine designer had carelessly omitted the rounding of a corner in an important forging, thereby causing a serious accident. It certainly is surprising to an old-time designer that anyone who would overlook such an important matter should be permitted to work on so important a job and be honored by the name "designer." It does not seem likely that an experienced man who had had years of hard knocks and who had been thoroughly drilled in designing work and taught to avoid mistakes by his past observations would have neglected such a well-known and important rule. The writer believes that the reason for such mistakes and consequent accidents are due to the employment of incompetent men who are allowed too much liberty and freedom of play with their untrained ideas.

It is one thing to be technically aware of the rule for rounding corners; it is quite another thing to instinctively know and feel what the result would be if the rule were ignored. The same can be said of hundreds of other seemingly small but important points in connection with machine design. For this reason it would seem that the men who are young in the profession should be kept more in touch with experienced men until their work has been proved reliable by close observation.

In the past decade or so the clamor for young men to fill important positions has resulted in the discouragement of many of the older ones, and has thereby created a shortage of the highest available skill and knowledge. This is particularly true in the matter of machine design and other engineering work. Speed and quantity may be important, but they are not always prime essentials, especially not in those who are employed mainly to guide and direct operations, and when this fact is thoroughly recognized we will have come one step nearer to a true basis of economy, efficiency, and safety.

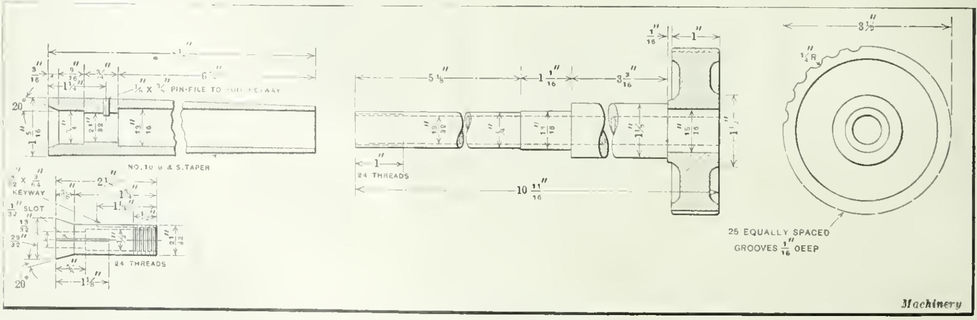
Chicago, Ill. William H. Kellogg

DRAW-IN CHUCK FOR MILLING MACHINES

The accompanying illustration shows an adaptation of the standard draw-in collet chuck, for use in holding small milling cutters in the spindle of a Brown & Sharpe universal milling machine. Standard type collets such as used on the Pratt & Whitney bench lathe were used. These collets fit into the sleeve, which has a No. 10 B. & S. taper to fit the machine spindle, and is provided with a 1/8- by 3/8-inch pin that engages a keyway in the collet. This arrangement makes a very handy device for use when small, straight-shank milling cutters are employed. The taper sleeve, threaded draw-in spindle, and collet are made from machine steel, and the handwheel from cast iron. The length of the threaded spindle that carries the handwheel should be such as to suit the length of the machine spindle.

Baltimore, Md. W. C. Steuart

Experiments made by the Bureau of Standards indicate that cold-rolling operations cause smaller stresses in the metal when rolled by a large number of light passes than when rolled by a smaller number of heavy ones.



Draw-in Collet Chuck for holding Small Straight-shank Milling Cutters on a Brown & Sharpe Universal Milling Machine

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, September 16

THE prospect of a lessened volume of business that showed itself some time back in the machine tool industry has been partly realized. The regular vacations that have been taken for the first time since the beginning of the war have also had their depressing influence, at any rate for the moment. At the same time manufacturers have a much clearer view of the road before them now that the excess profits tax of 60 per cent has been authorized. In the engineering trade a halt has been called to the stream of wage advances by the recent decision of the Industrial Court against a further increase, but other trades are getting ready for a renewed struggle for more money. Prices have reached figures that cause hesitancy in buying, and only through improved equipment and industrial organization can prices be brought down. As an instance, one of the leading motor vehicle manufacturers has reduced the price of its product 15 per cent by making full use of its war experience and the improved plant and methods now available. Some firms, particularly in the motor industry, have revised their production program as a result of cancellations. A slight fall in the price of steel is a welcome augury of a change toward more normal conditions.

Exports and Imports of Machine Tools

From the British point of view the continued improvement in the ratio of exported to imported machine tools is a welcome sign. Prior to the war Great Britain exported machine tools to the value of £260 for every £100 worth imported. At the beginning of the present year the exports were £50 per £100 of imports, but the ratio is now 75 to 100. Roughly, three times the value of drilling machines, planers, and presses was imported as compared with the value of those exported, whereas more than double the value of lathes and milling machines was imported.

The latest returns show that exports from Great Britain have increased considerably and reached a much higher figure than ever before. Imports, after averaging up fluctuations, tend to remain stationary, although the value per ton of imported tools remains at 40 to 50 per cent higher than the corresponding value of exported machines.

The British Engineering Standards Association has issued a report giving data to be recognized as standard for milling cutters and reamers—a matter long overdue. This country is increasing its export trade, American included, in such tools as are dealt with in the report, and it is therefore of equal interest to both sides as exporters to supply what is required and understood to be standard in the importing country. British-made milling cutters and reamers should be interchangeable with the American-made articles, and fortunately in such tools there is little divergence to be bridged.

Labor Conditions

In spite of several reports in circulation that large numbers of workmen in the engineering trades had been discharged, the official figures for the past months indicate that employment in these trades was good and showed little variation from the previous months. What unemployment exists seems to be confined mainly to the less skilled workers; shortage of fuel and materials is assigned as the main cause. Shortage of castings, which is still being felt in some districts, is another cause. Against this a considerable amount of over-time is reported as having been worked in some districts. The unemployment is stated to have caused men to become more careful of their jobs and to adopt a more serious attitude toward productive efficiency. No one, however, wishes to see unemployment made the price of improved efficiency and energy; but there is no gainsaying the fact that high wages, lessened hours of work, and the attitude against systems of payment by results will inevitably lead to reduced business which will, in turn, lead to unemployment. It is for labor to understand this, and equally so for those manufacturers who contribute to a lessened demand by expecting dividends or profits on a high prewar scale.

The Amalgamated Engineering Union came formally into existence about a month ago. Its membership is estimated at about 460,000, while its funds amount to £4,000,000. The eleven societies amalgamating include the most important trade unions in the engineering and allied trades.

Two serious labor troubles have crystallized during recent weeks, and negotiations between employers and men in the engineering trades have broken down, an immediate lock-out being threatened. The difficulty has arisen over the power of the employer to appoint as foreman any man he may choose, while the Electrical Trade Union wishes to compel the appointment of union foremen over union men. The Engineering Employers' Federation, having accepted the challenge, a lock-out would result in one and a half million men being deprived of work, although the trade union concerned amounts to some ten thousand only, who are directly connected with engineering shops.

The threatened coal strike, ostensibly for higher wages, is undoubtedly part of a plan for a nationalization coup. The public are apt to meet the threat as a cry of wolf, but the Government is preparing as far as is possible for any emergency.

Industrial Developments and New Machine Tools

The largest plant devoted to the production of typewriters in this country is the Imperial Typewriter Co. Ltd., Leicester, and demands for its products have necessitated a threefold increase in its factory. The new buildings will have a floor space of 46,000 square feet. Wadkin & Co., also in Leicester, the well-known makers of all classes of woodworking machines, have also been compelled to erect a new factory on a site covering eight acres. John Hetherington & Sons, Ltd., Manchester, have arrangements in progress to double their output of machine tools, and particular attention is being given to railway wheel and axle turning lathes. J. W. Bradley Small Tools Co., Ltd., Leicester is developing a new plant for the extensive manufacture of twist drills.

A new production by the Lumsden Machine Tool Co., Newcastle-on-Tyne is a vertical-spindle grinder. The table has a working surface of 15 by 72 inches, and the heavy cross-rail is supported on a planer-type box housing on one side and on a large-diameter vertical pillar on the other side. The latter carries the grinding wheel spindle bracket. The grinding wheel is built up of eight segmental blocks with clearances between each, and this construction enables very heavy cuts to be taken without fear of bursting. This machine tool is being placed on the market by Alfred Herbert, Ltd., Coventry.

The Olympia Exhibition

While the machine tool trade, the barometer of production, has naturally followed the general hesitancy in purchasing that has set in in all trades, it is expected that the machine tool exhibition at Olympia will result in a sharp, if temporary, increase in sales. At the same time, the educational value of such an exhibition is great. Economy of operative labor is the keynote in the majority of the machines that were shown. In manufacturing machines, the stepped cone pulley has all but disappeared, and centralized control replaces the time-wasting scattered controls. The push-button method of controlling the heavier machines has made advances, and parallel steps have been made with shockless changes of speed and direction attained by electrical means.

It would be invidious to pick out any one branch of machine tool design as showing the greatest development, although gear-cutting machines showed a remarkable advance since the exhibition held prior to the war. During recent years the demand for machine tools of all kinds has been so great that British makers have been forced to import in large numbers certain lines of tools, and this has given rise to the impression that such particular machines could only be obtained from the United States; among these lines one of the most prominent is the horizontal milling machine. Without in any way belittling the progress made by America, it is certain that concurrently with the developments in America, there has been a development in design, essentially British, that is at least equal. The evidence available thus far leads one to believe that, while the industry has been working without cessation at a very high pressure for quite six years in fulfilling vital and immediate requirements, the future has not been forgotten. British manufacturers are moving, without exception, toward a definite objective, and considering the difficulties with which they have to contend, there is much upon which they are to be congratulated.

The production of gages in this country has now been established, the methods of manufacture and measurement being the direct product of the work of the National Physical Laboratory, Teddington, the British equivalent of the United States Bureau of Standards.

* * *

PEAT FOR GAS PRODUCERS

The U. S. Geological Survey calls attention to the use of peat in gas producers properly designed for this purpose. Peat will give a gas of as good quality as coal and in greater quantity. There are also valuable by-products which may be obtained when peat is used. It is believed that the gas producer will make possible the most effective utilization of peat fuel for generating power, because when peat is used in this manner, it does not need to be so carefully prepared or so thoroughly dried as when it is consumed directly under a steam boiler. This utilization of peat in gas producers opens up an enormous supply of fuel for power purposes in a great many parts of the world. Gas-producing plants using peat are now operated in England, Ireland, Germany, Sweden, and Italy. As far as is known, no gas-producing plants are operated with peat in the United States, although experiments have been made.

* * *

The California Industrial Accident Commission has handed down a ruling that should make workmen engaged in occupations where accidents are likely to happen careful to use the provided safeguards. A case came before the California Commission where an employe was not wearing protective goggles provided by his employer, and in refusing to wear goggles he acted in direct disobedience to posted orders requiring employes to use these safety devices. The man was injured, and the commission ruled that the employe's action in neglecting to wear the goggles was an act of serious and willful misconduct, and since the employer had enforced the rule by reprimanding employes for violations of it, the employe's accident compensation was reduced to one-half.

FOUNDRYMEN'S CONVENTION AND EXHIBITION

The program of the American Foundrymen's Association convention to be held in Columbus, Ohio, October 5 to 8 contains a great variety of papers to be read and technical sessions on the various fields that are of importance to the foundryman. On Tuesday, October 5, there will be a gray iron session in the morning, and a non-ferrous metal session in the afternoon. The latter session will be held jointly by the American Foundrymen's Association and the Metals Division of the American Institute of Mining Engineers. Simultaneously with this session there will also be a session on steel castings.

Wednesday, October 6, there will be a second non-ferrous metal practice session in the morning, held simultaneously with another steel casting session. In the afternoon of the same day, industrial relations will be discussed, and this session will be continued in the morning of October 7. There will also be a metallographic session of the metals division of the American Institute of Mining Engineers in the morning of October 7. Malleable iron will be discussed at the Friday morning session, October 8, and simultaneously with the session a general session will be held dealing with such subjects as foundry equipment; design of foundries; cleaning room methods; arc and fusion welding in the foundry; foundry illumination; molding sand; foundry cost accounting; molding machines; concrete molding floors; and similar subjects.

The business session will be held at 8 P. M. Thursday, October 7, at which the annual address of the president C. S. Koch of the Fort Pitt Steel Foundry Co., McKeesport, Pa., will be delivered.

In connection with the convention, there will be an extensive exhibition of machine shop and foundry equipment during the whole week of October 4 to 9. The exhibition is expected to be the largest ever held in connection with the foundrymen's convention. There will be much of interest to men in the machine building field in the exhibits. Many of the machine tools as well as the foundry equipment exhibited will be operated during the exhibition week.

* * *

CONVENTION OF AMERICAN SOCIETY FOR STEEL TREATING

From September 14 to 18, inclusive, the American Society for Steel Treating held its second annual convention in the Commercial Museum, Philadelphia, Pa. This society represents the amalgamation of the American Steel Treater's Society of Chicago, Ill., and the Steel Treating Research Society, of Detroit, Mich. For the time being the headquarters of the amalgamated organization will be at 208 N. Wabash Ave., Chicago, Ill. Morning, afternoon, and evening meetings were held on the 14th, 15th, and 16th at which there were read papers dealing with a number of phases of advanced practice in heat-treating. Arrangements were made for those in attendance at the convention to visit important Philadelphia manufacturing plants on Friday, the 17th. In the morning, the factories which were open for this purpose were those of the Leeds & Northrup Co., makers of pyrometers, electric furnaces, and electrical measuring instruments; Edward G. Budd Mfg. Co., makers of automobile bodies, steel stampings, etc.; and Hess-Bright Mfg. Co., makers of annular ball bearings. In the afternoon, the plants open for inspection were the League Island Navy Yard, Hog Island Ship Yard, and the Midvale Steel & Ordnance plant. Delegates and visitors to the convention were also given an opportunity to see many of the latest forms of equipment used in heat-treatment, which were exhibited by manufacturers. One hundred and sixteen firms had their products on exhibition. The exhibits were kept on view on Saturday, the 18th, but no meetings were held on that day.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Norton Self-contained Cylindrical Grinding Machine. Norton Co., Worcester, Mass. 177

Seneca Falls Multi-head Lathe. Seneca Falls Mfg. Co., 381 Fall St., Seneca Falls, N. Y. 179

Potter Bench Hand Screw Machine. S. A. Potter Tool & Machine Co., 77 E. 130th St., New York City 180

Hanson-Whitney Oil-grooving Attachment. Hanson-Whitney Machine Co., Hartford, Conn. 181

Exhaust Attachment for Surface Grinders. Abrasive Machine Tool Co., East Providence, R. I. 182

Norton Universal Multipurpose Grinding Machine. Norton Co., Worcester, Mass. 183

Lovejoy Face Milling Cutter. Lovejoy Tool Co., Inc., Springfield, Vt. 184

Gray Bench Knurling Machine. Gray Machine & Parts Corporation, Batavia, N. Y. 184

Doyle-Wall Taper Gage. Doyle-Wall Machine & Tool Co., 318-324 Pearl St., Syracuse, N. Y. 184

"Ashmac" Combination Tool-holder. Ashley Machine Works, 714 University Ave., Rochester, N. Y. 185

Mummert-Dixon Oilstone Grinder. Mummert-Dixon Co., Hanover, Pa. 185

H. E. Harris Thread Grinding Machine. H. E. Harris Engineering Co., Bridgeport, Conn. 186

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Alfred Herbert No. 5 Automatic Lathe. Alfred Herbert, Ltd., 54 Dey St., New York City 190

"Fastfeed" Combination Drill and Reamer. Fastfeed Drill & Tool Corporation, Toledo, Ohio 190

Williams, White Power Presses. Williams, White & Co., Moline, Ill. 191

Nelson Quick-acting Milling Machine Vise. Nelson Tool & Machine Co., Inc., 82-88 Llewellyn Ave., Bloomfield, N. J. 191

Newton Continuous Milling Machine. Newton Machine Tool Works, Inc., 23rd & Vine Sts., Philadelphia, Pa. 192

American Broaching Machine. American Broach & Machine Co., Ann Arbor, Mich. 195

Westinghouse Electric Arc Furnace Regulator. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. 195

Griscom-Russell Oil Heater. Griscom-Russell Co., 90 West St., New York City 196

Barker Wrenchless Chuck. Foster Machine Co., Elkhart, Ind. 196

Combination Surface and Plain Grinder. Johnson & Biddle Tool Co., 312-314 N. Main St., Elkhart, Ind. 197

Ransom Tool Grinder. Ransom Mfg. Co., Oshkosh, Wis. 197

Simonds Inserted-tooth Metal Saw. Simonds Mfg. Co., Fitchburg, Mass. 197

Bench Drilling Stand for Portable Electric Drills. Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. 198

Norton Self-contained Cylindrical Grinding Machine

In the past the highest table speed ever attempted on cylindrical grinding machines has been twelve feet per minute. The shock and noise at the point of reversal has made it impracticable to increase the table speeds beyond this limit. In the machine here described, a radical departure has been made in the matter of table speed. By the use of a patented reversing mechanism invented by Charles H. Norton, it has been found practicable to bring the table speed up to as high as thirty-six feet per minute; yet the reversal is practically noiseless, and the machine operates more quietly than machines of the past having only one-third or one-fourth the table speed.

A CYLINDRICAL grinding machine embodying in its design several radical departures from past practice has been brought out by the Norton Co., Worcester, Mass., the machine being known as a 10- by 72-inch Type B Norton cylindrical grinding machine; 36-, 48-, and 60-inch sizes will also be manufactured. The observer in examining this machine will doubtless first give his attention to the fact that the machine is entirely self-contained; being provided with a motor drive, there are no overhead belts whatever. The most noteworthy feature of the machine, however, is not seen until the machine is observed while in operation; this feature is the speed at which the table travels. In the past, the speed of cylindrical grinding machine tables was limited to a maximum of twelve feet per minute by the shock and noise incident to reversal at higher speeds. The present machine has a minimum operating table speed of ten feet per minute, which is close to the maximum in past designs, and it has a maximum table speed of thirty-six feet per minute, which is three times the speed attempted in past practice. The increase in production possible by such a decided increase in table speed is evident.

As mentioned, the drive is by means of an electric motor mounted at the rear of the machine, as clearly shown in Figs. 2 and 4. There are only two belts on the machine, neither of which is visible when the machine is in opera-

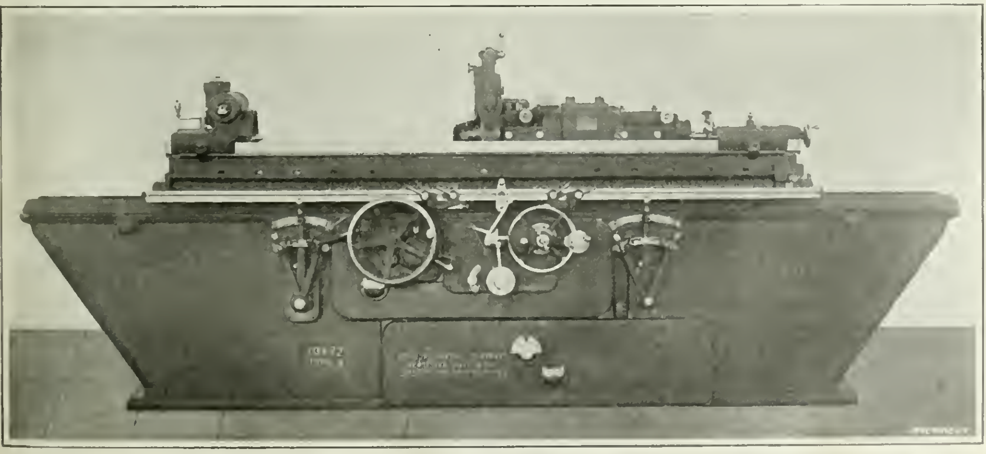


Fig. 1. Self-contained Cylindrical Grinding Machine built by the Norton Co., Worcester, Mass.

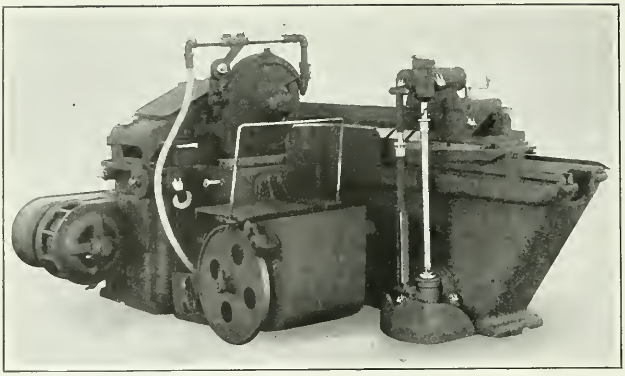


Fig. 2. Rear View of Grinding Machine, showing Arrangement of Settling Tank

tion; all other power transmission is by means of gears or chain drives.

The wheel-head or wheel-slide shown in Fig. 3 is provided with a novel and unique bearing box design. The box is made in three parts. One of these parts, made from bronze, is in the form of a half-circle, so located that the entire pressure of the spindle is taken by it. The other two parts are babbitted and are pressed against the spindle, one on the horizontal center line and the other on the top vertical center line. These babbitted boxes are adjusted by means of the screws on the top and side of the boxes, as indicated. The adjustment is by means of thumb-nuts, and the arrangement is such that the operator cannot cause the spindle to stick when adjusting the bearings, as he simply screws down the adjusting screws by thumb and finger until he cannot turn them any more. This adjustment may be made at any time while the spindle is running. The end thrust is taken by a thrust bearing, which is also adjusted by a thumb-screw as shown at the extreme right of Fig. 3. The oil is supplied to the spindle bearings by means of force feed, and the circulating oil is visible through two glasses facing the operator, as indicated in the upper part of the bearings. The wheel-slide contains the chain-driven pump and oil reservoir for oiling the wheel-spindle bearings and the end-thrust bearing.

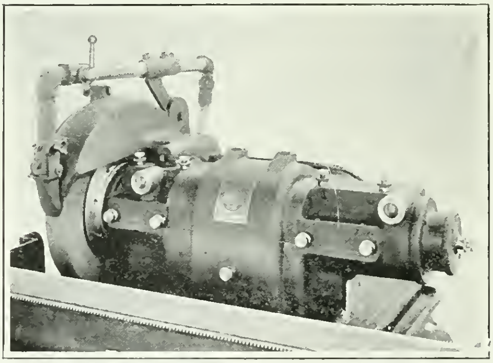


Fig. 3. Detail View of Wheel-head, showing Adjustment Screws for Bearing Boxes

The wheel-spindle is driven by a belt from the main shaft in the base of the machine. The driving pulley on the wheel shaft is placed between the two spindle boxes, and the belt pull is always downward. An idler is provided for taking up the slack of the belt. It is possible to transmit a greater amount of power to the wheel-spindle by this design than in former drives, because with the belt pull downward, the wheel-slide is always pressed on the base. The wheels used in connection with this machine are of the large-hole type. The largest grinding wheel allowable is 18 inches in diameter by 6 inches wide. The standard size wheel is 18 inches in diameter by 2½ inches wide. The speed of the spindle is 1300 revolutions per minute. The wheels are so mounted upon the wheel sleeve that the wheel practically passes over the end of the spindle bearing. A single spindle speed is used, because with the large-hole wheels of a size such as required for this machine the difference between the speed required for the new wheel and one partly worn is so slight that there is no need for a variety of spindle speeds. The speed has been fixed to be correct for the mean diameter of the size of the wheel.

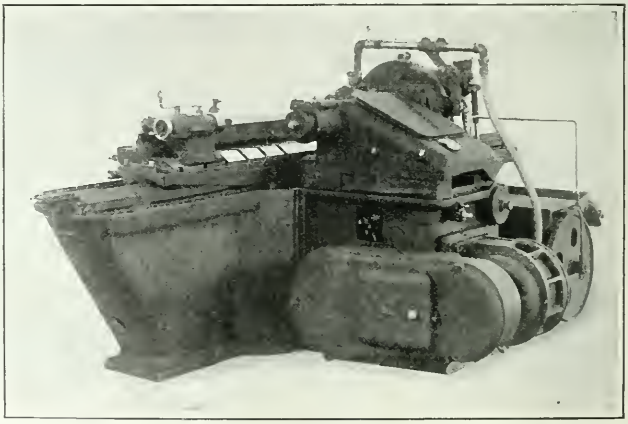


Fig. 4. Rear View of Norton Cylindrical Grinding Machine, showing Electric Motor Drive

An interesting feature is also introduced for the balancing of these wheels. Instead of drilling a hole in the wheel and filling it with lead for the purpose of balancing, there is a small groove on both sides between the wheel sleeve and the inside of the wheel rim. Into this groove is dropped a lead weight mounted on a spring wire. This weight can be slid around in the groove to any point where it is required for balancing, and the spring wire then grips against the inside of the wheel and holds the weight tightly in the position in which it has been placed. The wheel feed mechanism permits of automatic feed, ranging from 0.00025 to 0.0035 inch diameter reduction at each reversal of the table, with steps of 0.00025 inch, the amount represented by each tooth in the index feed gear.

The table speeds used on this machine are made possible by a new patented reversing mechanism, by means of which, at the end of the table travel, the speed is slowed down gradually until the table reverses, at which point the speed is again gradually increased until the full table speed has been reached. This gradual slowing and accelerating of the table speed makes it possible to reverse without shock or noise. At the same time, the mechanism is so arranged that the reversal is controlled by positive clutches.

The headstock, shown in detail in Fig. 5, is driven through a telescoping shaft provided with universal joints at the ends, as more clearly shown in Fig. 2. The drive is through spiral and worm gearing, all the driving gears being entirely enclosed and running in oil. The work revolution may be started or stopped simultaneously with the table, or independent of

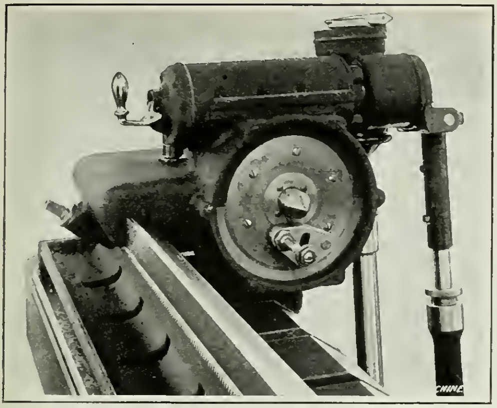


Fig. 5. Headstock of Norton Cylindrical Grinding Machine

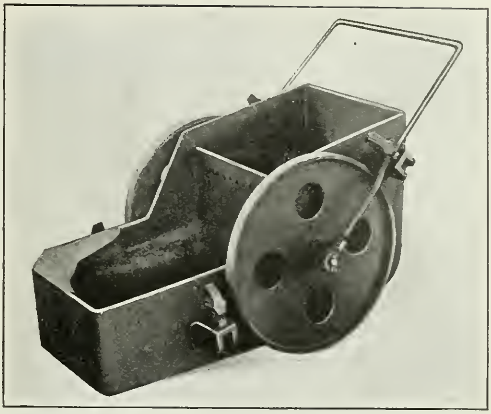


Fig. 6. Settling Tank removed from Machine for cleaning

the table movement, as desired. The footstock is of the combined screw and lever type construction.

The wheel feed involves several new features. A quick-acting hand cross-traverse for the wheel-slide and a micrometer adjustment for sizing work are provided. The pawl action for the in-feed is of an improved construction, and is operated either at each end of the table stroke or when the table is not in motion, as in case a direct in-cut is desired. The change from one condition to the other may be made by a simple movement of a lever.

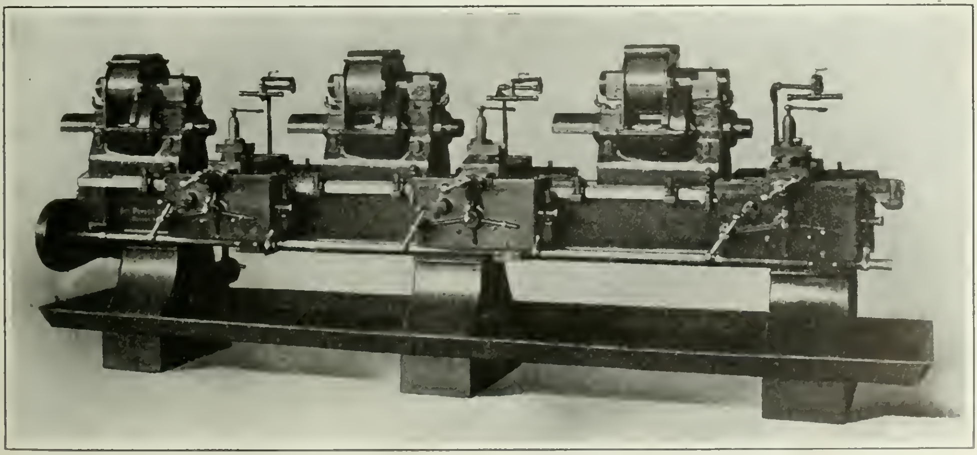
Special attention has been paid, in the designing of the machine, to the lubrication of bearings. With the exception of a few places where it is not essential that the oiling be frequent, all the bearings are automatically oiled. There are also forty-seven ball bearings throughout the machine, all of which are enclosed in oil baths.

A unique feature of the machine to which special attention should be called is the arrangement of the settling tank. This tank is shown in Fig. 2 in place on the machine, and is mounted on wheels. The pump tank and the settling tank are integral parts. The pump is arranged to swivel on its driving shaft, so that it can be swung out of the tank and the tank removed for dumping the settled dirt and grit. While one tank is removed, a duplicate tank can be filled with clean compound and rolled into place; hence, the machine need not be out of operation for more than from three to five minutes for the purpose of changing tanks for cleaning. An entire battery of machines will need only one extra settling tank in order to keep the whole battery going at all times. Fig. 6 shows the tank as removed with its handle in position for pushing it along the floor. In Fig. 2, where the tank is shown in place on the machine, the handle is swung upward and locked in a position where it forms a hand-rail for the small platform provided for the operator to stand upon when changing wheels.

The motor supplied with this machine is a 15-horsepower constant-speed motor, making 1200 revolutions per minute. The width of the main driving belt is 6 inches. The approximate net weight of the machine, complete with motor, is 11,000 pounds, and the approximate floor space is 16 feet 3 inches by 7 feet 2 inches.

SENECA FALLS MULTI-HEAD LATHE

With a view to economizing the time of men employed to operate lathes engaged upon the performance of repetition production work, through finding employment for the man while a tool that he has brought into contact with the work is engaged upon its operation, the Seneca Falls Mfg. Co., 381 Fall St., Seneca Falls, N. Y., has developed a multi-head lathe which is here illustrated and described. Instead of allowing the operator to remain idle while the tool is taking its cut, it is possible for him to keep several heads going,



Multi-head Lathe built by the Seneca Falls Mfg. Co.

as it is only necessary to remove the finished piece of work, put another one in place between the centers and pull a lever that starts the feed. After this has been done, the operator proceeds to the next head on the lathe. On one typical job handled on these machines, a single operator was able to run two triple-head lathes, that is, a total of six heads. This job consisted of turning pieces of tubing approximately 6 9/16 inches in diameter by 6 inches long, and the work was held on mechanically operated expanding mandrels. The depth of cut was 3/32 inch, and on this operation the total machining time was approximately three minutes for six pieces of work. The cutting tools were made of stellite.

Method of Operating the Machine

After a piece of work has been set on the lathe mandrel, the lever at the right-hand end of the apron is lifted, which provides for first advancing the cross-slide and tool to the work, where it is held in place by a latch. The same lever movement that engages this latch also engages clutches for the longitudinal feed, and when the carriage has traveled through the required distance, a lever at the left-hand end of the carriage engages a cam mounted on the vee of the bed, which throws out the latch that holds the tool in place and allows the cross-slide to drop back out of the way, so that the work will not be scored while the tool is moving back to its starting position.

In addition to returning the cross-slide to its initial position, a quick return clutch is engaged, that runs the apron back to its starting point at high speed. At this point, the carriage is stopped by having the lever at the right-hand end of the apron come into contact with a second cam mounted on the vee of the machine bed. The positions of these two cams are adjustable and they may be set to meet the requirements of various work. By this method it is not necessary for the operator to stop the carriage or to bother about returning it to the starting position; and this not only eliminates some physical labor but also relieves him from the necessity of carefully watching the progress of the cut. As a result, the operator is free to attend to a number of these lathe heads.

Features of Construction

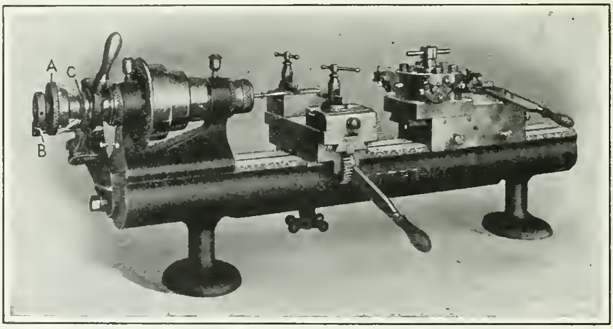
The headstock carries a casehardened spindle, the front bearing of which is 3¼ inches in diameter by 5½ inches long, while the rear bearing is 2¾ inches in diameter by 4½ inches long. Both bearings are ring-oiled. Upon the spindle there is mounted a large gear which is driven from a pinion shaft carried in the upper bearings of the headstock. This shaft runs in liberally proportioned bearings which are also ring-oiled, and it receives power from a driving pulley measuring 6 inches face width by 10½ inches in diameter. The two gears run in a bath of oil and suitable provision has been made for preventing the leakage of oil from this gear-case. The carriage is carefully gibbed to the bed and the apron is of the so-called "double-wall" type of construction, with the clutches and practically all gears, pinions, etc., made of alloy steel and heat-treated. The rack is made of tool steel and securely fastened to the bed.

Power for operating the feed mechanism is taken directly from the countershaft to a pulley at the left-hand end of the machine and by means of a silent chain is transmitted to the feed shaft that is shown at the front of the bed. Both the carriages and aprons are so arranged that should any one of them get out of commission, it may be removed without incapacitating the remainder of the machine. A chain-driven oil-pump is mounted at the rear of the lathe and supplies an abundance of lubricant to the tools. Suitable provision is made for collecting the used fluid and carrying it back into the pan for subsequent circulation.

In addition to the machine here illustrated and described, the Seneca Falls Mfg. Co. also makes a cone-driven type without back-gears, which is adapted for use in turning brass, bronze, or steel where only a light cut is required. This machine is of substantially the same construction that has been described, with the exception of the headstock, which is not furnished with back-gears. Both machines are built along the lines of a 16-inch lathe and swing 11¼ inches over the carriage and 18½ inches over the bed. Smaller sizes can be built to special order.

POTTER BENCH HAND SCREW MACHINE

The S. A. Potter Tool & Machine Co., 77 E. 130th St., New York City, is now building its standard precision bench lathe equipped as a manufacturing tool. This machine consists of the regular lathe bed and headstock and special equipment including an improved lever chuck-closer, a turret fixture and a double cross-slide. The chuck-closer is substituted for the regular lathe draw-in sleeve, so that the work may be chucked or released while the machine is in operation. It will be seen that the lever chuck-closing device consists of two latches or fingers carried in a retaining collar. These fingers bear against an adjustable knurled jam nut *A* on the end of the draw-in sleeve, and they are operated by a clutch collar *C*, the tapered end of which is engaged by the extremities of the two fingers. By moving the hand-lever to the left, the draw-in sleeve and spring collet are forced toward the rear of the headstock, which results in tightening the work. When the operating handle is moved in the opposite direction, tension on the work is released, but the chuck is not actually opened without an additional movement of the handle, which brings the small roller *B* against the side of the jam nut, resulting in opening the chuck and releasing the work.



Bench Size of Hand Screw Machine manufactured by S. A. Potter Tool & Machine Co., showing Chuck Closer, Double Cross-slide, and Turret Fixture

The attachment by means of which this lathe is converted into a turret lathe or hand screw machine is the turret which is fitted to the ways of the lathe bed. This unit has a base 7 inches long in which there is fitted a dovetailed slide, 9 inches in length and having a 3-inch stroke. The turret is 4 inches in diameter, has six tool positions and will accommodate ⅝-inch standard Brown & Sharpe equipment. The indexing mechanism is fully automatic, and allowance has been made to permit travel for all overhanging box-tools. The indexing movement consumes but about 1⅛ inches of travel so that a movement of 1⅞ inches is obtained before the indexing pin on the turret is released

The double cross-slide shown mounted on the lathe bed between the turret and the headstock consists of a main slide carrying two adjustable tool-post blocks, and an operating lever by means of which a rack attached to the bottom of the main slide is operated by a spur gear. Suitable stops and a stop-pin are provided to govern the front and rear transverse movements of the slide, the stop being attached to the base of the attachment and the stop-pins to the main slide. Both the turret and the cross-slide are recommended by the manufacturers for heavy service and precision work.

In addition to the equipment shown in the accompanying illustration, the bed of this lathe will accommodate all Potter standard tool-room lathe equipment, including the special tailstock, hand-rest, compound slide-rest, steadyrest, universal grinding attachment, internal grinding attachment, milling attachment, etc. The maximum capacity draw-in chuck spring collet which the machine spindle can accommodate is ¾ inch. The swing over the bed is 7⅜ inches and the distance between centers is 16 inches. Both the headstock and the tailstock are fitted with No. 4 Jarno tapered holes.

HANSON-WHITNEY OIL-GROOVING ATTACHMENT

Probably it is safe to say that the oiling of slides in machinery has never received the same careful consideration that has been given to the oiling of revolving bearings, but accuracy and freedom from wear in a slide is just as important as in any other bearing of a machine. Oil-grooves are provided to distribute lubricant over a slide bearing, and when these grooves are chipped, the operation is expensive and the quality of workmanship is difficult to control. Many machine designers leave the question of making oil-grooves to the judgment of men in the machine shop; whereas, the form of grooves to be used should be definitely specified and standard tools should be available for their production. Many experienced machine designers prefer a V-shaped groove of about 120 degrees included angle to an oil-groove of half-round section, because it helps the oil to wedge itself between the wearing surfaces. Also, the oil-groove should be of the so-called zigzag form, as shown in the accompanying illustrations. The V-shaped groove has a further advantage in that it is possible to produce different widths of grooves with the same tool.

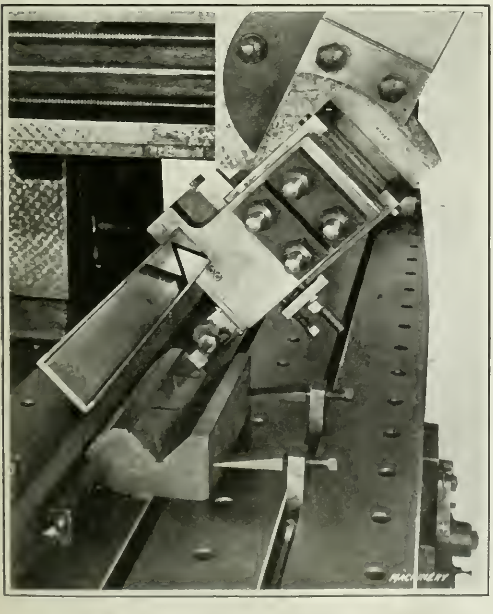


Fig. 1. Hanson-Whitney Oil-grooving Attachment for Planers, cutting Oil-grooves in a Female V-bearing

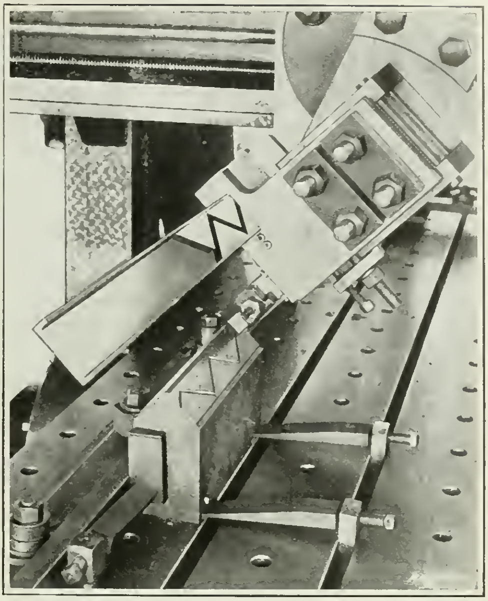


Fig. 2. Hanson-Whitney Oil-grooving Attachment for Planers, cutting Oil-grooves in a Male V-bearing

To provide for the rapid and accurate cutting of oil-grooves in slides, the Hanson-Whitney Machine Co., Hartford, Conn., has developed a planer attachment which is here illustrated and described. This device can be used on any standard type of planer, and it is furnished with a master cam which guides the oil-grooving tool to provide for producing a groove of accurate form. It is said to take practically no longer to set this tool up on a planer than it does other tools that are used on the machine; and attention is called to the desirability of cutting oil-grooves while a piece of work is on the planer, instead of making this an entirely separate operation.

Features of the Oil-grooving Attachment

This attachment is secured in place on the machine by means of the clapper bolts, and the holes are not drilled for this purpose, owing to the fact that the location of the bolts varies on different machines. In setting up the attachment, it should be located on the clapper so that the hook-bolt *A*, Fig. 5, touches the bottom of the clapper. When the hook-bolt is tightened, the clapper will be squeezed so that it cannot move. In the hook-bolt there is a hole into which a hardened bushing is driven; and a drill that fits this bushing should be used to drill a hole into the clapper-box. A pin which fits the hole in the hook-bolt should then be driven into the clapper-box, and this pin and the friction of the clapper squeezed between the fit of the box will hold the attachment firmly in place; but the bolts in the clapper-box should also be tightened up.

On the oil-grooving attachment there is a small clapper-box *B*, which can be adjusted along a reciprocating slide; and various widths of zigzag paths for the oil-grooves can be obtained by adjusting the clapper *C* which transmits movement from the cam bar to the reciprocating slide. The cam bar is attached to cross-piece *D*, which is connected to upright *E*, this upright being strapped to the planer table at a convenient position, while the cross-piece is located at approximately the correct height on the upright. The cam bar can slide vertically in the cross-piece, and the cross-piece slides horizontally on the upright, thus affording considerable freedom of action for the grooving attachment in both horizontal and vertical directions.

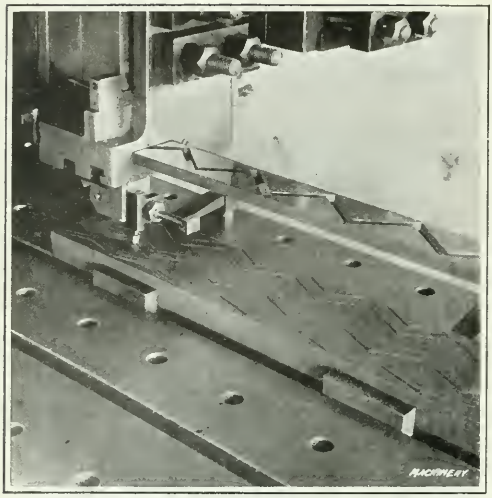


Fig. 3. Hanson-Whitney Oil-grooving Attachment for Planers, cutting Oil-grooves in a Flat Slide Bearing

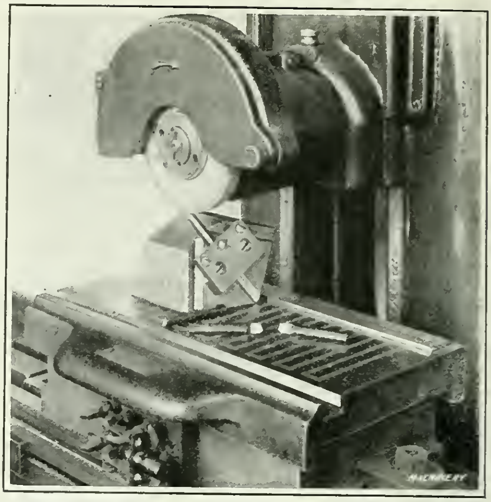


Fig. 4. Holding Block used to obtain Correct Form in grinding Tools for Use on the Hanson-Whitney Oil-grooving Attachment

Forms of Oil-grooving Tools

Three forms of oil-groove cutting tools are used. For work where there is no projection, a straight tool is used and it is always located at right angles with the surface to be grooved. When an oil-groove has to be made in a dovetail, either a right- or a left-hand tool is employed according to the form of the work, and the tool should always swing at 45 degrees to give the required cutting angle. When cutting oil-grooves in V-shaped slides, such as those in a planer bed or on the V-part of a large planer table, the whole oil-grooving attachment is swung by adjusting the clapper-box or the vertical slide, or by a combination of these two movements. When planing grooves in a 45-degree angle V-bearing, it is found most satisfactory to swing the clapper-box to 20 degrees and the vertical slide to 25 degrees. On this oil-groove cutting attachment the maximum length of groove that can be cut is 30 inches; the maximum width of the zigzag path for the oil-groove is 1¼ inches, and the minimum width of the zigzag path is ⅜ inch.

Method of Procedure in Sharpening Tools

To provide for rapidly and accurately sharpening the cutting tools used on this planer attachment, a special holding block is furnished. Any grinder, such as the Brown & Sharpe surface grinder, or the Cincinnati cutter grinder, will give satisfactory results for this purpose. From Fig. 4 it will be apparent that the block is provided with grooves in which the cutting tool is strapped, so that the combination of the angularity of the groove and the supporting face of the block will provide for bringing the tool into contact with the grinding wheel in such a position that the desired form of tool point will be secured.

EXHAUST ATTACHMENT FOR SURFACE GRINDERS

Modern requirements for the safety and health of employes demand an efficient device for disposing of the dust generated by grinding machines, especially surface grinders, when operating without the use of water, which is so frequently necessary. Where these machines are not placed in groups to be served from one central exhaust system, it is most desirable to have each individual machine equipped with its own unit, and in many cases it is really more economical to have each machine of a group individually

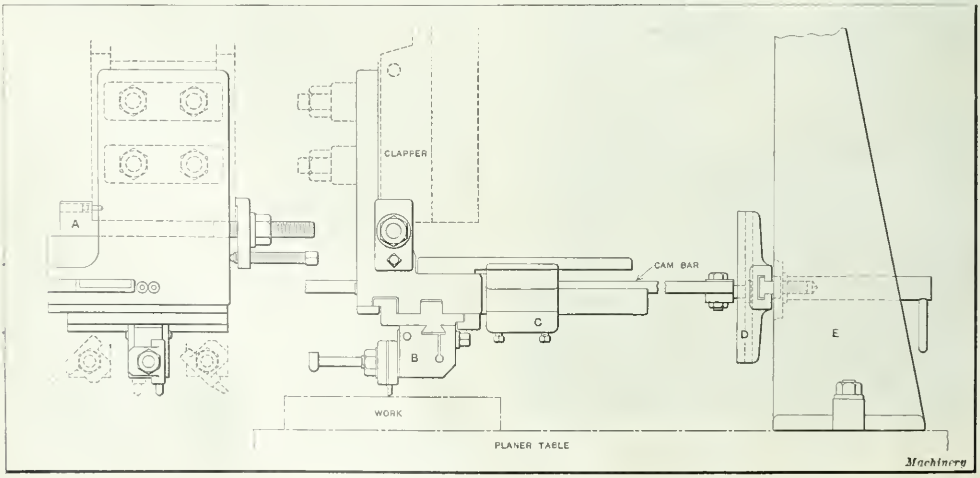


Fig. 5. Details of Construction of the Hanson-Whitney Oil-grooving Attachment for Planers

equipped, as the exhauster is then running only while the machine is operating. This is especially true with individual motor drive.

Realizing the importance of collecting at least 90 per cent of this dust, the Abrasive Machine Tool Co., East Providence, R. I., designed a complete new system for its machines. This exhauster is equipped with S K F ball bearings, and an aluminum fan running at 4000 revolutions per minute. It is connected with the aluminum dust collector on the grinding wheel hood by means of a large flexible wire-insert rubber suction tubing. The wheel dust is drawn in through the flexible tubing, and forced into the centrifugal drum attached to the rear of the machine, where the dust is separated and deposited at the bottom of the cone. The free air passing out through a circuitous route is practically dustless. The accumulation of dust can be easily removed by unscrewing a cap at the bottom of the separator drum, which should be attended to each morning.

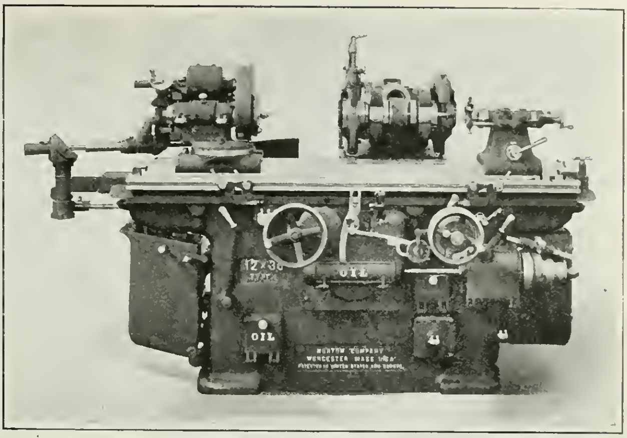


Fig. 1. Universal Multipurpose Grinding Machine built by the Norton Co., Worcester, Mass.

NORTON UNIVERSAL MULTIPURPOSE GRINDING MACHINE

A universal grinding machine embodying in its design several new features in grinding machine construction has been brought out by the Norton Co., Worcester, Mass., this machine being known as a 12- by 36-inch Type L, universal multipurpose grinding machine. There are two main features about this machine that particularly demand attention. One is that the machine is entirely self-contained, having a single-pulley drive, the belt to the pulley on the main drive shaft passing to the rear of the base of the machine, as indicated in Fig. 3. The pulley is enclosed in a belt guard, the latter being so attached to the base that it may be rotated so that the machine may be driven from a pulley on an overhead lineshaft in any position, or from a motor on the floor.

The other main feature which embodies entirely new ideas of design is the method of transmitting power from the countershaft in the base of the machine to the wheel-spindle, which is done in such a manner that the belt, passing up over idler pulleys, can be twisted to any of the positions to which the wheel-head may be set either for regular or internal grinding. This arrangement of the driving belt to the wheel-spindle has made it possible to make the wheel-head double-ended, carrying the regular wheel-spindle at one end, as shown in Fig. 1, and an internal grinding spindle at the other. The wheel-head may be turned through 180 degrees for placing the internal grinding spindle in the operating position, as shown in Fig. 2, where the regular wheel spindle is at the rear, the wheel being replaced by a pulley that drives the internal grinding wheel spindle by means of a belt. The wheel-head is graduated on the base in degrees, and the cross-slide may be rotated to any angle. The belt drive to the wheel-head is so arranged with idlers, as mentioned, that it is not affected by the swiveling of the wheel-head.

The wheel-spindle runs in bronze boxes, tapered on the outside for adjustment. The end thrust is taken by a collar on the spindle. The wheel-spindle is made of heat-treated alloy steel and is double-ended, each end being arranged to carry wheel sleeves for grinding wheels 12 inches in diameter, from ½ to ¾ inch thick, and with a 5-inch hole. The wheel feed is either automatic or by hand, and operates independently of the position of the cross-slide relative to the work-table. The automatic feed at each reversal of the table can be set to reduce the diameter of the work from 0.00025 to 0.004 inch, by increments of 0.00025 inch. The wheel feed is provided with a stop for automatically disengaging the feed when the work has been ground to size.

The drive to the headstock is through a splined shaft, as shown to the left in Fig. 1 and to the right in Fig. 2. The speed changes are obtained through a gear-box, six work speeds ranging from 53 to 320 revolutions per minute being obtainable, these speeds being entirely independent of the table or wheel speeds. The spindle is hollow so that rods up to ¾ inch in diameter may pass through it. Provision is made so that the center may be rotated or dead, as required.

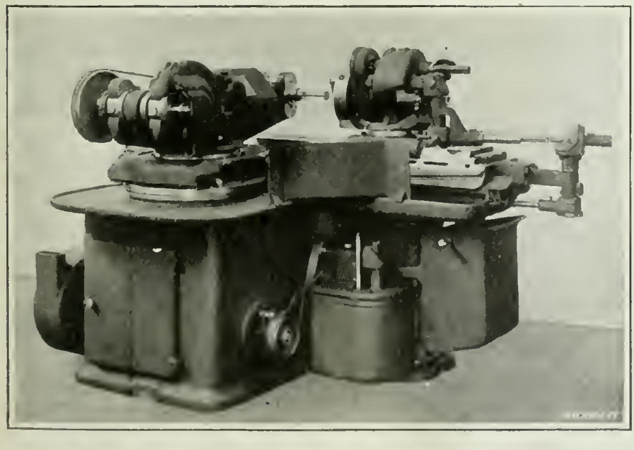


Fig. 2. Rear View of Norton Universal Grinding Machine showing Internal Grinding Spindle in Working Position, and the Regular Wheel-spindle at the Rear

The table speeds are obtained from a four-step cone pulley, shown to the right in Fig. 1, in conjunction with back-gears. Eight table speeds are available, ranging from 2 to 11½ feet per minute. The table is made in two parts, the top table swiveling on a stud in the center, and having clamping provisions at both ends. At the right-hand end, Fig. 1, graduations are provided on a triple scale up to 7 degrees, 3 inch taper per foot, or 25 per cent taper. The top of the swiveling table is flat and provided with a T-slot for holding steadyrests and splash guards, this T-slot running the entire length

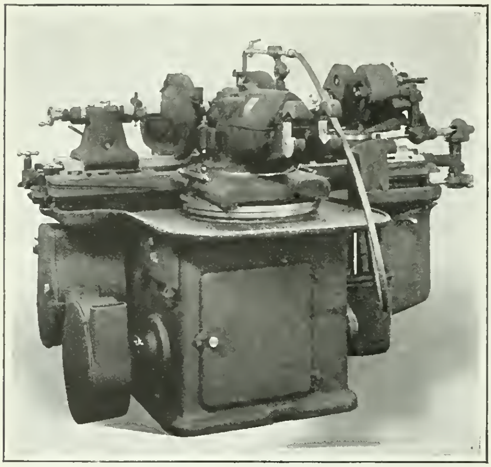


Fig. 3. Rear View of Norton Universal Grinding Machine, showing Arrangement for Single-pulley Drive

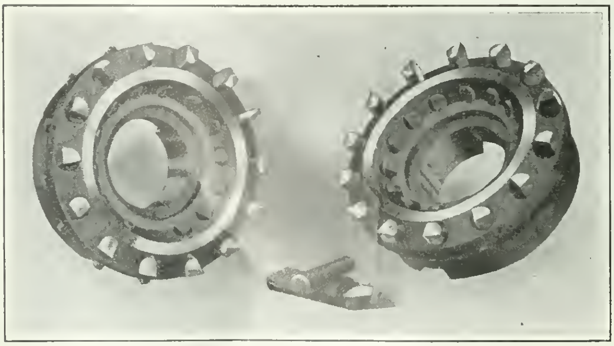
of the table. The lower or sliding table is equipped with the reversing dogs, and guards extending downward to protect the ways of the base.

Rolls in oil wells in the base provide for uniform oiling of the ways. The reversing mechanism for the table is the same as that used on the regular Norton cylindrical grinding machines. The footstock is of the combination lever and screw type held by an eccentric clamp to the table. A diamond tool-holder is provided, which is mounted on the tail-center for truing the wheel.

The pump is belt-driven and is of the centrifugal type. The connection to the water pipe and nozzle on the wheel-head is by a flexible steel hose, as shown in Fig. 3. The settling tank is hinged to the base of the machine, as shown to the left in Fig. 1 and to the right in Fig. 2, and is easily tipped down for emptying it, or removed for cleaning. The machine is provided with regular equipment of chucks, steadyrests, wheel sleeves, dogs, tooth rests, splash guards, and wrenches. The approximate net weight of the machine, with regular equipment, is 4950 pounds, and the approximate floor space is 11 feet 8 inches by 5 feet 5 inches.

LOVEJOY FACE MILLING CUTTER

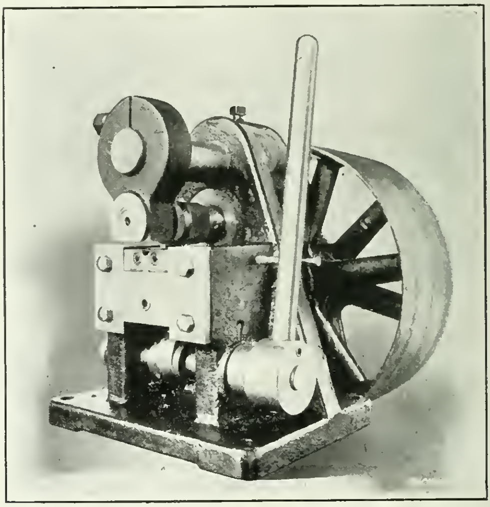
The Lovejoy Tool Co., Inc., Springfield, Vt., has added to its line of tools a Type A face milling cutter, which is recommended for use in all cases where the depth of cut does not exceed 9/16 inch. The teeth of this cutter are positively locked, and it is claimed that there is no possibility of their slipping or loosening under heavy or intermittent cuts. The teeth are made to gage, and they are interchangeable, with a liberal amount of stock provided for wear. The bodies of the cutters are made from hardened steel. The way in which the teeth are adjusted forward to compensate for wear, or replaced with new ones when necessary, is made quite obvious from the illustration. It is stated that this type of milling cutter body holds stellite teeth in a very satisfactory manner, and teeth made of this material may be furnished on special order. Standard tools of this kind are made in nine different sizes, with diameters ranging from 6½ to 18 inches.



Type A Face Milling Cutter made by the Lovejoy Tool Co., Inc.

GRAY BENCH KNURLING MACHINE

The machine shown in the accompanying illustration is particularly adapted for knurling cylindrical work without centers, such as shafts, pins, etc., which have been cut from the bar. The product from screw machines can also be handled advantageously. One knurl is used, which is mounted on an arbor running in bronze bearings, driven through reduction gearing from the driving pulley mounted at the rear. An overhead arm carries the outboard bearing for the arbor. A knee, movable vertically by means of a cam and lever, and adjustable for height, carries two hardened and ground rollers running in hardened bearings, which support the work to be knurled. In operation, the work is placed in position on the rollers with one end against an adjustable locating stop. The work revolves when brought into contact with the knurl by means of the hand-lever, which, through the cam, raises the knee. In cases where the entire length of the work is to be knurled, leaving no blank spaces for bearings, knurls are substituted for the plain rollers, giving the effect of three knurls in contact with the work. This machine is a recent product of the Gray Machine & Parts Corporation, Batavia, N. Y. The illustration shows a bench type of knurling machine, but equipments will be built with legs for handling larger work.



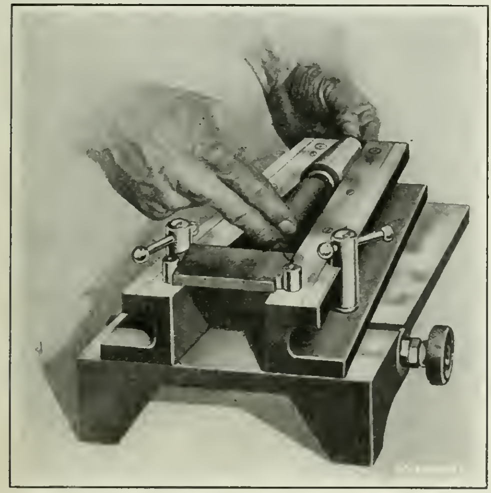
Bench Type of Knurling Machine built by the Gray Machine & Parts Corporation

DOYLE-WALL TAPER GAGE

For use in making precision measurements of tapered work, that are required when originating tapers or duplicating those that are already in use, the Doyle-Wall Machine & Tool Co. of 318-324 Pearl St., Syracuse, N. Y., has recently developed a double sine bar and angle-measuring gage, which is here illustrated and described. It consists of steel parallels mounted on angle-bars which are pivoted on pins set in a baseplate and operated simultaneously, for convergence or divergence, by means of an adjusting screw. When the required taper has been established, the bars are immovably secured in position by means of lock-nuts.

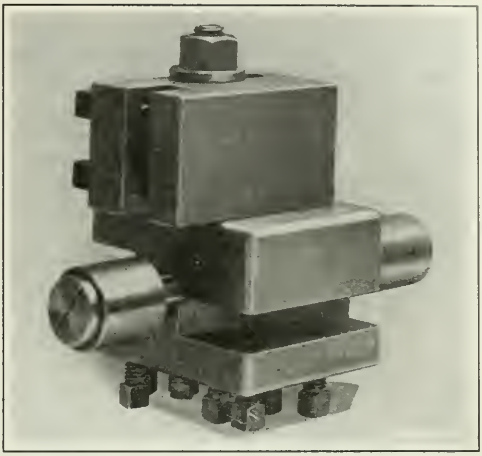
It is claimed that this gage constitutes an exceptionally rapid though accurate method of measuring tapered work. To set the gage, reference is made to a chart on which twice the sines of one-half the angles are tabulated, and the gage is then adjusted by turning a knurled nut until the specified micrometer reading is obtained across the ½-inch movable measuring pins. This will give the correct taper per foot over a range from 0 to 4 inches per foot. A chart, figured to four decimal places by intervals of 1/16 inch from 1/16 inch to 4 inches, is supplied with each gage. After the gage has been set for a given taper, it will measure as many pieces of work as desired without requiring further adjustment.

Any mechanic who can read a micrometer can use this gage, as there is only one measurement to be taken over the measuring pins. If it is desired to use precision gage-blocks, measurements are taken between the ½-inch pins. It is stated that with ordinary care, this precision taper measuring gage may be depended upon to give perfect service indefinitely. The parallels and pins are hardened, ground, and lapped to a high degree of accuracy. This gage is regularly made in two sizes, with 12-inch and 6-inch centers; but special gages will be made in any size to take any desired taper.


Taper Gage made by the Doyle-Wall Machine & Tool Co.

"ASHMAC" COMBINATION TOOL-HOLDER

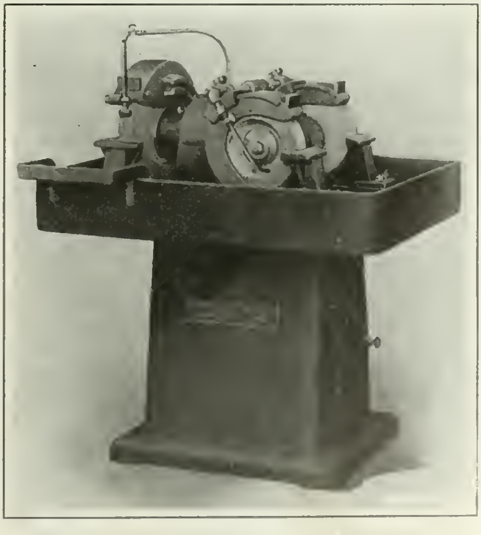
The "Ashmac" combination tool-holder which is here illustrated and described is a recent product of the Ashley Machine Works, 714 University Ave., Rochester, N. Y. These tools are made in two sizes, known as No. 1 and No. 2, and each size of tool-holder is furnished with a tool-block, a pilot stem, and a pilot bushing of any standard size. The pilot stems are made in four different sizes, known as Nos. 3, 4, 5, and 6, and a wide range of different sized bushings are made for each size of pilot stem. These bushings range in size from ⅝ inch to 3 inches, varying by steps of 1/16 inch. For the No. 3 pilot stems the bushings range from ⅝ to ⅞ inch, inclusive; for the No. 5 pilot stems the bushings range from 15/16 to 1½ inches, inclusive; for the No. 4 pilot stems the bushings range from 1 inch to 1¾ inches, inclusive; and for the No. 6 pilot stems the bushings range from 1 13/16 to 3 inches, inclusive. All bushings are ground 0.001 inch under size.


"Ashmac" Combination Tool-holder made by the Ashley Machine Works

The No. 1 size of tool-holder has a 1¼-inch shank, and it is equipped to carry ½-inch tools. The pilot bushings range from ⅝ inch to 1½ inches, inclusive, by steps of 1/16 inch; and two pilot stems (Nos. 3 and 5) are made for this size of tool-holder. The No. 2 "Ashmac" tool-holder has a 1½-inch shank, and it is equipped to carry ⅝-inch tools. The available pilot bushings for use with this tool-holder range from 1 inch to 3 inches, inclusive. Either of two pilot stems may be used, a No. 4 stem carrying bushings from 1 inch to 1¾ inches, inclusive; and a No. 6 stem carrying bushings from 1 13/16 to 3 inches in diameter, inclusive.

MUMMERT-DIXON OILSTONE GRINDER

For use in the performance of miscellaneous tool grinding operations in machine shops and tool-rooms, the Mummert-


Triple-purpose Oilstone Grinder built by the Mummert-Dixon Co.

Dixon Co., Hanover, Pa., has recently added to its line an oilstone wet tool grinder which is equipped with three grades of stones—coarse, medium, and fine. This machine is capable of handling such work quite rapidly, owing to the possibility of quickly bringing large tools to shape on the coarse-grained wheel; the medium wheel is well suited for ordinary grinding, and the fine wheel is adaptable for producing a smooth finish on the cutting edge of the tool. It will be apparent from the illustration that all of the wheels are conveniently arranged for the operator and, if so desired, three men can use the machine at the same time. Kerosene is used on the wheels to prevent glazing and to keep them clean and sharp, and also to avoid overheating the tools. A small centrifugal pump located at the bottom of the oil reservoir is used to deliver kerosene to the wheel, and a large pan catches the oil and returns it to the reservoir.

Ball bearings support the grinding wheel arbors, and they are mounted in housings provided with grease and oil retainers. The arbor which carries two wheels runs at one-half the speed of the arbor on which the large grinding wheel is mounted, and it is driven from the first arbor by a set of bevel gears having a ratio of 2 to 1, which are enclosed in an oil-tight gear-case filled with grease. Regular equipment furnished with the machine includes one coarse-grained oilstone wheel, 16 inches in diameter by 2 inches face width; one medium oilstone wheel, 10 inches in diameter by 2½ inches face width; one fine oilstone wheel, 10 inches in diameter by 2½ inches face width; a ball-bearing countershaft for a belt-driven machine, and a motor belt tightener for a motor-driven machine.

H. E. HARRIS THREAD GRINDING MACHINE

While practical difficulties have retarded the commercial application of thread grinding, there is a demand for more accurate threads, and these cannot be produced without accurate taps and dies, nor can they be checked without accurate thread gages. There is also a demand for accurate worms and worm-gear hobs which cannot be produced without accurate means of grinding them. During the past five years, the H. E. Harris Engineering Co., Bridgeport, Conn., has ground a large number of taps, hobs, and thread gages for its customers and found that tools thus ground would improve both the accuracy of the work and the amount of production. This firm's experience in grinding accurate taps and thread gages led to the design of a machine which will commercially and accurately grind taps, thread gages, hobs, and worms. It is suited both to highly accurate production of one or a few thread gages and to quantity duplicate production of taps, worms, etc. It requires only an operator taught to do the work and not a highly skilled mechanic.

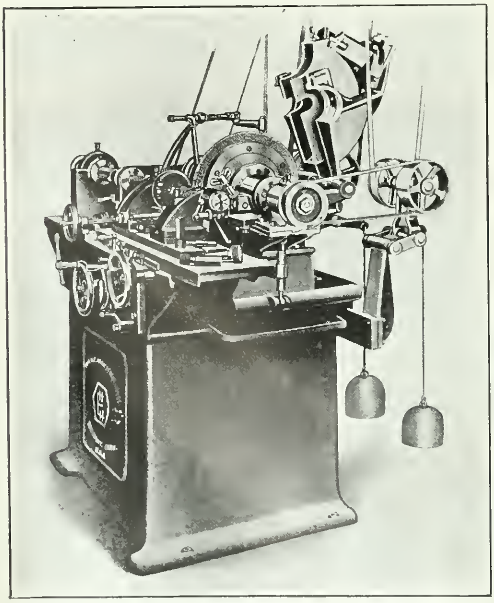


Fig. 1. Thread Grinding Machine built by the H. E. Harris Engineering Co.

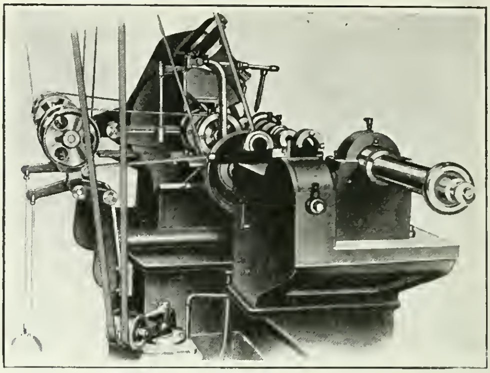


Fig. 2. End View of Harris Thread Grinder showing Arrangement of Drive

Features of the Machine

Fig. 1 shows a view from the right-hand end of the machine with the upper bearing caps carrying the lubricant guard and angular diamond truing devices hinged up. Fig. 2 shows the left-hand end view with the lead-screw removed with its two-piece nut, the lead-screw drive, the pump and the uniform belt tension device. Fig. 3 shows a close-up view of the work, the grinding wheel, and the diamond truing device. In this view the upper lubricant guard has been removed so as to show the other parts more clearly. Fig. 4 shows the method of removing the grinding unit which is by far the most important single feature of the machine. These illustrations are supplemented by Fig. 5 which shows the construction of the grinding head, the diamond truing device, and the drive, and Fig. 6 which shows the method of driving the work to give it the correct lead without a side movement which would destroy the grinding wheel and prevent accuracy.

The grinding wheel on this machine is of prime importance. To eliminate rapid wear of the cutting edge and bearings, and to provide for using high rotative speeds, the grinding wheel is made 16 inches in diameter, presenting to the work a continuous edge at each revolution, that is 50¼ inches long or a turn of about 4¼ feet to each cutting particle before it contacts with the work again. At 1600 revolutions per minute, a surface speed of 6700 feet per minute is obtained, thus combining a relatively low rotative speed with a high surface speed. The grinding wheel is a ring of abrasive material clamped in the rim of a very heavy and accurately balanced gyrostatic wheel. This essential feature of a perfectly balanced and heavy flywheel or gyrostat maintains the grinding edge in a true path, at a uniform speed and without vibration. Due to its weight, it absorbs any shocks from inequalities caused by flutes in taps or hobs; and due to its momentum, the wheel keeps a uniform rate of speed, despite possible changes in belt power, and overcomes uneven resistances due to high spots in the work or as the work is fed on or off the grinding edge. In this way it prevents any tendency toward sudden retardation or acceleration of speed; and also due to the gyrostatic action of this balanced mass, it exerts ample power to resist changes of axial or lateral position and tends to hold the entire rotating mass in a floating position between its bearings. This not only takes any undue pressure off the journals and bearings, but holds the wheel in a true rotative position and prevents errors due to side thrust movement or elliptic action.

Arrangement of the Driving Mechanism

This gyrostatic wheel *A*, Fig. 5, is forged in one integral piece with its two journals *B* which rotate in double ball bearings, and it is turned all over and balanced to a perfect running or gyrostatic balance. Belt pressure or alignment strains are not allowed to affect this wheel, the drive being transmitted to it at each end from driving pulleys *C* carried by independent shafts and bearings. Flexible couplings *D* and driving jaws transmit power from these auxiliary pulley shafts to the wheel-spindle, and therefore a purely rotative drive is imparted. The two belts are of jointless fabric, and an equal pull is kept on both of them by weights *E* through a pivoted bellcrank tightener, which also keeps the overhead countershaft belts under a uniform tension.

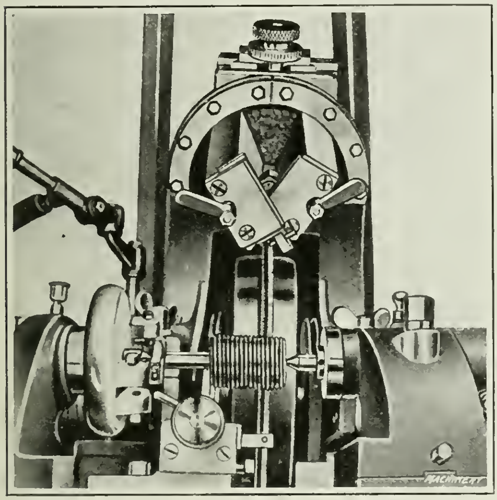


Fig. 3. Close-up View of Wheel-truing Device and Work on Harris Thread Grinder

Construction of the Grinding Wheel

The abrasive wheel is a special ring made for this machine. Its weight is only a few ounces, compared to the 200 pounds weight of the gyrostat carrying this ring, so that even were the abrasive material not absolutely uniform in weight, the running balance would not be materially affected. The ring-wheel is clamped by a circular dovetail, and should it be cracked in segments it will not fly apart. These parts would maintain their positions and the wheel could be used for grinding and be dressed occasionally as required, just as though the ring were not cracked. The rings are made in vitrified, silicate and elastic abrasives, and a special ring has been devised particularly for the purpose of thread grinding, in which the section on the vertical plane through the center of the ring and apex of its dressed edge is made of a harder binder and a finer grit than the outer sides, so that the V-shape may be maintained longer without redressing when grinding into the root diameter of the threads. This fine extreme outer edge is what ordinarily wears away and loses its shape the fastest, although it removes the least metal, and making it finer and harder adds greatly to its efficiency. As this hard, thin section extends from the apex of the cutting edge clear down through the ring to its inner diameter, it is not dressed away when truing, even when the ring has been dressed down to its minimum size and barely projects beyond the metal surfaces of the gyrostat.

The ball bearings are of the fully enclosed labyrinth type, without felt washers; once adjusted and lubricated, they need little attention, and they are permanently carried on the gyrostat wheel journals, even when removing the wheel to replace a worn out abrasive ring with a new one, as shown in Fig. 4. They may be instantly removed by unscrewing nut *F* and can be disassembled in a few minutes. The wheel is removed by loosening the two wing-nuts *G* on the swing-bolts, and swinging the upper members upward and back on their pivots. The angular wheel-truing devices *H* and metal splash guard are carried up out of the way with this upper member, as shown in Fig. 4. The upper member is released to swing back merely by loosening the two thumb- or wing-nuts without disturbing the set-up or any other part of the machine, and the wheel is replaced just as readily. No great pressure is required on the wing-nuts, as the machine will actually operate and the wheel will grind without the upper member, so great is the effect of the gyrostatic action after speed of rotation has been attained.

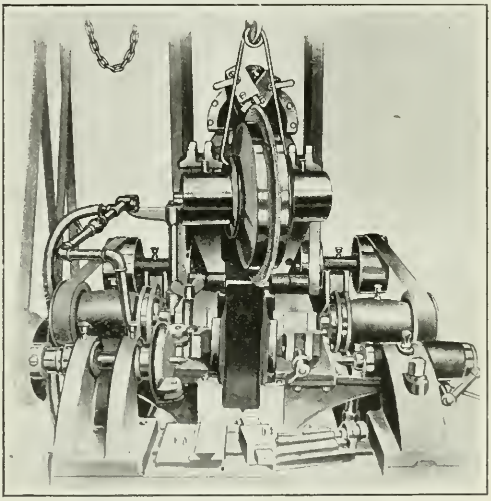


Fig. 4. Close-up View showing Method of lifting the Wheel and Arbor out of the Bearings

The wheel operates under full flooded lubrication from the pump shown in the lower left-hand part of Fig. 2. Two large circular separation disks *I* with holes in them to assist in removing the wheel (see Fig. 4) are forced on the gyrostat hubs and balanced with the gyrostat as part of it. They keep any of the cooling compound from working out beyond them and also keep any oil from the bearings from working over on the wheel—thus the term "separation disks."

Wheel-truing Device

The cutting or grinding edge is dressed or trued to the required form by a set of three diamond tools which can be operated while the machine is grinding work if desired. They are located so as not to interfere with the work in any case. The two diamond tools for truing the angular faces of the grinding edge are shown in Fig. 3, where the upper metal splash guard has been removed for clarity. The diamond tools are carried in two rack-operated slides controlled by hand-levers. One of these slides is set slightly under the other so that they may cross in a line in the diametral plane of the apex of the cutting edge. The main truing slide carries the points of these tools inward on a radial line toward the center of the grinding wheel and keeps the crossing point of the two diamonds on this diametral plane. Therefore, as the main truing slide is fed in toward the center, the apex is not shifted laterally; but the angles of the trued faces remain constant and the only change is the gradual reduction of diameter of the cutting edge. In other words, once set for the desired angles, the wheel will always be dressed or trued to these angles without any change in relation to the work, except that whatever amount the slide *J* is fed in by its micrometer screw to dress the wheel, that same amount must slide *K*, carrying the wheel-head, be fed into the work by the micrometer screw controlled by the middle handwheel shown in Fig. 1. These diamond tool-slides can be adjusted to any angle, from an almost vertical position to a horizontal position, by swinging their frames about their common pivot.

Adjustment for the Helix Angle

The entire wheel-head mechanism and the pulley drives are carried on a circular sliding saddle *L* which is adjusted about the intersection of the axial and diametral centers of the grinding wheel to the required thread or worm helix angle by the adjusting link *M*. Saddle *L* is securely clamped by four screws *N* passing through oblong slots, to the wheel-head carriage *K*. The axis of the wheel and the axis of the work are in the same horizontal plane so that this angle is in the correct relation where it contacts with the work. Slide *K* is moved toward or from the work by a handwheel which has a micrometer dial and operates through a worm, worm-gear, rack, and pinion.

An automatic feed operates this handwheel at every stroke of the carriage, feeding it in the desired amount after each cut, and an adjustable stop motion is supplied so that when the grinding wheel has been fed in to the required depth to produce the desired diameters of the work, this feed is thrown out. This permits automatic reproduction of duplicate work, the wheel-head only being adjusted by hand for the amount dressed off by the angular diamond tools.

The diamond tool *O* is shown in the working position for dressing the flat or land on the periphery of the wheel. Its base is adjustably clamped to the work-slide in a fixed relation to the work-centers, so that when once set it will continue to dress the periphery of the wheel as the wheel-slide is fed in, producing the correct root diameter without changing or adjusting. This diamond tool is carried in a small rack slide, with a motion at right angles to the plane of the wheel and parallel to its axis, thus always dressing a flat edge as required. The amount it may be set in relation to the work-slide is controlled by a micrometer screw adjustment. While generally left in place while the machine is operating, it is so arranged that it can be removed to accommodate large diameters of work up to the extreme capacity of the machine. All diamond dressing is done on a flooded wheel resulting in a long life to the diamonds.

Method of Controlling the Lead of the Ground Thread

The method of controlling the lead of the thread ground on this machine is to reproduce the lead from an accurately cut or milled master screw, which is connected in rigid continuity with the work to be ground. The work to be ground is carried between centers, the dead or tail center *P*, Fig. 6, being of the spring type usually employed in grinding machines, with a clamp for locking it into position. This holds the work against a live center on the end of the headstock or revolving spindle, and the work is driven by a dog or other driving device clamped rigidly to the driver provided with jaws for such clamping. The live spindle *Q* is fitted with bearings having adjustment to remove all lost motion. These bearings are fully protected from the possibility of dirt, grit, or cutting fluid working their way in. The lead-screw *R* is carried in perfect alignment with the live spindle, and is secured to it by the clamp *S*, the bore of which is a true gage fit on the cylindrical end of the lead-screw. This carries the right-hand end of the screw, while the other support of the screw is the two-piece nut *T*. The stationary portion of the nut is tapered on the outside and drawn up and clamped by the knurled nut in a tapered hole in the upper member of the auxiliary adjusting slide which has an exceedingly fine screw adjustment operated by a handwheel This handwheel is shown on the upper left-hand side in Fig. 1 and gives a delicate adjustment to "catch the thread" by moving the nut, lead-screw, and slide with the work longitudinally across the cutting edge of the grinding wheel. This can be used either when the lead-screw and work are turning or when they are at rest. Provision is made for taking up all lost motion between the screw and nut, thus eliminating any side movement between the work and the

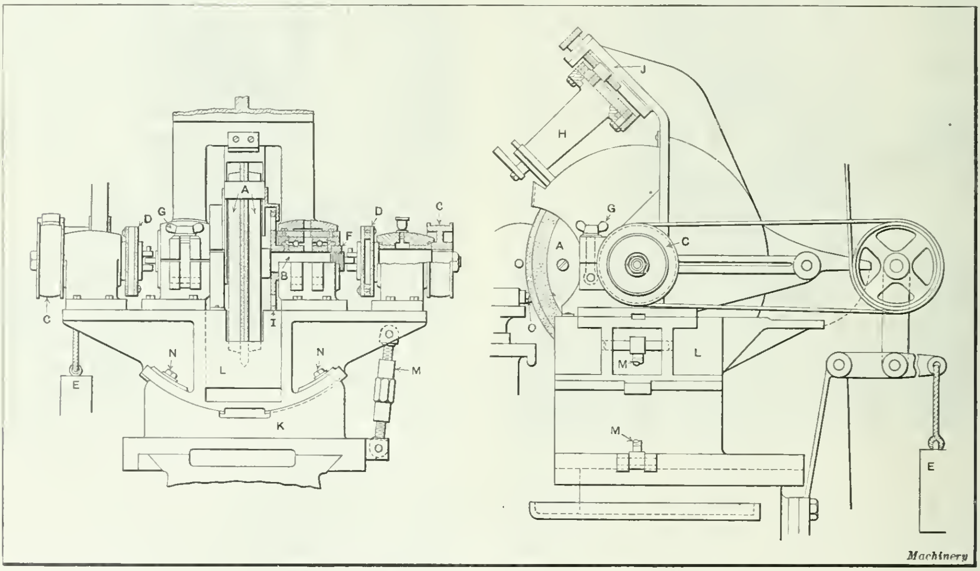


Fig. 5. Details of Mechanism on the Harris Thread Grinding Machine

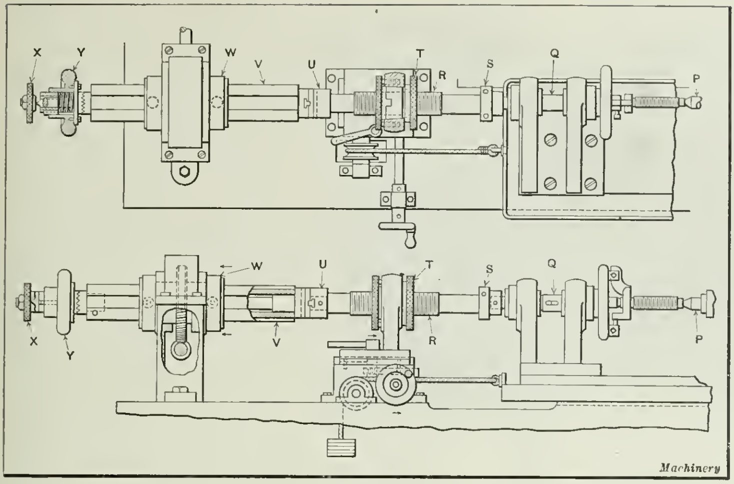


Fig. 6. Arrangement for controlling Lead of Thread on the Harris Thread Grinding Machine

grinding wheel, which would have the same effect as side thrust of the grinding wheel, namely, to grind on the left side of the thread when fed to the right, making a wide thread with a flat bottom, and also rapidly destroying the cutting edge of the wheel by side pressure. This effect of taking up slack is supplemented by a counterweight which is just sufficient to offset the inertia of the work-table.

Method of Driving the Lead-screw

The left-hand end of the lead-screw clamps in a full floating coupling *U* on the end of the floating follower spindle *V*. This follower spindle, which transmits the rotary motion to the lead-screw, work, and table, is made full floating with eight ball bearings so that no drag, side pull, or other strains can be transmitted from it while turning the lead-screw. The worm drive to this spindle consists of a worm-wheel driven by a worm from the reverse gear and mounted on and rotating a large hollow spindle *W* carrying eight ball bearings on pins, which work in four wide grooves or keyways, in the follower spindle. The four-grooved spindle *V* is made hollow and carries within it the spindle which directly carries the full floating coupling *U*.

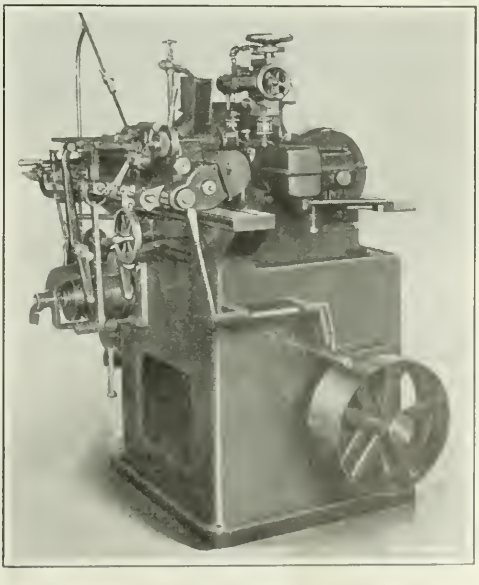
At the extreme left in Fig. 6 there is shown a knurled knob *X* which can be turned to connect or disconnect a clutch which transmits rotary motion from the outer grooved or keywayed follower spindle *V* to the inner spindle carrying the floating coupling *U* that drives the lead-screw *R*. When this knob is turned so that the clutch is out, the lead-screw and work may be freely turned by hand by the handwheel *Y* or by the periphery of the driver on the work-spindle. This clutch between the two spindles also has a spring release designed so that any undue strain tending to retard the work-table, such as would occur if the reverse gear were set for left-hand threads when a right-hand lead-screw was in the machine, would cause it to throw out instead of breaking some part of the machine. The change from right-hand reversing to left-hand reversing is done by means of the small lever shown toward the left end of the machine in Fig. 1. The reversing gear is driven direct from the cone pulley on the end toward the wheel-head. This pulley is driven from a separate shaft on the double countershaft and has four speed changes, and an additional range of work-speeds, by gearing. It may be stopped by a separate belt shifter without stopping the grinding wheel. This cone pulley is keyed to its shaft by a safety shearing device. Additional speed changes, if required, may be arranged by substituting cone pulleys on the double countershaft. As it takes a few minutes to get the gyrostatic wheel up to speed and as the bearings do not heat, it is advisable to leave the wheel drive running, while stopping the work drive only, except when the machine is not going to be used for some time.

The reversing of the lead-screw is done the instant the grinding wheel leaves the thread of the work by means of dogs on the front of the table operating the reverse lever shown projecting up from behind the middle handwheel, Fig. 1, and at the same time the automatic feed to the wheel-slide operates, feeding the wheel in for the next cut.

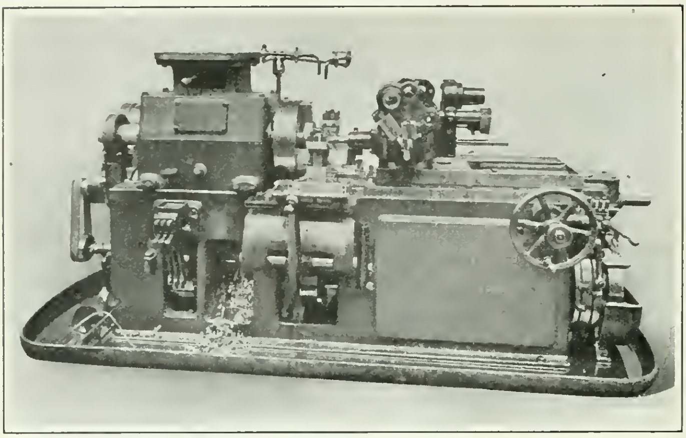
Reversing the lead-screw motion turns the work thread back through the same helical path against the wheel, and the wheel cuts continuously both ways, the automatic feed operating at either end of the table (or lead-screw) travel. By this means the backing out at the end of a single stroke and running back for the next cut is avoided. Besides practically cutting the grinding time in half, this grinding back and forth seems to give a keener cutting action and smoother finish than when grinding threads from one end only. The lead-screws can be very easily changed, in less than a minute's time. The handwheel to the right, Fig. 1, moves the table direct through a rack and pinion, and is a convenience when changing lead-screws. It cannot be operated by hand when the lead-screw is in.

FRASER AUTOMATIC GRINDING MACHINE

The grinding machine shown in the accompanying illustration has been recently placed on the market by the Warren F. Fraser Co., Westboro, Mass. This machine is designed primarily for grinding rolls and the first machines



Fraser Automatic Grinder designed primarily for grinding Rolls



Alfred Herbert No. 5 Automatic Lathe

of this type were built for the Bock Bearing Co. The machine is entirely automatic in operation and although built especially for roll grinding it can be adapted for grinding many different articles which are required in sufficient quantities to warrant the use of an automatic grinder. Among the notable features of this machine are its rigid construction, the method of protecting its bearings from emery dust, the three-bearing wheel-head, the three bearing headstock, and a live tailstock and reciprocating wheel-spindle.

The wheel-dressing device is permanently mounted on the wheel-head. The spindles are hardened and ground and run in bronze boxes which are adjustable for wear. The control unit consists of a cam set rotated by a worm and worm-wheel. The rotation of the cam set causes the feed-arm to swing from the feed-pipe to the chuck. The piece is held by the feed-arm until the chuck has closed on one end and the tailstock center has entered the piece. The work then commences to rotate and the wheel is brought up quickly to a predetermined point, after which it is moved at the proper rate for grinding for a predetermined distance, held stationary for a number of revolutions of the work and then quickly moved back to the starting position where rotation of the work is stopped. The jaws of the chuck then open and the tailstock center moves back, allowing the work to drop out.

When testing out one of these machines on rolls ¾ inch in diameter, the rate of grinding was found to be 12.2 rolls per minute. For six hours' operation, allowing time for dressing the wheel, setting the machine, etc., which consumed about 20 per cent of the total time, the production was 3489 rolls.

ALFRED HERBERT No. 5 AUTOMATIC LATHE

Alfred Herbert, Ltd., 54 Dey St., New York City, has recently placed on the market the No. 5 automatic lathe shown in the accompanying illustration. In this machine all operations except chucking are performed automatically. No countershaft is needed, as a single pulley drive is employed. The machine is low and can be set up and controlled from the floor without the use of a platform. Automatic speed and feed changes can be made while the tools are cutting, and no changing of cams is required for any work within the capacity of the machine. The front and back cross-slides may operate separately or simultaneously.

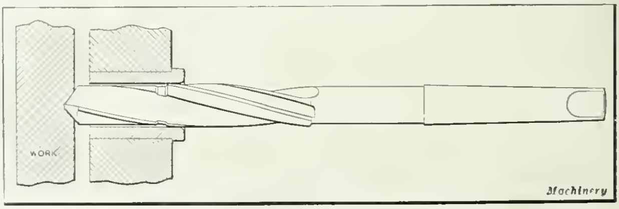
Among the patented features found on this machine are the following: Friction clutches in the head, self-selecting feed motion, instantaneous feed change and three-revolution type of turret feeding and indexing cam. The head is adjustable along the bed for a length of 6 inches, and is of the enclosed type with the gears running in an oil bath. The single pulley runs on ball bearings and drives the head by a friction clutch which can be engaged or disengaged by a hand-lever conveniently located for starting and stopping the machine. The hole through the spindle is 3⅝ inches in diameter. A flange is provided on the spindle nose for carrying a 15-inch Coventry chuck when this type of chuck is desired.

The main spindle bearings are of white metal and the thrust is taken by a ball thrust bearing. Six spindle speeds are provided, and five ratios of automatic change for each spindle speed are available. The total range of speed is from 14 to 411 revolutions per minute. Provision is made for stopping the spindle automatically at any instant, thus permitting the tools to be withdrawn without leaving spiral markings on the work. After stopping a sufficient length of time to permit the tool to be withdrawn from the work, the spindle is automatically started as the next tool comes into position.

The turret slide has a working stroke of 15 inches; it is indexed in the extreme back position and is clamped automatically. The turret is square and its flat faces are accurately surfaced. The turret cam is of the drum type driven directly by a worm and worm-wheel. It has two grooves, one for moving the turret slide and the other for indexing. For each complete forward and return movement of the turret, this cam makes three complete turns. The maximum swing over the bed is 18½ inches; the maximum distance from the flange of the spindle to the face of the turret is 34 inches and the minimum distance 15 inches. The speed of the single pulley is 400 revolutions per minute and 7 horsepower is required to drive the machine. The floor space occupied by the machine is 12 feet by 6 feet and the net weight is approximately 8500 pounds.

"FASTFEED" COMBINATION DRILL AND REAMER

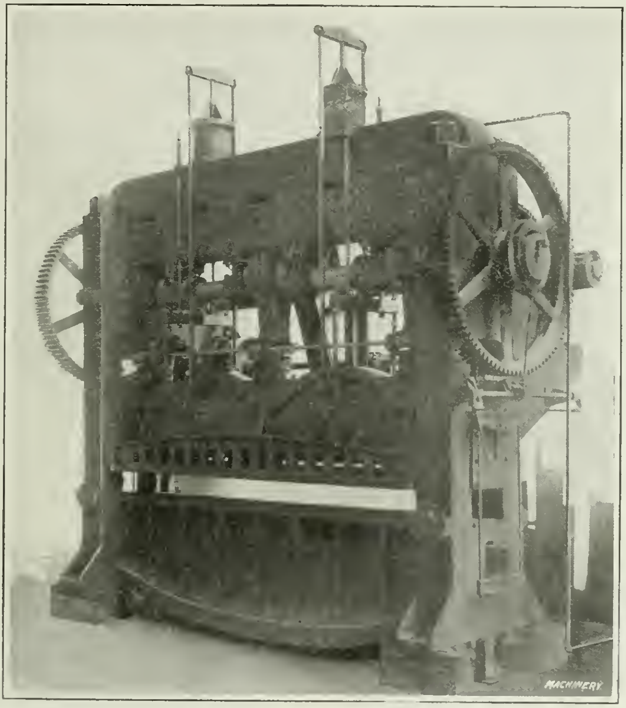
In the accompanying illustration there is shown a combination drill and reamer, which is a recent product of the Fastfeed Drill & Tool Corporation, Toledo, Ohio. The drill is made 0.010 to 0.015 inch smaller than the reamer, and it is guided by the reamer entering the bushing before the drill starts cutting. The reamer can be resharpened in the same manner as a standard machine reamer. The bushing should be made 0.0005 inch over the reamer size, and the reamer should enter the bushing approximately ¾ inch before the drill starts cutting. A four-lipped spiral fluted



Combination Drill and Reamer made by the Fastfeed Drill & Tool Corporation reamer is employed, which assures a good clean cut. Features of this tool will be made sufficiently apparent from the illustration without requiring a detailed description. It is at present made in thirty-three sizes, covering a range of reamer diameters from 0.500 to 1.500 inches, and a range of drill diameters from 0.485 to 1.485 inches. The small sized tool has a reamer 2⅜ inches long, and a drill ⅞ inch long, while the large size tool has a reamer 4⅜ inches long and a drill 2⅜ inches long.

WILLIAMS, WHITE POWER PRESSES

Heavy bending, blanking, pressing, shearing, multiple punching, group punching, and similar operations are efficiently performed on power presses of the tie-rod type of construction, if the quantities of work to be handled are sufficient to earn a satisfactory rate on the investment in a press having sufficient capacity to accommodate pieces of large dimensions. It is stated that an equipment of this kind owes its usefulness to three outstanding features. All gears and other parts of the mechanism are located overhead, so that the work may be placed in and removed from the machine from either the front, back, or either end. For this purpose the side housings are made with ample openings or "windows" between the tie-rods. The table and ram are designed with ample die areas and openings, and T-slots to hold the tools required for handling various jobs. All vertical operating stresses are supported by heavy forged steel tension members which fasten the table housings and bridge tree together, and practically eliminate broken side housings.



Tie-rod Type of Power Press built by Williams, White & Co.

Williams, White & Co., Moline, Ill., have recently added to their line two large tie-rod presses of 500 and 800 tons capacity. These machines are for use in blanking out side rails for motor vehicle frames, the smaller machine being used for blanking side rails for passenger cars while the larger one is used to blank side rails for trucks. These machines have been designed along similar lines and general features of their construction conform to standard practice of the firm by which they were built.

Adjustment of the die space is accomplished by screws in the pitmans, which are operated through worm-gearing by an independent motor mounted on the ram. The hold-downs or strippers are made of steel with a T-slot in the face of each for the attachment of special shaped contact fingers. They are operated by cams on the main crankshaft. Four T-slots are provided in the table, and there is an opening 6 inches wide in the center, which extends the full length of the machine. There are five T-slots in the ram. An ample operating surface has been provided for the friction clutch, and each machine has an automatic stop and brake. All gears are made of steel and a twin type of drive is employed with cut tooth driving gears and pinions at each end of the main shaft. This arrangement equalizes the drive and eliminates torsional lag. An automatic die knock-out connected to the ram and operated by it strips the work from the dies.

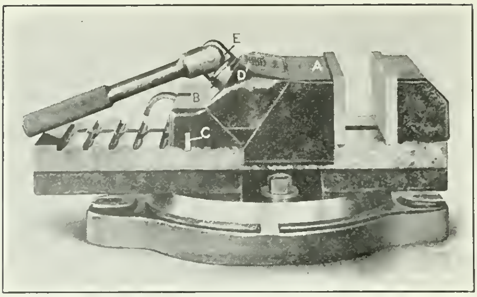
NELSON QUICK-ACTING MILLING MACHINE VISE

The following description deals with a milling machine vise recently placed on the market by the Nelson Tool & Machine Co., Inc., 82-88 Llewellyn Ave., Bloomfield, N. J. The distinguishing characteristics of this vise are its rapid clamping action and ample holding power. These results are accomplished by a rather novel construction of the movable jaw and of the clamping medium employed to actuate it.

Referring to the accompanying illustration, the movable jaw *A* is connected to a latch block *B* by two pins, on each of which a coil spring is carried for exerting tension against the force applied on the movable jaw during the operation of the vise. A lug on the seat of the latch block fits in a groove in the vise bed, thereby furnishing a guide for the block when it is slid along the bed, whenever this adjustment becomes necessary. There are seven transverse slots on the upper surface of the bed, which are located at ⅝ inch intervals, to enable the vise to be readily set for holding any piece of work within its range, by simply engaging the lower part of latch *C* in one of these slots. When the vise is in use, the latch is held in the slot by two light coil springs, so that it becomes necessary to lift the latch from its slot when increasing the opening of the jaws an additional ⅝ inch. For convenience in doing this it is evident that the latch has a handle provided for the purpose.

The angular surface on the movable jaw inclines 55 degrees from the horizontal and the corresponding surface of the latch block, at a 45-degree angle. A steel wedge *D* is the actuating medium by means of which the movable jaw is advanced against the work. This wedge has angular surfaces to conform to those of the latch block and of the jaw, and carries the operating screw *E* which extends through the movable jaw and into a square threaded nut under the jaw. It will thus be seen that by operating the screw by means of the pivoted handle, a wedge action is produced, which exerts a pressure on the movable jaw fifty times greater than that exerted by the hand-operating screw. The manipulation of this hand-operated screw enables the movable jaw to be advanced ⅝ inch (the spacing of the transverse slot in the bed) before it becomes necessary to change the position of the latch. The nut in which the operating screw engages is integral with the movable jaw. This nut does not serve as a guide for the jaw, although it extends into the slot in the vise bed, similarly to the guiding lug on latch block *B*. The movable jaw is guided by means of the flange-like extension of its sides.

The jaws have hardened and ground steel faces with plain gripping surfaces and are attached to their respective castings by machine screws. The base of the vise is graduated in degrees, and is attached to the milling machine table by bolts in the regular manner. This tool may be furnished either with or without the swiveling feature shown in the illustration. The vise is made in two sizes: Size No. 1 has jaws 6 inches in width by 2 inches in depth, and will open 5¾ inches; size No. 2 has jaws 4 inches wide by 1½ inches deep and has a maximum capacity of 4 inches.



Wedge-operated Milling Machine Vise built by the Nelson Tool & Machine Co.

NEWTON CONTINUOUS MILLING MACHINE

For the performance of many classes of repetition work in the manufacture of duplicate parts, rates of output are increased through applying the so-called continuous principle of machining. This result is obtained as a result of provision made by the machine tool designer for reducing nonproductive time of both the machine and its operator; and this principle has been successfully employed in the construction of various types of machine tools. Figs. 1 and 2 show opposite sides of a continuous rotary milling machine, which is a recent product of the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., and Figs. 4 to 7, inclusive, show close-up views of the milling cutters and fixtures for the milling of pieces shown in Fig. 3.

It will be apparent that the column and the base of this milling machine are cast integral to afford ample rigidity. Provision has been made for mounting various types of work-holding devices on the circular table, so that the machine is adapted for handling quite a wide range of work. Also, the table is adjustable on the base, making it possible to properly position the work-holding fixtures in relation to the milling cutters. By this means the radius from the center of rotation of the table to the point of cutting may be held down, and the milling cutters may be made of the smallest suitable diameter for the work which they are required to perform. Bearing in mind the fact that the rate of production is largely controlled by the number of pieces of work that can be handled per revolution of the table, the advantage of properly setting up the work on the table will be readily appreciated. It is essential for the pieces that are to be milled to be set up with the least possible space between them, and this statement applies regardless of whether the spaces are rectangular or wedge shaped, due to the pieces being set up on the table at an angle to each other. Machines of this type are built with tables 24, 36, and 48 inches in diameter on their working surface, which is surrounded by a pan for collecting the coolant that is used in milling steel.

Arrangement of the Feed Mechanism

In operating one of these Newton continuous rotary milling machines, the spindles revolve but otherwise remain in a stationary position, while the table revolves to provide for feeding the work under the milling cutters. Rotative movement of the table is controlled by a fixed feed mechanism so that there is no danger of the operator increasing or decreasing the production of the machine. The employment of a specified rate of table rotation also requires a given number of work-holding fixtures to pass the loading station per

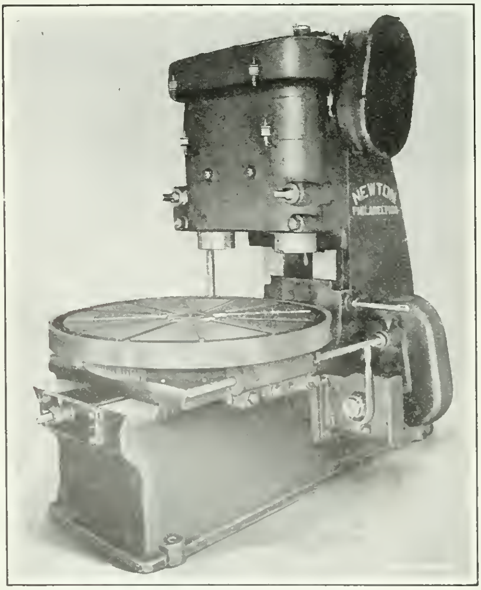


Fig. 1. Continuous Rotary Miller built by the Newton Machine Tool Works

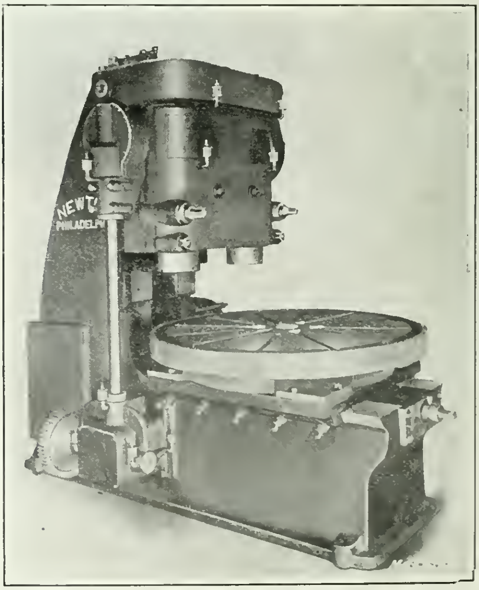


Fig. 2. View of Opposite Side of the Newton Continuous Rotary Milling Machine

hour, and failure of the operator to produce the stipulated number of pieces of work should immediately lead to investigation concerning the cause. While the feed mechanism normally remains fixed, provision is made for allowing authorized employes to increase or decrease the rate of table rotation.

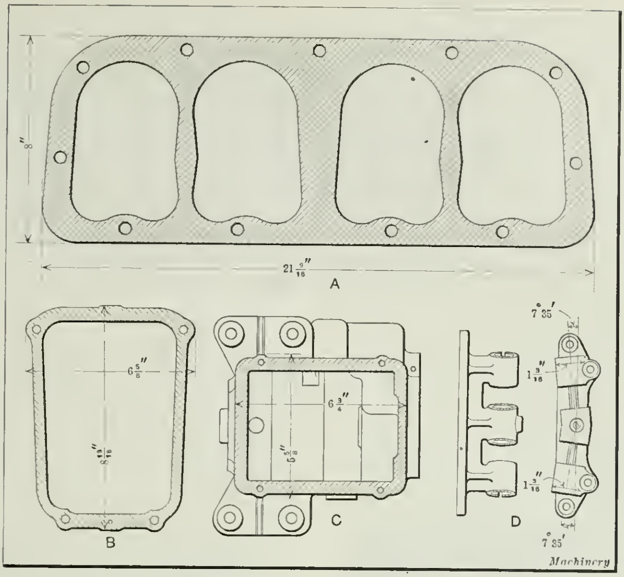


Fig. 3. Examples of Work done on Newton Continuous Rotary Miller. Shaded Areas indicate Milled Surfaces

Arrangement of the Speed Mechanism

Changes of spindle speed are controlled in the same manner as adjustments of the rate of feed. Attention is drawn to the fact that power is transmitted to the spindles by means of worms and worm-wheels of a type which is extensively used in machinery built by the Newton Machine Tool Works. It will be seen that the head which carries the spindles is made adjustable on the column, which is a necessary feature of this type of machine, in order that the work-holding devices may be set as low on the table as the form ot the work will permit. Adjustments are accomplished by lowering the spindle into the correct position for the work. This arrangement reduces the extension or overhang of the spindle, and also permits the work-holding fixture to be made as compact as possible.

Advantage of Dividing the Work between Roughing and Finishing Cutters

It will be seen that the spindle head is equipped with two spindles, each of which is individually adjustable to provide for setting the cutters to gages. Roughing cuts are taken by the left-hand spindle, and finishing cuts by the right-hand spindle. On the machine with a 48-inch table, the distance between the spindle centers is 22½ inches, and on the machine with a 24-inch table, the spindles are located 13 inches from center to center. On the largest machines, ample capacity is provided to enable large pieces of work to be passed over by the roughing cutter before the finishing operation is started on the same piece. It is claimed by the builders of these machines that continuous rotary milling is one of the most accurate methods of machining parts in quantities, because any variation in the work done by the roughing cutter, due to inequality in the size and physical properties of the castings, is absorbed while performing the finishing operation.

Owing to the small amount of work to be performed by the finishing cutter, both the accuracy and perfection of workmanship of the product are said to be maintained at a high standard, without requiring the cutters to be ground at frequent intervals. Also, the ability of the finishing cutter to hold the required degree of accuracy, while taking a light cut, makes it possible to run the machine at much higher cutting speeds and feeds than would otherwise be practicable. It is stated that pieces measuring 6 by 20 inches on the milled surface have frequently been taken out of the work-holding fixture and laid on the surface plate, where it was found that they would hold six tissue paper "feelers," and also that it was impossible at any point to enter a thickness gage measuring 0.0015 inch. These tests indicate that not only is a high finish produced, but that there is no warping of the casting or digging in of the cutter on the leading side.

To those who make a careful study of the operation of one of these machines, it will be apparent that the manner in which the work presents itself to the cutters is one of the big factors in making possible the high rates of spindle speed and table feed that are commonly employed. As the table revolves to feed the work under the cutters, each casting to be milled presents a constantly changing angle to the cutters, thereby affording a shearing action and avoid-

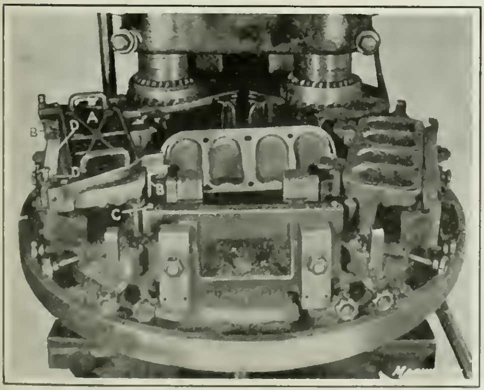


Fig. 4. Newton Continuous Rotary Miller machining Automobile Engine Cylinder Heads

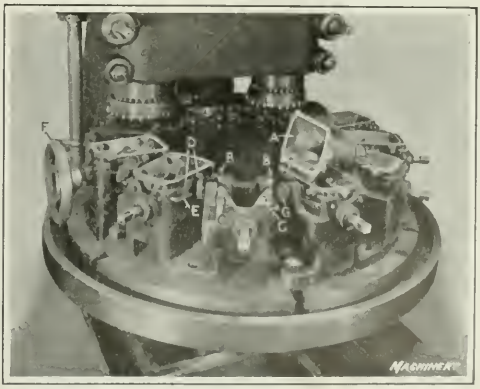


Fig. 5. Milling Automobile Gear-case Covers on Newton Continuous Rotary Miller

ing the presentation of a large contact area to the milling cutter teeth. All driving gears in the machine are made of hardened steel and they are mounted in fully enclosed cases, so that they may be run in oil.

Milling Automobile Engine Cylinder Heads

Fig. 4 shows one of the Newton machines equipped for milling automobile engine cylinder heads, which are located from the rough cast surface by means of a gage *A*. Each casting is placed in the work-holding fixture after which the gage is set in position over it, and then the location of the casting is adjusted to the gage, which locates it from the top of the combustion chamber, in order that the volume and combustion area of this chamber may be held uniform for all castings. The way in which this result is accomplished is as follows: Gage *A* is provided with lugs that engage hooks *B* on the work-holding fixture, and in the bed of the fixture there are spring plungers *C* which apply sufficient thrust against the work so that the rough cast inside surface of the combustion chamber is pushed up firmly against the under side of gage *A*.

After this result has been accomplished, two straps *D* are tightened up to provide for securely holding the work in place, after which the setting gage *A* is removed, so that the casting may be fed under the milling cutters to provide for taking a roughing and a finishing cut, with the result that the under side of the cylinder head is faced off to leave a combustion chamber of the required capacity. At *A* in Fig. 3 the dimensions and form of the area to be milled are illustrated, and on this job the rate of production obtained is 30 cylinder heads per hour.

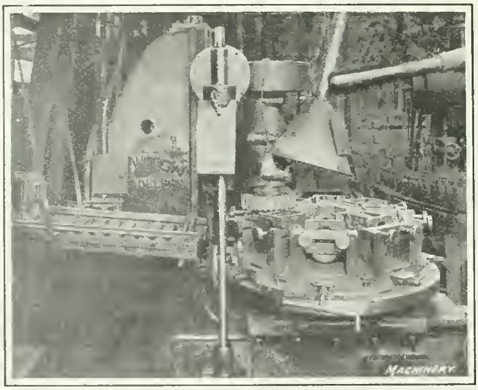


Fig. 6. Newton Continuous Rotary Miller machining Automobile Transmission Gear-cases

Milling Automobile Gear-case Covers

In Fig. 5 there is illustrated the equipment of a Newton continuous rotary miller used for milling automobile gear-case covers, and at *B* in Fig. 3 the shaded area shows the surface that has to be milled on these castings. Attention is called to the way in which these pieces are set up around the circumference of the table, with the result that there is practically no loss of time while the cutters are leaving one piece and starting work on the next piece. On this job the rate of production is 120 castings per hour. In this case, the method of holding the work in the fixture is quite simple, as will be realized by referring to the station of the milling machine table where casting *A* has been removed from the fixture. It will be noticed that the surface to be milled is the under side of a flange that surrounds the open end of the casting. As this flange is not very thick, there would be danger of springing the work out of shape by the pressure of the cut, unless special precautions were taken to avoid difficulty of that kind.

At the back of the fixture there are two screw heads *B* that support the work from the under side of the flange; and at the front of the fixture there are two spring plungers *C* which rise into contact with the work, after which the plungers are secured in place by tightening up the binding screw. At each side of the fixture it will be noticed that there are two leaves *D* which are supported by spiral springs *E*, these leaves affording support at each side of the casting to the flange that is to be face-milled. After each casting has been set up in the fixture in this manner, screws *F* and *G* are tightened to provide for clamping it securely in place for performing the milling operation. In Figs. 4 and 5 a good idea is given in regard to the large diameters of the milling machine spindles as compared with the cutters.

Milling Operations on Automobile Transmission Cases

The milling operation to be performed on automobile transmission gear-cases of the form shown in process of manufacture in Fig. 6 consists of facing the area shown in cross-section at *C* in Fig. 3. Fig. 6 is of especial interest because it gives a definite idea of the way in which Newton continuous rotary milling machines are being employed to obtain high rates of production in handling repetition work. It will be seen that gravity carriers are arranged to bring the work to the machines and to carry away the milled casting, the actual rate of output being from 100 to 125 transmission gear-cases per hour.

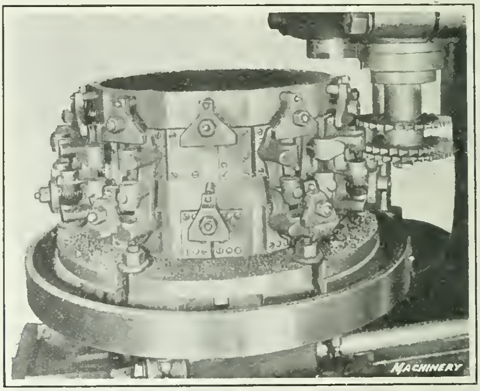


Fig. 7. Machining Angular Bracket Faces on Newton Continuous Rotary Miller

Method of Facing Bracket Bosses

Fig. 7 illustrates the equipment of a Newton continuous rotary milling machine which has been worked out along essentially different lines from those which have already been described and illustrated in this article. In the present case, the machine is employed for facing brackets with straddle-milling cutters, the work done on the machine being indicated at *D* in Fig. 3. Here it will be seen that there are six faces to be milled, three of which are parallel to each other, while the three remaining faces are also parallel to each other. As a result, it will be apparent that two operations are required to complete this job, and Fig. 7 shows a gang of three cutters that are used to simultaneously perform the required operation on three of the faces. With a feed of 4 inches per minute, a production of 30 brackets per hour is obtained.

With the preceding statement concerning the nature of the work to be handled on these castings, reference to the unloaded station on the milling machine table and to the station on which a casting is set up ready for milling, together with the detailed view of the work shown in Fig. 3, will show the method of procedure in handling this job without requiring more than a brief description. In Fig. 3

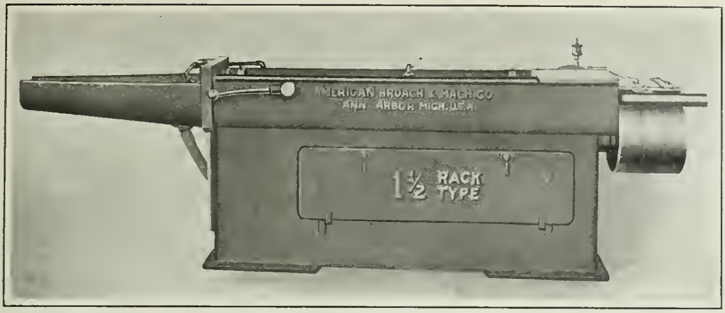


Fig. 1. American No. 1½ Rack-operated Broaching Machine

it will be seen that there are four holes drilled in the work, and these have already been finished at the time the work comes to the milling machine, so that pilots on the vertical faces of the work-holding fixture may enter these holes to provide for locating the work to obtain the required angular positions for the milled faces of the bracket. Then the work is secured in place on the fixture by bolting the straps back in place. It will be seen that two bracket castings are carried on each face of the milling fixture.

AMERICAN BROACHING MACHINE

The American Broach & Machine Co., Ann Arbor, Mich., has recently brought out the No. 1½ rack type broaching machine illustrated in Fig. 1. The manufacturers state that this machine is capable of more rapid operation than their screw-operated type of broaching machine. The main driving shaft is hardened and ground and is keyed to a special bronze worm-gear. The worm and worm-wheel shown in Fig. 3 are encased and run in grease. The main driving pinion is hardened and engages the D-shaped rack.

The machine is provided with a high-speed return motion which operates at double the speed of the cutting stroke. The loose pulleys which are shown in Fig. 2 are mounted on Hyatt roller bearings. There are no clutches employed on this machine, but an automatic brake band is provided which operates immediately when the sliding head reaches either end of the stroke. This brake absorbs the momentum of the driving mechanism and enables the travel of the table to be accurately controlled by the automatic stops.

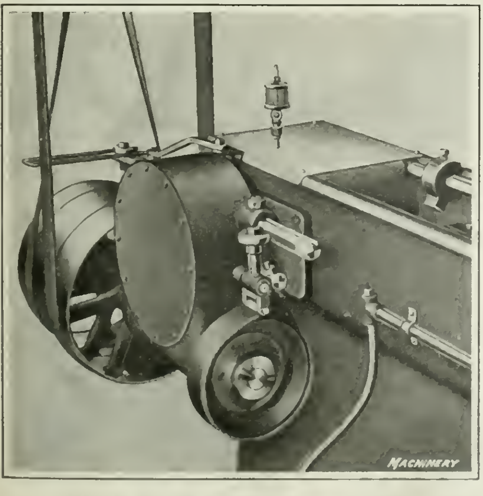


Fig. 2. View showing Tight and Loose Pulleys, Worm-wheel Housing, and Band Brake

When using a broach 4 feet in length, the time required for the cutting stroke and the return of the broach to its starting position is from 28 to 30 seconds. The machine has a cabinet base which is fitted with shelves. The face of the base is finished within 2 inches of the foot and has two machined T-slots for attaching boring fixtures, an oil trough or other attachments. The oil pump, which requires no priming, is furnished as standard equipment, and detachable oil trough is also furnished with the machine. It is claimed that the life of the rack-operated machine is lengthened because of freedom from twisting action.

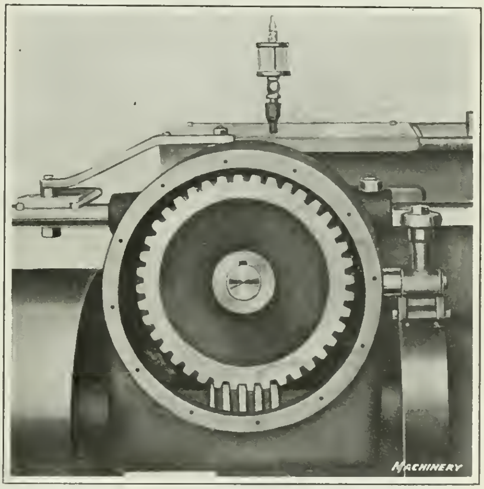


Fig. 3. View showing Cap removed from Worm-wheel Housing

WESTINGHOUSE ELECTRIC ARC FURNACE REGULATOR

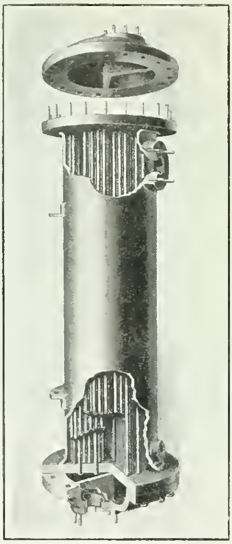
High electrode operating speed and close precision of regulation are the two important features of the electric arc-furnace regulator just placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. The ability of this regulator to incorporate high speed with a narrow current zone is due to the fact that the electrode speed varies all the way from full to zero as the regulated current approaches its normal value. In other words, within certain limits the restoring speed is approximately proportional to the amount that the current in the electrode deviates from normal. This permits the greatest possible electrode speed for a given current variation. This feature is particularly appreciated during the melt-down of cold scrap. For small variations in current the speed is slow enough to prevent continuous breaking of the arc, and at the same time, when the solid metal begins to cave into the pools of molten metal under the electrodes, sufficient speed is available to permit the regulator to extricate the electrode before the time relay allows the breaker to trip.

When the current is turned on in a furnace charged with cold scrap, it is only necessary to throw the regulator control to the automatic position. Regardless of the position of the electrodes at this time, the regulator will allow each one to run down at full speed until it touches the steel, when complete automatic regulation will commence. It is absolutely impossible for an electrode to get into the steel, and practically no attention is required from the operator. One very important feature of the regulator is its utilization of the arc voltage as well as the arc current to control the motors. Under-voltage relay trips on the control circuits are unnecessary. With any purely current-actuated device, it is said to be impossible to maintain equal arc lengths in furnaces using two or more electrodes, particularly when operating at reduced power. In this regulator, the arc voltage and the electrode currents are maintained balanced. The voltage coils also make the control of each electrode independent of the others. In fact, one electrode may be entirely withdrawn without disturbing any of the others. In a regulator dependent upon current control exclusively, any movement of one of the electrodes causes the elements of all other electrodes to change their positions.

GRISCOM-RUSSELL OIL HEATER

The Griscom-Russell Co., 90 West St., New York City, has recently placed on the market a new oil heater unit of the straight tube type. This heater is intended to supplement the line of coil heaters made by this firm, and is known as the G-R oil heater. As shown in the accompanying illustration, it is designed for the preheating of fuel oil before it goes to the burner for the purpose of insuring complete atomization of the oil and perfect combustion under boilers or in furnaces. The oil is pumped through the tubes, and steam at a pressure of 250 pounds per square inch in the shell serves as the heating medium.

Arc Furnace Regulator made by the Westinghouse Electric & Mfg. Co. East Pittsburg, Pa.



Griscom-Russell Oil Heater designed for preheating Fuel Oil

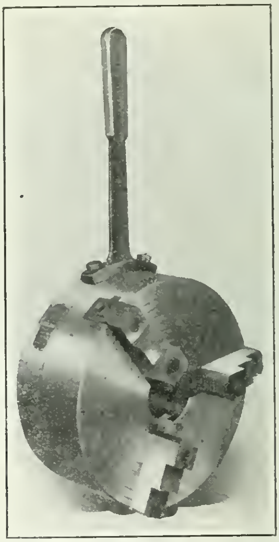


Fig. 1. Barker Wrenchless Chuck manufactured by the Foster Machine Co.

The shell of the heater is constructed of wrought steel welded to the steel tube-plates. The tubes are of seamless drawn steel and their ends are expanded in the steel plates at either end. The heaters are made in twelve sizes, the smallest size No. 9 has an inside diameter of shell of 4 inches, a length of 54⅞ inches, and a weight of approximately 150 pounds. The largest heater No. 432 has an inside diameter of shell of 21 inches, an over-all length of 69¾ inches, and weighs approximately 3100 pounds.

BARKER WRENCHLESS CHUCK

In the accompanying illustration there is shown the Barker wrenchless chuck which is made according to the design of W. A. Barker and manufactured by the Foster Machine Co., Elkhart, Ind. Its purpose is to obtain rapidity and ease of operation. The fundamental idea involved in its construction is to transfer movement from a hand-lever equally to each of the jaws regardless of whether the chuck is revolving or at rest. This movement is accomplished by means of the combination of a cam and trunnion levers and a planetary gear system. A slight pressure on the hand-lever is sufficient to release the work from the jaws.

This chuck provides a quick and effective means of gripping the work and affords ample jaw pressure. Accurate rechucking may be obtained, due to freedom from wear on the cam surfaces owing to their rolling action on the trunnion levers. Should it happen that unequal wear occurs on the cam surfaces, the resultant eccentricity of the jaws will be reduced to one-quarter of the wear owing to the ratio of the trunnion levers.

A sub-committee of the Committee on Science and the Arts of the Franklin Institute of the state of Pennsylvania, after fully investigating the merits of the Barker wrenchless chuck recommended the award of the Howard N. Potts gold medal to the inventor of this device, Wendell Addison Barker, in recognition of the improvements embodied in the chuck and its successful use on a large scale. This award was made on July 22.

In this connection a test made at the Fairbanks Co. in Philadelphia showed the following results: A piece of 35-point carbon steel forging 7 inches in diameter by 4½ inches long with a 3⅞-inch hole ⅜ inch out of center was mounted in a 12-inch, three-jaw Barker chuck. The hand-lever was tightly pulled down. Each jaw had a gripping surface of ½ inch. Three cuts were made at the same time with a feed of 0.008 inch

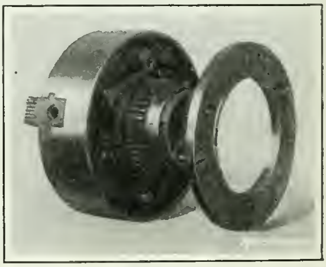
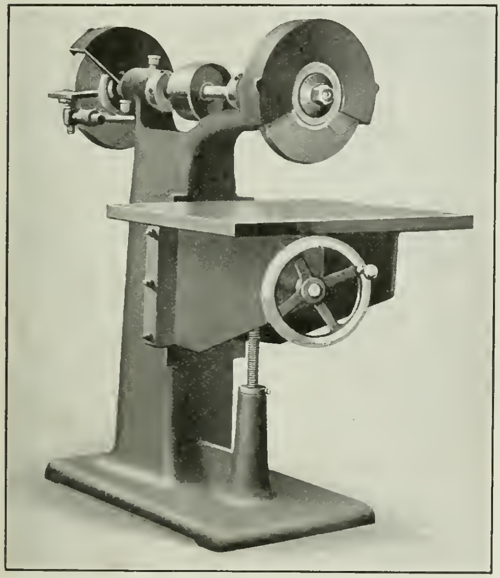


Fig. 2. Mechanism of the Barker Wrenchless Chuck

toward the headstock, at 30 revolutions per minute. A cut of ⅜ inch in depth was made by the first tool; a second tool at 1 inch distance from the cutting edge of the first tool made a cut of ½ inch in depth; the third tool cut the hole to 5⅝ inches in diameter, cutting ¼ inch on one side and ⅝ inch on the other. The chuck held the work without difficulty.

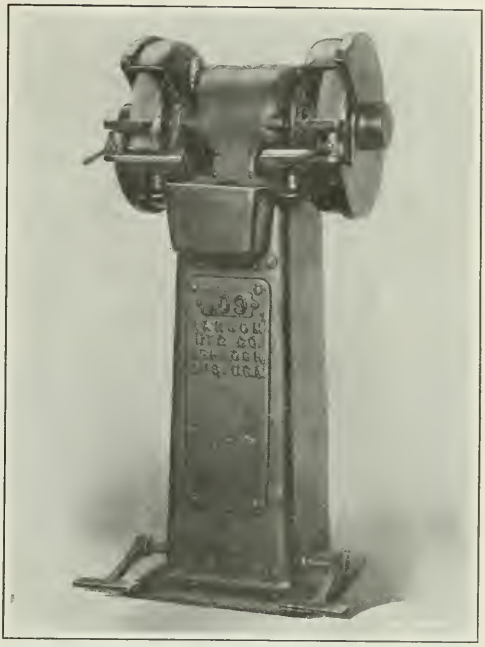
COMBINATION SURFACE AND PLAIN GRINDER

The Johnson & Biddle Tool Co., 312-314 N. Main St., Elkhart, Ind., is building the combination surface and plain grinding machine shown in the accompanying illustration. This machine weighs 600 pounds and has a capacity of 12 inches from wheel to column. The maximum distance from the wheel to the surface of the table is 10½ inches. Two 12-inch by 1¼-inch wheels are mounted on the spindle which is provided with long bronze bearings that are adjustable for wear and which can be easily replaced when it becomes necessary. The table is raised and lowered by means of the graduated handwheel.


Combination Surface and Plain Grinder made by the Johnson & Biddle Tool Co.

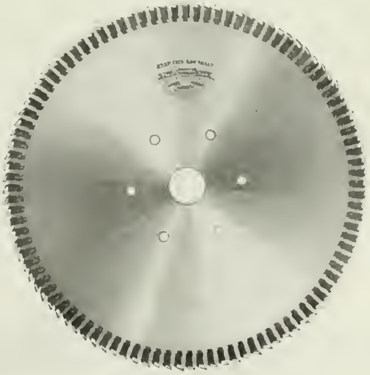
RANSOM TOOL GRINDER

The Ransom Mfg. Co., Oshkosh, Wis., has added to its line of grinding machines a No. 109 ball-bearing motor-driven tool grinder. This machine is equipped with a ¾-horsepower General Electric induction motor, suitable for operation on sixty-cycle two- or three-phase current of any voltage. Two 12- by 1-inch wheels used on the machine are furnished with guards, and the spindle is carried by self-aligning ball bearings mounted in a manner that provides for the exclusion of dirt. A quick make and break oil switch controlled by pedals enables the machine to be started by a light pressure of the foot, these pedals being conveniently located at the ends of the machine, and arranged in such a manner that when the foot pressure is released, the machine stops automatically. This prevents a waste of power by having the machine running when it is not in use. The grinder occupies a floor space of 17 by 17 inches, and its weight, as shown in the illustration, is 480 pounds.


No. 109 Tool Grinder built by the Ransom Mfg. Co.

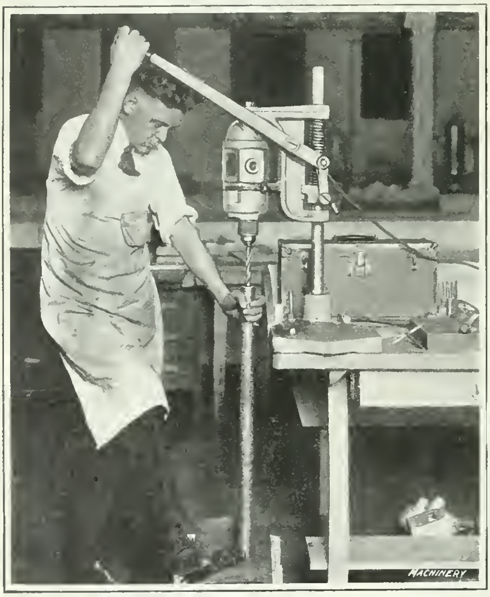
SIMONDS INSERTED-TOOTH METAL SAW

The inserted-tooth metal saw shown in the accompanying illustration has been recently placed on the market by the Simonds Mfg. Co., Fitchburg, Mass. This saw is designated as No. 000, and was especially designed to meet the requirements for cutting structural iron, I-beams, channels, and stock having thin walls, which could not be as efficiently cut with saws of ordinary design in which the pitch or spacing of the teeth is too coarse. This new saw, having closely spaced teeth, provides smooth running qualities and eliminates chatter. The saws are made in sizes from 10 inches in diameter with a kerf of ¼ inch and a maximum of 40 teeth up to 40 inches in diameter with a 15/32-inch kerf and a maximum of 210 teeth.


Simonds No. 000 Metal Saw for cutting Structural Iron and Stock having Thin Walls

BENCH DRILLING STAND FOR PORTABLE ELECTRIC DRILLS

A bench drilling stand designed for supporting portable electric drills has recently been placed on the market by the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. With this stand, the Black & Decker portable drills of the pistol grip and trigger switch type are readily adapted for use as a drilling machine. The bracket carrying the drill can be raised or lowered on the vertical column, and it is secured in any desired position by means of a split collar and clamping screw. The drill may be swung clear of the base for performing drilling operations such as those that are required in assembling ring gears on automobile axles, drilling the ends of shafts, and other work which is too long to be drilled on the bench. Both vertical and horizontal adjustment is secured by means of the clamping screws, and the drill can be swung through a complete circle about the vertical stand.



Black & Decker Bench Drilling Stand

The feed-lever has a leverage ratio of 6 to 1, so that a pressure of 100 pounds applied to the handle will feed the drill into the work under a pressure of 600 pounds. The base has six tapped holes to accommodate ½-inch studs which may be used to clamp the work in place. The base is also provided with four holes for fastening the stand to the bench. The stand is shipped complete with an adapter block to take various different sizes and types of Black & Decker drills. The dimensions of the stand are: Height, 30 inches; vertical adjustment of drill, 12 inches; distance from center of drill spindle to circumference of vertical column, 7 inches; vertical travel of drill when operated by feed-lever, 4 inches. The net weight of the machine is 70 pounds.

NEW MACHINERY AND TOOLS NOTES

Oil Filtering and Sterlizing System: S. F. Bowser & Co., Fort Wayne, Ind. A filter and sterilizer which automatically removes foreign matter and sterilizes the cutting oils.

Knurling Tool: Newman Mfg. Co., 717 Sycamore St., Cincinnati, Ohio. A knurling tool having upper and lower knurling wheels which bear on opposite sides of the work so that the tool centers automatically.

Tool Grinder: United Sates Tool Co., 3160 W. 106th St., Cincinnati, Ohio. A self-contained motor-driven tool grinder equipped with a five-horsepower direct-current, adjustable-speed, 230-volt motor which gives a speed of from 1120 to 1600 revolutions per minute.

Light Fixture Cleaner: Associated Engineers Co., Chicago, Ill. A device which cleans the lamp and shade of electric lamps each time the light is turned on or off by means of two wiping blades, one of which rotates against the interior of the reflector and the other against the lamp bulb.

Electric Melting Pot: Cutler-Hammer Mfg. Co., 50 Church St., New York City. An electrically heated melting pot for melting lead, tin, solder, babbitt, and other soft metals, which is made in 10- and 25-pound portable sizes. A bench type melting pot is also made in three sizes of 50, 100, and 150 pounds capacity.

Steel Bench Legs: Angle Steel Stool Co., Otsego, Mich. Shop bench legs known as "Ot-Steel" bench legs, which are made in various heights and styles. They are so designed that boards of any width may be used for the bench, or if desired heavy planks can be used along the front edge where the wear is most severe.

Optical Pyrometer: Rhode Laboratory Supply Co., 17 Madison Ave., New York City. A portable optical pyrometer for measuring high temperatures, known as the "Wedge" optical pyrometer, which can be used for determining any temperature above 525 degrees C. The actual temperature is read on a scale attached to the side of the instrument.

Calorizor: Mahr Mfg. Co., Minneapolis, Minn. A combination of oil atomizer and gasification and combustion chambers for attachment to industrial furnaces, intended for handling any grade of oil or gas. The machines are built in two types and three sizes having oil consumption capacities for the straight type of 5, 8, or 12 gallons per hour, and for the angle type of 4, 7, or 10 gallons per hour.

Heat-treating Furnace: Advance Furnace & Engineering Co., Springfield, Mass. An automatic "moving-floor" heat-treating furnace in which the material to be treated is carried first through a preheating chamber, which uses the waste gases of the heating chamber, and then through the heating chamber to the outlet of the furnace where it automatically dumps the material into the quenching tank.

Portable Grinding Machine: Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. A portable grinding machine known as Type 2 UA. This machine can be adapted for either internal or external grinding. Spindle extensions of 5, 10, or 15 inches in length may be attached for internal grinding. The motor is of ¼ horsepower, and the total weight of the machine without equipment is 25 pounds.

Lathe Grinding Attachment: Société pour l'Industrie Mecanique, Basle, Switzerland, with temporary offices established at 2632 Equitable Bldg., 120 Broadway, New York City. An attachment intended chiefly for use on a lathe, which is so arranged as to carry the grinding wheel at any desired angle. It is equipped with its own driving motor and is intended for both external and internal grinding operations.

Furnace: American Metallurgical Corporation, Franklin Trust Bldg., Philadelphia, Pa. An automatic conveyor furnace known as the "Amco," in which the conveying hearth never leaves the furnace. The material is moved along in stages under automatic control. A clock-mechanism timing device can be set so that each step can be varied to meet the requirements for heating such work as crankshafts and camshafts, axles, frames, and tubes.

Melting Furnace: Monarch Engineering & Mfg. Co., Baltimore, Md. A revolving non-crucible melting furnace, which is a direct development of the Simplex type of furnace manufactured by this company. The new model differs in that continuous rotary motion is provided by a motor. The burner is at one end, and the charging and skimming takes place at the other end. The capacity for melting is approximately 750 pounds of metal per hour.

Lift Truck: Stuebing Truck Co., 312 East Court St., Cincinnati, Ohio. A number of improvements have been made in the lift truck manufactured by this company. A new platform stop designed to prevent injury to both goods and truck has been provided, and the hydraulic hoisting device has been equipped with an improved type of valve which permits the truck to be lowered quickly when unloaded, or at a slow speed to insure safety when heavily loaded.

Hand Vise: Newman Mfg. Co., 717 Sycamore St., Cincinnati, Ohio. A hand vise for holding small parts, which is intended especially for the use of tool and jig makers, diesinkers, and machinists. By operating a lever, three gears are rotated in unison which cause the jaws to open or close

A ball socket in the base permits the vise to be held in any position. The length over all is 9½ inches, the width of jaws 1 inch, and the maximum opening between jaws 2¼ inches.

Machine Vise: Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City. A three-jaw vise known as the "Fixie," which is designed for holding pieces of irregular shape while machining. This vise is adapted for use in the tool-room as well as for quantity production work. All three jaws can be swiveled independently of each other and can be fixed in the required positions. The device is made in sizes having maximum openings between the jaws of 4, 6, 9, 12, and 18 inches.

Drilling Machine: Silver Mfg. Co., 385 Broadway, Salem, Ohio. A drilling machine which is an improved type of the 20-inch drilling machine previously manufactured by this company, the principal changes being in the style of the frame and an increase in capacity under the spindle. The spindle is provided with a No. 3 Morse taper hole, and the machine can be supplied with either hand or power feed. It can also be furnished with motor drive and in gangs of either two, three, or four spindles.

Belt Sander: C. Mattison Machine Works, Rockford, Ill. A No. 124 automatic-stroke belt sander which is designed to eliminate hand-stroking by the use of a device which automatically moves the sand belt across the surface being sanded. The levers, pulleys, slides, and other parts connected with the shoe, which is mounted on ball bearings, are made of aluminum. Provision is made whereby the motion of the shoe can be controlled by the operator and the pressure changed to suit requirements.

Turret Lathe: Alfred Herbert, Ltd., Coventry, England, with offices at 54 Dey St., New York City. A turret lathe having the cross-slide, turret, and chuck operated hydraulically by means of cylinders and pistons controlled by conveniently located valves. This machine was designed to be operated by men who were disabled in the war. A minimum air pressure of 75 pounds is required to operate the hydraulic cylinders. Individual stops are provided for the turret slide. The swing over the bed is 12 inches, and the machine occupies a floor space of 2 feet by 5 feet 8 inches.

Rivet Forge: Mahr Mfg. Co., Minneapolis, Minn. A No. 16 oil-fuel rivet forge designed for stationary use but furnished with a chain by which it may be lifted and moved by a crane. Either fuel oil or kerosene may be used with the Mahr V-1 type burner. The normal capacity is four hundred, ¾ by 3-inch rivets per hour. Also a No. 12-D hand-portable oil-fuel rivet forge intended especially for shipyard and scaffold work. This forge is composed of two units, the upper containing the forge and tank while the lower unit consists of a stand arranged with tray and rivet bin.

Turret Lathe: W. K. Millholland Machine Co., Indianapolis, Ind. A geared-head turret lathe especially designed for production work. Four spindle speeds are obtainable. Eight feed changes are available through the feed-box, and adjustable stops are provided for automatically tripping the feed. The stops operate automatically for each position of the turret, and when adjusted for the length of each cut may be locked in position. The machine is built in three sizes, Nos. 3, 4, and 6, to swing work 6, 6¾, and 8 inches in diameter over the turret slide and 16½, 18¾, and 21¾ inches, respectively over the bed.

Drill Jig: Automatic Drill Tool Co., 549 W. Washington Blvd., Chicago, Ill. A semi-automatic drill jig sold under the trade name "Adjusto," which has been designed for use in drilling small steel and brass parts up to 1 inch in diameter that are required to be drilled in jigs on high-speed drilling machines. The drill jig automatically clamps the part, trips and returns the spindle of the press when the proper depth is reached, and then unclamps and ejects the part. All these functions including the feeding of the drill are operated by a foot-lever connected with an operating rod in the jig so that the operator's hands are free for handling the parts.

Plate Milling Machine: Marshalltown Mfg. Co., Marshalltown, Iowa. A plate milling machine intended for beveling and squaring the edges of boiler plates up to 1 inch in thickness. Curves can also be milled. A five-horsepower motor mounted on the head drives both the spindle and feed mechanism. Both a friction slip and a quick return are provided in the feed mechanism. An inserted-tooth cutter, 8½ by 2½ inches, is used, the end thrust on the spindle being taken by ball bearings. A spindle traverse of 2 inches provides for milling offset edges. Rollers are provided on both sides of the cutter for holding down the work. The machine is built in four sizes with capacities for milling sheets 8, 12, 16, and 24 feet in length.

Portable Shaper: Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass. A portable shaper designed primarily for drop-forge work such as replaning and truing up drop-hammer die slots, rams, bases, and columns, but which can be used also to replane vees in rams and guides and similar work. The shaper is made in two sizes. The small size is built to plane any part of a surface 48 by 48 inches, and the head has a vertical travel of 8 inches. The large size planer is adapted for planing a surface 66 by 66 inches and the head has a vertical movement of 8 inches. The machines can be adjusted to 15 degrees each side of the vertical and may be set to any required angle horizontally. A three-horsepower electric motor which drives the machine is installed at one end of the bridge.

Countersinking Machine: Langelier Mfg. Co., Arlington, Cranston, R. I. A two-spindle opposed countersinking machine designed for simultaneously countersinking both ends of a pin. Each drilling head has a high-speed spindle driven by a single belt at 2000 revolutions per minute. The spindles run in adjustable phosphor-bronze bearings. The spindle pulleys run on two radial ball bearings mounted on stationary sleeves anchored in the drill head casting, so that pulling strains on the spindle are eliminated. The cutting lubricant flows only when actual countersinking is in progress and is filtered before it returns to the pump for recirculation. The work is released from the jig either by a hand- or a foot-lever, and is held between two jig heads which have beveled bushings adapted for holding pins of various diameters. Drills up to ⅜ inch in diameter can be used, and the machine will handle pieces of a minimum length of 1 5/16 inches and a maximum length of 4½ inches, and minimum and maximum diameters of ⅝ and 15/16 inch, respectively.

* * *

ALUMINUM AUTOMOBILE PISTONS

Aluminum automobile pistons require more careful handling and fitting than cast-iron ones, but there is no doubt that they can be used with satisfaction if the designer and manufacturer observe the following fundamental principles: (1) Careful attention should be given to the oiling system to prevent an excessive amount of oil being fed into the cylinder; (2) the cylinder walls should be finished smooth and round and should be so constructed that they will remain round as they are being worn; (3) the piston, while being finished, should be held within close limits as to the diameter and the clearance allowed when in the cylinder, (4) the piston should have satisfactory bearing surfaces, the wrist-pin bosses should be properly located and supported, and there should be no superfluous ribs or uneven sections to cause distortion.

Aluminum alloys have a greater coefficiency of expansion than cast iron; therefore the maximum size that a piston may reach under operating conditions must be considered, and the size of the piston when cold held accurately to a given figure. The tolerance given the production department should be such as to make the piston smaller rather than larger; however, if the tolerance is too great, a tendency toward piston slap will result. Nevertheless, aluminum pistons can be fitted sufficiently free to allow the running of the engine without piston slap, at any speed within the driving range of the car. Attention is called to the extremely desirable thermal qualities of aluminum pistons. The pistons used in the Liberty engines, when finished, weighed approximately three pounds; if cast-iron pistons had been provided, containing the same capacity for heat conductivity as the three-pound pistons, the cast-iron pistons would have weighed over 22 pounds.

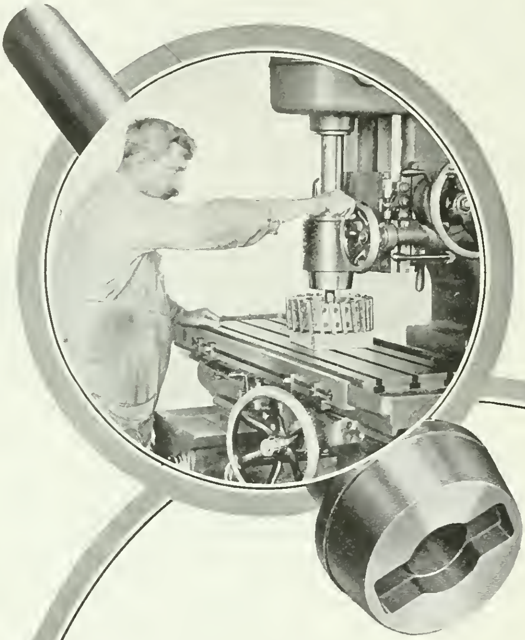
This statement can be quickly checked by the fact that heat conductivity is a question of volume rather than of weight and that aluminum has at least three times the heat conductivity properties of cast iron. A cast-iron piston, therefore, to have the same capacity for heat dissipation as one of aluminum, would have three times the volume of metal, which, if cast iron weighed the same as aluminum, would necessitate a 9-pound piston. Since cast iron weighs over 2½ times more than aluminum, it is obvious that a cast-iron piston having the same thermal qualities, would have weighed more than 22 pounds.

* * *

BRITISH EXHIBITIONS PLANNED AT OLYMPIA

The British Society of Motor Manufacturers and Traders, Ltd., has announced that a commercial vehicle exhibition will be held at Olympia (London) October 15 to 23; an automobile exhibition, November 5 to 13; and an international motor boat and marine and stationary engine exhibition, March 11 to 23, 1921

Brown &
Vertical
Milling

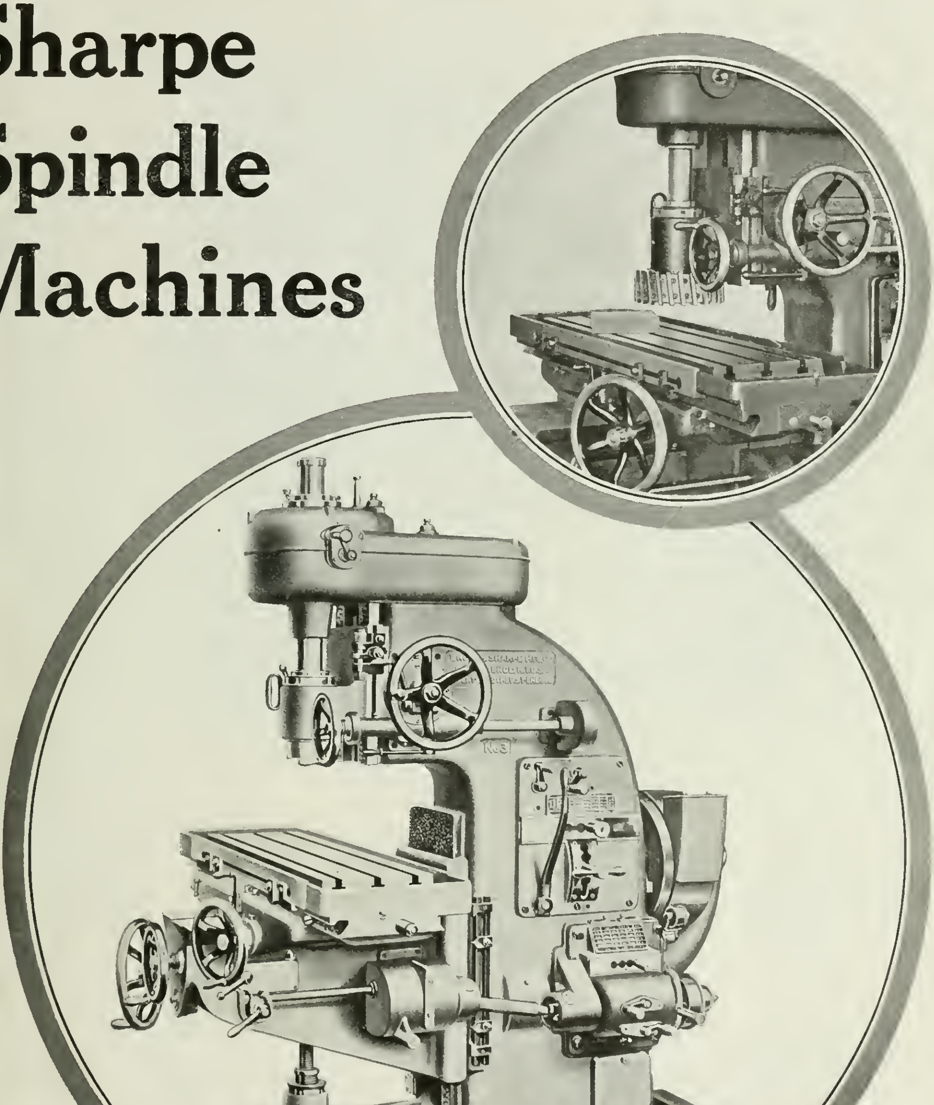


The
Taper Nose
Spindle

assures a positive cutter drive under all conditions. The front end of spindle is tapered, hardened and ground and has a recess to receive cutter driver and clutch on arbors and collets. The ease with which face milling cutters are removed and replaced is particularly noteworthy—simply place cutter on table, lower spindle until nose enters cutter, as shown in the illustration and tighten drawing-in bolt. There are no plates, screws or loose parts used and when arbor, collet or cutter is in place it is essentially as firm as though a part of the spindle itself. This is one of the many outstanding features of Brown & Sharpe Milling Machines. For further information send for our Milling Machine Book.

Brown & Sharpe Mfg. Co.
Providence, R. I.,
U. S. A.

Sharpe Spindle Machines



Federated American Engineering Societies

As referred to in the July number of Machinery, an organization has been formed for the purpose of representing the entire engineering profession of the United States, the object of this organization being to provide means for the consideration of matters of common concern to engineers, as well as of matters of public welfare in which the engineering profession is interested. The organization will also furnish means whereby united action may be taken on public questions where the service of the engineer may prove of value. It is not intended that this organization shall in any way replace the present engineering societies, nor is it intended that engineers individually shall become members of the Federated Engineering Societies; but on the other hand, members in this organization are the societies themselves.

Fundamental Principles of Organization

Delegates representing sixty-one national and local engineering and technical societies from all parts of the United States attended the conference held in Washington, D. C., June 3 and 4 for the purpose of creating an affiliation of engineering societies to be known as the Federated American Engineering Societies. Among the societies represented were the leading national engineering bodies, such as the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, and many others.

The management of the new organization consists of a body known as the American Engineering Council, which acts through an executive board created by the council. Each member-society is entitled to one representative on the council for a membership of from 100 to 1000 inclusive, and to one additional representative for every additional 1000 members or major fraction thereof; but it is provided that no organization can have more than twenty members on the council.

The first meeting of the American Engineering Council, the governing body of the Federated American Engineering Societies, will be held at the New Willard Hotel, Washing, D. C., November 18 to 20. All engineering societies not yet members of the new organization are invited to join and to send representatives to the meeting of the council. The organization of the Federated American Engineering Societies is considered the most important step taken by the engineering profession since the formation of the large national engineering societies. The potential power for valuable civic service that the new organization will have is beyond question, and it deserves the support of all engineering societies, national or local, throughout the United States.

First Meeting of the American Engineering Council

The first meeting of the American Engineering Council of the Federated American Engineering Societies will be held at the New Willard Hotel, Washington, D. C., November 18 to 20. A complete program has been outlined, beginning with registration at 8:30 A. M. of the first day, November 18, followed at 10 A. M. by the opening session. At 2 P. M. an address will be made by J. Parke Channing of New York City on the "Engineering Council." This address will be followed by a discussion of the field of activity for the Federated American Engineering Societies.

Friday, November 19, the morning session beginning at 9 A. M., will be a business session devoted mainly to reports of committees and election of officers; an afternoon session will also be held, devoted mainly to reports. At the evening session at 8:30 P. M. there will be an address by Herbert C. Hoover, president of the American Institute of Mining and Metallurgical Engineers, after which there will be an informal reception and smoker. Saturday morning, November 20, there will be an organization meeting of the executive board of the Engineering Council.

Field of Activity of the Federated American Engineering Societies

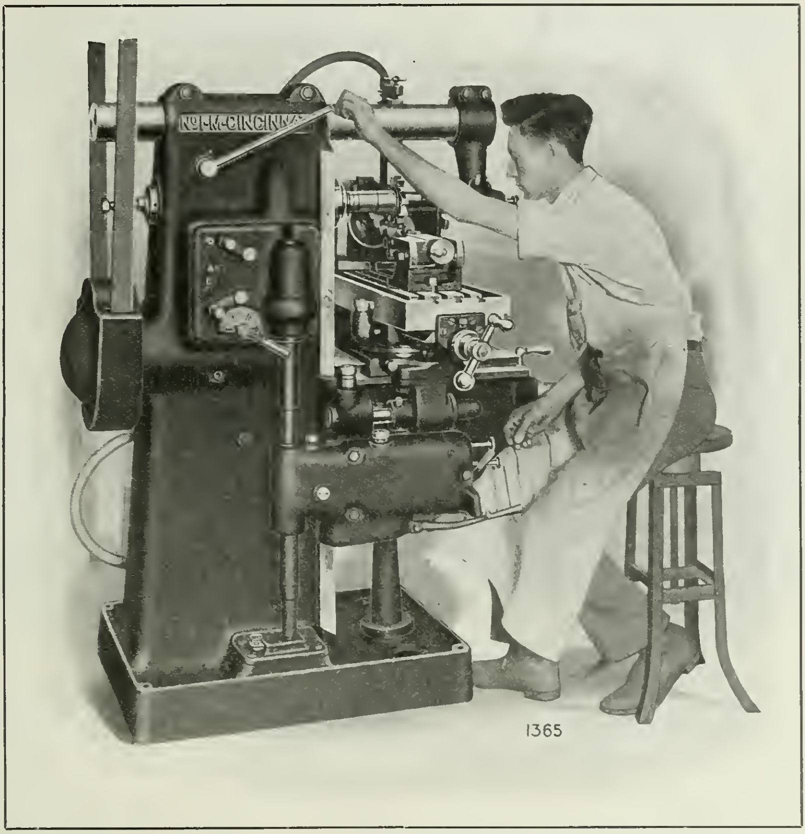
At least 90 per cent of the money spent by the federal, state, and municipal branches of the Government is spent in one way or another for engineering work—for work that is or should be directed and carried out by engineers. The war made it clearer than ever before that our security and independence rests primarily upon the capacity of the engineering profession. Statesmen and military men alike were helpless without the aid of the engineer to furnish the means wherewith the war could be prosecuted; but the services of the engineer in time of peace can be made even more important than in time of war. It is the purpose of the Federated Engineering Societies to use the power that it derives from representing over 100,000 engineers—and ultimately probably 200,000 such men—for the service of the community, state, and nation in public affairs, whenever engineering experience and technical knowledge are involved. The engineer has been too much in the background. The time will come when he will take a leading part in the affairs of the nation, and it is to further this end that the Federated American Engineering Societies has been formed.

With an advance and development of our civilization, which may well be termed an engineering civilization as compared with the civilizations of the past, there will be an increasing number of questions arising in which the opinions of the engineering profession will be of fundamental value to the welfare of the nation. The new organization will speak for a group of men who by reason of special training and knowledge represent a high order of organizing ability and intelligence, and who individually and collectively are capable of materially aiding the solution of many of the great problems that are facing the nation as a result of disorganized conditions due to the world war. It is therefore an unusually appropriate time for the engineering societies to join at this moment in a common organization; and it is likely that as the years pass, it will become evident that if the nation avails itself more regularly of the services of engineers, it can accomplish in peace times as remarkable results as were produced in time of stress during the war.

Invitations have been issued to all engineering and technical societies to join in the federation, and those societies who have not yet taken action are urged to lend their aid in strengthening the new organization by making it truly representative of all local as well as national engineering bodies.

* * *

The International Harvester Co. has conducted an investigation in one of its plants in an endeavor to find the causes for labor turnover. It was found that much dissatisfaction among new employes was due to the practice of the older workers of discouraging the new men with whom they came in contact. The number of men leaving decreased greatly after precautions had been taken to prevent this.



Who Would Expect it of a Universal?

The new 1M and 2M Cincinnati Universals will take the same heavy cuts with the same quiet ease as the 1M and 2M Plains.

But more important is the story of this picture. The toolmaker easily reaches the starting lever. The feed changes are at his finger tips. Feed changes made while running. The feed trip is arranged to permit engagement of the feed forward or reverse without running off the dogs by hand.

What could be more convenient!

There are other important and significant facts about these new M Type Cincinnati Millers that will interest you.

Ask about them

The Cincinnati Milling Machine Company

CINCINNATI, OHIO, U. S. A.

JAMES HARTNESS NEXT GOVERNOR OF VERMONT

James Hartness, president of the Jones & Lamson Machine Co., Springfield, Vt., received the Republican nomination for governor of Vermont in the primary elections held September 14, running far ahead of the other three contestants. In Vermont the Republican nomination for the governorship is equivalent to election. The platform on which Mr. Hartness appealed to the electors of the state was a constructive and progressive one. It advocated such measures as would develop the industrial resources of the state, and thereby insure the prosperity of the entire population. Two of his opponents were seasoned politicians, and Mr. Hartness' victory at the polls is therefore a distinct tribute to the man. Efforts were made to discredit his industrial platform with the farmers, but the straightforward statements made by Mr. Hartness convinced them that industrial prosperity means prosperity for those engaged in agricultural pursuits as well.

Mr. Hartness will bring a new set of ideas with him into the political atmosphere of Vermont. An unusually clear thinker, and a man of straightforward and honest opinions, he will apply the methods of the engineer rather than those of the politician to the affairs of the state. Doubtless he will meet much opposition from old-line politicians; but, the same indomitable will which insured his great success in the industrial field, will enable him to put into operation the progressive ideas incorporated in his platform.

Mr. Hartness has been equally successful as a business man and as an engineer, having also made a name for himself in the field of science—an unusual combination of ability. If more men of this type were selected by the people for public office, our state and national governments would be administered on business instead of political lines. Mr. Hartness will have the best wishes not only of the whole machine tool industry, but also of the mechanical engineering world in which he is well known, having served in many capacities in the American Society of Mechanical Engineers, and as its president in 1914. It is safe to predict that the record of Mr. Hartness as governor of Vermont will be as notable as his record as engineer, inventor, manufacturer, scientist, and business man.

PERSONALS

Jack Alden has been made foreman of the recently enlarged steel rule die-making department of M. Freedman & Bro., 78 Duane St., New York City.

Alphonse A. Adler has opened an office as consulting engineer at 9 Murray St., New York City, with machine, power, and industrial plant design and research as his specialties.

W. L. Chandler of the Dodge Sales & Engineering Co., Mishawaka, Ind., is a candidate for the presidency of the National Association of Purchasing Agents, the election for which will be held on October 12.

C. H. Smith, formerly of the sales department of the R. D. Nuttall Co., Pittsburg, Pa., is now associated with the Allegheny Gear Works, Chateau and Page Sts., Pittsburg, Pa., in the capacity of sales manager.

J. H. Kreidler, for several years an executive in various automobile plants in the Detroit locality, has joined the sales organization of the J. R. Stone Tool & Supply Co., Detroit, Mich., manufacturer of machine tools and accessories.

C. E. Neubert, assistant district manager of the Warner & Swasey Co.'s Chicago office, has been appointed district manager of the company's Buffalo office located in the Iroquois Building, to succeed W. E. Marshall, former manager, who recently died.

R. W. Thomas has become affiliated with the McCrosky Tool Corporation, Meadville, Pa., in the capacity of publicity manager. Mr. Thomas is a graduate of Harvard University, where he studied the psychology of advertising, and was for some time professor of English in De Pauw University.

Julius Janes, formerly president of the Standard Steel Castings Co., Cleveland, Ohio, has recently made an arrangement with the Farrell-Cheek Steel Foundry Co., of Sandusky, Ohio, according to which he will be the sales representative of this organization in Cleveland and Cuyahoga County.

R. T. Cloyes for the last four years with the Lees-Bradner Co., Cleveland, Ohio, two years as sales manager and the last two years as production manager, has left this company to engage in the gear-cutting and thread milling business. The company that he has formed for this purpose is the Cloyes Gear Works, 7708 Quincy Ave., Cleveland, Ohio.

C. B. Cole, formerly manager of the Chicago store of the Union Twist Drill Co., and previous to that chief tool inspector of the Wright-Martin Aircraft Corporation, Long Island City, N. Y., and New Brunswick, N. J., has become associated with the W. L. Romaine Machinery Co., of Milwaukee, Wis., in the capacity of vice-president and sales manager.

Edward Grossman, formerly of the Jasper Bayne Co., of New York City, is now associated with the T. P. Walls Tool & Supply Co., 25 Leonard St., New York City, in the capacity of sales manager. It is believed that Mr. Grossman's experience will materially add to the service that the company renders in the line of machine shop, mill, and factory supplies.

F. P. Jenkins, for some years with the Brown & Sharpe Mfg. Co., Providence, R. I., and more recently with the Screw Machine Products Corporation of the same city, where he has had charge of tool work including designing, estimating, and supervising, has become superintendent of the Advance Tool Co., of Cincinnati, Ohio, manufacturer of reamers, cutters, jigs, fixtures, etc.

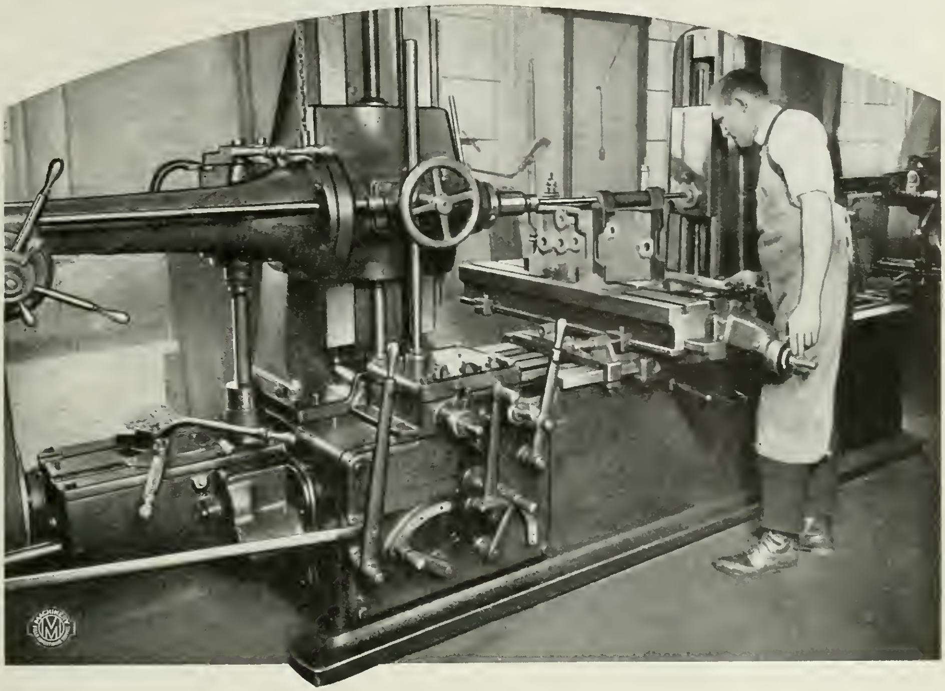
George T. Aitken, for the last year sales manager of the Frontier Chuck & Tool Co., Buffalo, N. Y., and previous to that manager of sales in the Buffalo district for the Syracuse Supply Co., is now manager of sales in the Buffalo district for the Reed-Prentice Co., Becker Milling Machine Co., and the Whitcomb-Blaisdell Machine Tool Co., with offices in the Associated Service Bldg., 256 Main St., Buffalo, N. Y.

A. B. Way, until recently secretary and general manager of the Bridgeport Chain Co., Bridgeport, Conn., has become district sales manager for New England, with headquarters at 150-152 Chamber St., New York City, for the Chain Products Co. of Cleveland, Ohio. For many years prior to his becoming identified with the chain industry, Mr. Way was affiliated with various New England manufacturing enterprises.

Dr. E. F. Northrup has resigned from his professorship at the Princeton University in order to devote his entire time to his work with the Ajax Electrothermic Corporation of Trenton, N. J., manufacturers of the Ajax-Northrup high-frequency induction furnaces. Dr. Northrup has recently been elected vice-president of this company and is now engaged in development work on a brass-melting furnace of the Ajax-Northrup type.

Charles Whiting Baker, for many years editor-in-chief of *Engineering News*, and since 1917 consulting editor of *Engineering News-Record*, has retired from engineering journalism with which he has been so long identified, and has established the Engineering Business Exchange at Hudson Terminal Building, 30 Church St., Room 347, New York City, an agency the purpose of which is to bring together those desiring to sell any sound engineering or technical business—manufacturing, constructing, selling, or professional—and those seeking opportunity to purchase.

L. L. Myers has been appointed general western sales manager of the Burke Electric Co., Erie, Pa. Mr. Myers' headquarters will continue to be in the Illuminating Building, Cleveland, Ohio, where he has been located in the capacity of sales representative for the Burke Electric Co. in



Pratt & Whitney's Boring Machine Equipment Consists Principally of

LUCAS "PRECISION"

Boring, Milling and Drilling Machines

The accompanying photo, which was taken in the tool department of the P. & W. plant, shows a Lucas "Precision" Boring Machine engaged in locating and boring 21 holes, from 9/16″ to 2¼″ diameter, in a box drill jig. Distances from center to center, in this instance, are held within 0.001″ limits; but when necessary a skilled operator makes this machine perform this same class of operation within limits of 0.0002″.

There are seven of these machines in a row in the P. & W. toolroom—all devoted exclusively to manufacturing tools and jigs. Another row in the manufacturing department is an important factor in obtaining the accuracy for which P. & W. tools have long been famous.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS. Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

the Cleveland territory for several years. L. B. Ritchie has been appointed general eastern sales manager, with headquarters at 30 Church St., New York City, where he has been sales representative for the New York territory of the company for some time. The direction of eastern and western sales management was formerly centered at Erie under H. A. Brown, who is no longer associated with the company. The plan of having separate sales managers for the eastern and western territories has become advisable on account of the growth of the company's business, and it is felt that in this way it will be possible to give more efficient service to the customers.

OBITUARIES

Julius C. Hinz, president and general manager of the Bellevue Furnace Co., Detroit, Mich., died at the St. Bartholomew's Hospital, New York City, July 23, at the age of forty-eight years. Mr. Hinz established the Bellevue Furnace Co. eleven years ago. He was previously engaged in the painted china business, and designed many furnaces for this kind of work, and was considered an expert in furnace design and construction.

COMING EVENTS

October 4-9—Convention and exhibit of American Foundrymen's Association at Columbus, Ohio.

October 6-16—Electrical exposition to be held at the Grand Central Palace, Lexington Ave. and 46th St., New York City. Communications relating to the exposition may be directed to the Electrical Show Co., 130 E. 15th St., New York City.

October 11-13—Annual convention of the National Association of Purchasing Agents at Chicago, Ill.; headquarters, Congress Hotel. Secretary, L. F. Boffey, 19 Park Place, New York City.

December 2-3—Nineteenth annual convention of the National Machine Tool Builders' Association in New York City; headquarters, Hotel Astor. General Manager, Charles E. Hildreth, Worcester, Mass.

December 7-10—Annual meeting of the American Society of Mechanical Engineers at 29 W. 39th St. New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Utah, Salt Lake City, Utah. Catalogue containing calendar and announcements for 1920-1921, outline of courses of studies, list of students, etc.

California Polytechnic School, San Luis Obispo, Cal. Bulletin of information for the year 1920-1921, relating to the courses offered and the organization and methods of instruction.

BOOKS AND PAMPHLETS

Naval Consulting Board of the United States. By Lloyd M. Scott. 288 pages, 6 by 9 inches. Published by the Government Printing office, Washington, D. C.

A review of the work of the Board and of the problems handled by it.

Operation and Care of Vehicle-type Batteries. 94 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 92 of the Bureau of Standards. Price, 30 cents.

Saybolt Viscosity of Blends. By Winslow H. Herschel. 21 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 164 of the Bureau of Standards Price, 5 cents.

House Wiring. By Thomas W. Poppe. 208 pages, 4 by 6 inches; 160 illustrations. Published by Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.00.

This is the fourth revised and enlarged edition of a treatise intended primarily for those who are desirous of obtaining a practical knowledge of the installation of electric lighting and power systems. It describes and illustrates methods of installing electric light and power wiring, bell wiring, and burglar alarm wiring. This edition also contains additional chapters on telephone wiring, wiring in concrete construction, conduit bending, and motor wiring

Advertising the Technical Product. By Clifford Alexander Sloan and James David Mooney. 365 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $5.

This volume discusses the principal factors underlying the advertising of technical products, though it is conceded that the subject could not be entirely covered in a book of this size. The authors have pointed out by concrete examples what are considered to be good and bad points in modern advertising. The material is applicable to all advertising, though it is written with especial reference to the advertising of technical products. A brief sketch of the development of technical advertising is given, and examples of early advertisements are reproduced which indicate the great change that has taken place in the character of advertising in recent days. The question of returns is considered, as well as advertising appropriations, and the planning and carrying out of advertising campaigns. The various advertising mediums are discussed, including technical and trade magazines, popular magazines and newspapers, direct mail advertising, catalogues, and house organs. There are chapters on advertising display and on the writing of copy. The appendix of the book presents reproductions of a number of advertisements, picked at random from the technical, trade, and popular magazines, together with criticisms of each made by a sales manager, an advertising manager, a sales engineer, and a purchasing engineer. The book is divided into five parts, treating, respectively, of the General Problem and its Economic Elements; the Instruments Available for Advertising the Technical Product; Technical Advertisements; Advertising Organizations; and Appendix. The treatment of the subjects will best be understood by a list of the chapter headings: Introduction; Advertising the Technical Product; the Economic Problem; the Product; the Market for the Product; Advertising the Product to the Market; the Advertising Appropriation; the Campaign; the Technical and Trade Magazines; the Popular Magazines and Newspapers; Direct Mail Advertising; Prospectuses, Bulletins, Catalogues; House Organs; Educational Work; Advertising Ammunition; Technical Advertising Display; Technical Advertising Copy; the Advertising Department; Advertising Counsel; the Publisher's Service Department; Dealer Corporation; Criticisms of Advertisements; Bibliography; and Index.

NEW CATALOGUES AND CIRCULARS

Nickle Engineering Works, Saginaw, Mich. Bulletin 3-D descriptive of a new type of can-filling machine, adapted for the packaging of dry materials

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular advertising Cleveland punches, dies, rivet sets, chisel blanks, markers, barrel pins, drift pins, etc.

Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. Circular advertising the "Periodograph," for recording the exact amount of time each workman spends on every job.

Lees-Bradner Co., 6212 Carnegie Ave., Cleveland, Ohio. Circular advertising the Lees-Bradner gear-hobbing machine, which employs hobs having straight-sided rack teeth for generating involute gear teeth

Hyatt Roller Bearing Co., Sixth Ave. and 41st St., New York City. Circular advertising Hyatt roller bearings, illustrating their application in motor cars, tractors, traveling cranes, trucks, conveyors, etc.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City. Stock list for September, 1920, of cold-drawn seamless steel tubing in round sizes, square sizes, and odd sizes. A list of short lengths of tubing is also given.

Hobart Bros. Co., Troy, Ohio. Bulletin 91, illustrating and describing the HB ball-bearing motor grinder for grinding castings, sharpening tools, buffing tires, and other uses in machine shops, repair shops, garages, etc.

General Electric Co., Schenectady, N. Y. Bulletin No. 40017A describing small, direct-current generators and exciters, Type ML. Bulletin No. 60011 describing engine-driven continuous current generators of the commutating pole type.

Davis-Bournonville Co., Jersey City, N. J. Circular containing instructions for setting and operating the Davis-Bournonville radiagraph—a portable machine for cutting to straight and curved lines with an oxy-acetylene cutting torch.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Circular descriptive of the "Thor" universal electric drills, which are made in six sizes with capacities for drilling 1/4-, 5/16-, 3/8-, 1/2- and 9/16-inch holes, respectively.

Cleveland Automatic Machine Co., Cleveland, Ohio. Booklet containing general directions for setting up and operating Cleveland Model A motor-driven automatics. The book is intended for the use of operators and is illustrated with halftone engravings which make the instructions very clear.

Expansion Boring Tool Co., Detroit, Mich. Circular illustrating and describing expansion boring tools and reamers, by means of which cutters are under positive screw control and have a practical micrometer adjustment. The bulletin also gives a table of standard sizes of expansion boring-bars and cutters.

Golden Co., 405 Lexington Ave., New York City. Catalogue 261, describing the plain, limit, and standard gages made by the Societe Genevoise d' Instruments de Physique of Geneva, Switzerland. The book also gives tables and diagrams of fits and tolerances for various kinds of work in interchangeable manufacture.

Norton Co., Worcester, Mass. Bulletin entitled "Snagging" treating of the selection, care, and use of snagging wheels of different grains and grades for grinding various materials. The bulletin also gives information on grinding costs and the mounting of wheels, as well as price lists of Norton alundum or crystolon wheels.

Pennsylvania Forge Co., Bridesburg, Philadelphia, Pa. Catalogue No. 23, descriptive of forged and pressed steel die-blocks made from acid open-hearth steel. The catalogue is illustrated with views from the Pennsylvania Forge Co.'s plant and contains descriptions of die-blocks made from different grades of carbon and alloy steels.

Metalwood Mfg. Co., Detroit, Mich. Circular giving operating instructions and specifications for the Metalwood No. 300 hand-operated arbor press, which has a rated working capacity of 15 tons at 2500 pounds. Circular B-38, containing dimensions, prices, and other data for drop-forged steel hydraulic fittings and seamless cold-drawn steel hydraulic tubing.

Van Keuren Co., 362 Cambridge St., Allston Station, Boston, Mass. Circular G-1, descriptive of Van Keuren combination reference gages, which are cylindrical shaped blocks with highly accurate flat measuring surfaces adapted for reference purposes in checking tools and shop gages. Reference is also made to the use of "OK-VK" micro-gages for production requirements.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Bulletin BF entitled "A New Method of Recording Blast Furnace Temperatures," illustrating and describing how blast furnace temperatures are recorded by means of the potentiometer. Actual charts are reproduced showing exactly how the records obtained from the potentiometer appear in practice.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular entitled "Picking Up and Putting Down with a Shepard Monorail Hoist." The circular explains the advantages to be derived from the use of floor-controlled electric monorail hoists for handling heavy work in factories engaged in high-speed production, and shows illustrations of hoists engaged on this class of work.

Boston Scale & Machine Co., 100 Ruggles St., Boston, Mass. Circular describing the 12-inch rotary grinder built by the company. The aim in designing this grinder has been to produce a tool capable of maximum output coupled with convenience of operation and low maintenance cost. The circular gives a complete description of the main features of the machine, and also shows front and rear views.

Norton Co., Worcester, Mass. Circular showing front and rear views, and describing the characteristic features, equipment, etc., of the 12- by 36-inch Type L Norton multipurpose grinding machine. Circular showing front and rear views, describing the characteristic features, and giving specifications covering capacity, dimensions, speeds, etc., of the 10- by 72-inch Type B Norton cylindrical grinding machine.

Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. Bulletin No. 54 describing continuous milling machines, showing illustrations of the use and application of the machines in continuous milling, and giving specifications and table of standard dimensions. Bulletin No. 55 on model V-2 continuous milling machines with specifications, table of standard dimensions, and illustrations of application.

Royal Manufacturing Co., Rahway, N. J. Booklet entitled "Clean Clean Thru," containing interesting information relating to cotton waste. The purpose of the book is to familiarize the mechanical trades with a few of the intricacies associated with cotton waste in the making and in the buying. The booklet is illustrated with halftone engravings showing clearly step by step the methods by which cotton waste is manufactured in the company's plant.

Oesterlein Machine Co., Cincinnati, Ohio. Bulletin B, illustrating and describing the mechanical features of the 40-inch Ohio tilted rotary milling machine, which may be used either for continuous or station milling, though the latter is its principal field of application. A number of fixtures of the hand-clamping and compressed air-operating type, used for station milling, are illustrated, and in each case data are given covering the speeds and feeds employed, and the rate of output obtained.

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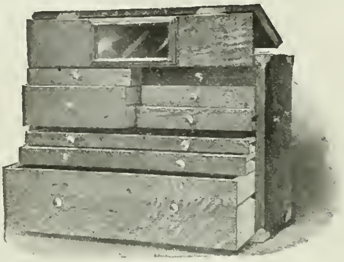

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Chicago Belting Co., 127 N. Green St., Chicago, Ill. Booklet entitled "Practical Information on the Use and Care of Leather Belting," containing many valuable pointers relating to the care of leather belting in order to insure satisfactory service and long life; rules for calculating horsepower, width and speed of leather belting; horsepower table; rules for calculating length of belting; size and speed of pulleys; methods of belt lacing; and other information valuable to belt users.

Anderson Bros. Mfg. Co., Rockford, Ill. Catalogue illustrating and describing the construction and use of the Anderson pneumatic scraper which may be applied to all classes of scraping operations in machine construction. The catalogue also illustrates and describes the turntables furnished as regular equipment with the stationary and small portable scrapers when desired. The halftone illustrations in this catalogue show clearly the many different applications of the pneumatic scraper.

Driver-Harris Co., Harrison, N. J. Bulletin N-21, entitled "Nichrome," illustrating and describing modern heat-treating containers, including carbonizing boxes and pots, lead tempering pots, cyanide and salt pots, tubular retorts, annealing pots, furnace muffles, pyrometer protection tubes, furnace floors, parts for continuous operation furnaces, dipping baskets, and parts for glass making machinery. The bulletin calls attention to the advantages gained by the use of cast nichrome containers, and gives information relating to nichrome and its uses, together with a list of the stock patterns of boxes and containers for heat-treatment made from this alloy.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Circular describing combination conduit bodies for exposed wiring, known as "Spraguelets." Circular entitled "The Universal Key," which comprises a quick cross-reference for matching any standard wiring device to any desired box and cover. The key gives the catalogue number of the device to be used and a symbol designating the proper box and cover for the various devices. These symbols are arranged under the names of different manufacturers of wiring devices, which are classified alphabetically. The boxes corresponding to the symbols are shown on the wings of the pamphlet.

General Electric Co., Schenectady, N. Y. Bulletin 41311, treating of synchronous condensers and their use for power-factor correction and power-factor control. Bulletin 48704 A, discussing G-E insulating compounds, including varnishes, japans, oils, stickers and shellacs, paints, and sealing compounds. Bulletin 48715, dealing with G-E insulating fabrics, including treated cloths, fibers and papers, insulating tapes, varnished cloth tapes, cotton tapes, asbestos tapes, friction and splicing tapes, cords and twines, and sleevings. The bulletin contains an especially prepared list of standard materials with a brief description of each, designed to assist customers in selecting the material they need.

Van Dorn Electric Tool Co., Cleveland, Ohio. Bulletin describing improved heavy-duty ball bearing electric grinders and buffers. The bulletin gives general specifications of the pedestal and bench grinders built by the company, illustrates graphically the various improvements that have been made in these machines, and shows by large halftone illustrations the exact design and construction of the different types. Specifications are given for one-horsepower floor grinder for two guarded wheels, one-horsepower floor grinder for one guarded wheel and left-hand extension for brush, one-horsepower floor type machine with buffer or grinder extension on both ends, one-horsepower bench grinder for two guarded wheels, and one-horsepower aerial grinder.

Driver-Harris Co., Harrison, N. J. Booklet entitled "Case Carbonizing," giving a complete outline of the methods used in case carbonizing or casehardening. The book is divided into eight chapters, as follows: Case Carbonizing; Cyanide Hardening; Gas Hardening; Lead Tempering and Hardening; Carbonizing Containers; Nichrome—Commercial and Technical Data; Cast Nichrome Containers; and Commercial Methods for Using Nichrome Castings. It also contains an appendix devoted to carbonizing boxes and dealing particularly with the nichrome boxes made by the Driver-Harris Co. These boxes are now made in a wide variety of standard stock patterns and sizes, the dimensions of which are given in the appendix together with drawings of the boxes and containers.

Joseph T. Ryerson & Son, Chicago, Ill. Bulletin entitled "Machinery Quarterly." This is the first of a series of bulletins which will be issued quarterly as the machinery and tool section of the Ryerson Steel Service Book. This publication is not intended as a complete machinery catalogue, but places before machinery users condensed descriptive matter covering the line of equipment manufactured and handled by Joseph T. Ryerson & Son. The book contains sixty-four pages, and illustrates and describes a great variety of lathes, planers, shapers, drilling machines, milling machines, grinding machines, drill grinders, power hammers, sawing and cutting-off machinery, power presses, punching and shearing machinery, bending rolls, pipe cutting machinery, welding and cutting machinery and outfits, etc.

Edwin Harrington, Son & Co., Inc., Philadelphia, Pa. Bulletins No. 76, on No. 40-A multiple-spindle drilling machine; No. 77, on No. 15, 16 and 17 multiple drilling machines; No. 78, on No. 15, 16 and 17 multiple drilling machines with special frames; No. 79, on No. 41-A, B and C multiple-spindle drilling machines; No. 80, on No. 51-A, B and C multiple-spindle drilling machines; No. 81, on No. 51-D and E multiple-spindle drilling machines; No. 82, on No. 61-B and C multiple-spindle drilling machines; No. 83, on No. 62-F and G multiple-spindle drilling machines; No. 84, on No. 62-A, 63-A and 63-B multiple-spindle drilling machines; No. 85, on No. 72-A and 72-B multiple-spindle drilling machines; No. 86, on horizontal multiple-spindle drilling machines; No. 87, on rotary top tables; No. 88, on No. 130 horizontal drilling machines; and No. 89, on No. 32 radial-rail drilling machine.

TRADE NOTES

Toledo Milling Machine Co., Toledo, Ohio, is now in full operation in its new Summit Ave. factory, producing high-duty vertical milling machines.

Shaw Mfg. Co., Lynn, Mass., would like to receive catalogues of automatic machinery, turret lathes, drilling machines, and machinery suitable for manufacturing small metal products.

Stewart Mfg. Corporation, 4500 Fullerton Ave., Chicago, Ill., manufacturer of bronze-back bearings and die-castings, has opened a branch office in New York City, at 30 Church St., in charge of Louis Ruprecht.

Wade-American Tool Co., Waltham, Mass., manufacturer of precision bench machines, tools, gages, dies, and fixtures, announces that its office and works are now located in its new building at 49-59 River St.

A/B Machinery O/Y, Abo, Finland, distributors of machinery, machine tools, and supplies, announce that they have closed their American office, and that the affairs of the company hereafter will be handled from the home office in Finland.

Boynton & Raleigh, 166 Rosewood Terrace, Rochester, N. Y., is a new firm that has been formed by S. E. Boynton and R. E. Raleigh for the designing of special machinery and tools, and for the planning and organizing of manufacturing plants and their equipment.

Bellevue Industrial Furnace Co., Detroit, Mich., manufacturer of steel-treating furnaces for oil and gas, announces that the present officers of the company are as follows: President, B. F. Drakenfeld, Jr.; vice-president, Walter E. Hinz; secretary and treasurer, C. A. Norman.

Lehmann Machine Co., 514 S. Broadway, St. Louis, Mo., manufacturer of engine lathes, is now located in its new plant at Chateau and Grand Aves. The new shop was designed by Mr. Lehmann and affords 40,000 square feet of floor space. The offices will be located on the second floor.

Isbecque, Todd & Co., 36, rue Otlet, Brussels, Belgium, will in the future be the name of the firm formerly conducted under the name of E. Isbecque & Co. There will be no change whatever in the organization, and the company will be devoted to the selling of American machinery and tools, the same as in the past.

Cloyes Gear Works, 7708 Quincy Ave., Cleveland, Ohio, has been organized by R. T. Cloyes, formerly production manager of Lees-Bradner Co., Cleveland, Ohio. The new concern will specialize in the manufacture of metal and composition gears and will also do job thread milling of all kinds, including precision lead-screws.

George G. Kuenstler, Post box 162, Riga, Latvia, formerly of Moscow, Russia, where he had an engineering office, announces that he has opened an office in Riga under the firm name of George G. Kuenstler, and expects to import machinery of all kinds for the requirements of Latvia and later for the trade with Russia.

Herberts Machinery & Supply Co., Los Angeles, Cal., announces that the company's San Francisco store has just moved into its new location at 140 E. First St. The new store is housed in a two-story building with basement, having approximately 2000 square feet of floor space and erected at a cost of approximately $100,000.

D. C. Oviatt & Co., 401 Garfield Bank Bldg., Cleveland, Ohio, has been organized for the purpose of dealing in used sheet-metal working presses. D. C. Oviatt, manager, was for five years sales engineer for E. W. Bliss Co., Brooklyn, N. Y., and for two years previous was connected with the sales department of Charles A. Strelinger Co., Detroit, Mich.

Simonds Mfg. Co., Fitchburg, Mass., manufacturer of saws, knives and files, announces that following out special plans for general advancement in research work, the company has just completed an addition, 40 by 50 feet, to its research laboratory connected with its steel mills at Lockport, N. Y. Additional equipment, in the form of electrical melting furnace, heating furnaces, etc., has been installed.

Henry Disston & Sons, Inc., Philadelphia, Pa., announce that they will have an exhibit of metal-cutting saws and files of all kinds in building No. 5 at the exhibit of the American Foundrymen's Association at Columbus, Ohio, October 4-9. Power hacksaws and sectional interlocked inserted tooth circular milling saws will be shown in operation. Metal slitting saws, hacksaw blades, screw slotting saws and files will also be exhibited.

Hobart Bros. Co., Troy, Ohio, has added a line of general-purpose ball bearing electric motors to its present line of electrical specialties. The line will consist of motors of 1, 2, 3, 5, 7½, and 10 horsepower, operating on both alternating and direct current. All the motors will be equipped with ball bearings. The company states that the production of electric motors will in no way interfere with its other manufacturing interests.

Pangborn Corporation, Hagerstown, Md., announces that it will have a varied line of equipment on exhibit at the American Foundrymen's Association convention and exhibit at Columbus, Ohio, October 4-9. Among the exhibits of the Pangborn Corporation will be a complete line of sand-blast equipment adaptable for metal cleaning from small parts up to heavy castings; several types of sand-blast barrels; automatic tables; hygienic rotative table cabinets; and auxiliaries for sand-blast equipment.

Fawcus Machine Co., Pittsburg, Pa., manufacturer of herringbone, spur, and worm gears, reduction gear drives, rolling mill machinery, and special heavy machinery, has consolidated all of its departments in its new office building at 2818 Smallman St., adjoining the Pittsburg Works, in order to facilitate the handling of its enlarged business. A downtown office will be maintained in suite 1501, Peoples' Savings Bank Bldg., where its allied company, the Schaffer Engineering & Equipment Co., is located.

Seneca Falls Mfg. Co., 381 Fall St., Seneca Falls, N. Y., manufacturer of lathes, has taken over the O. R. Adams Mfg. Co., Inc., of Rochester, N. Y. The Seneca Falls Mfg. Co. will continue to manufacture the Adams short-cut lathe in addition to its regular lines. Ogden R. Adams will not be connected with the short-cut lathe business in the future, but will give his entire time and interest to his machine tool business at the St. Paul St. store in Rochester. He will, however, handle the Adams short-cut lathe exclusively in the local territory.

Manufacturer's Steel Exchange Co., Naperville, Ill., announces that it is endeavoring to serve manufacturers by acting as a medium for the exchange of structural steel, bar and sheet steel, and bolts, machine screws, and rivets. The company sends out a printed form on which prospective clients may list both their requirements and their surplus stock of these products. Semi-monthly stock lists are made out from these forms. Thus manufacturers can secure material for their needs from those who carry a surplus.

Peerless Surfacing Machine Co., Inc., formerly of Newark, N. J., has been reorganized and is now located at Troy, N. Y. The company manufactures the Peerless belt sanding machines for grinding and polishing a wide variety of materials requiring a smooth flat surface, as well as the Peerless surfacing machines for beveling, squaring or grinding both angles and plane surfaces. The new location will enable the company to produce these machines on a larger scale. E. J. Bein, the inventor of these machines, will remain with the new company as chief engineer.

Acklin Stamping Co., 1657 Dorr St., Toledo, Ohio, announces that plans have been made to build a large fireproof factory to house an enlarged plant which will employ 750 men. The new factory will be erected on Nebraska Ave., near the Lake Shore Crossing, Toledo, Ohio, and the capitalization of the concern is to be increased from $50,000 to $500,000. The lay-out of the buildings includes a warehouse with a capacity of 50,000 tons of steel, punch press departments, annealing furnaces, nickel-plating and galvanizing plants, and electric welding and tool-making departments.

Carroll Foundry & Machine Tool Co., Bucyrus, Ohio, has purchased the business of the Carroll Foundry & Machine Co., for many years engaged in the production of heavy gray iron castings and heavy machine work, and also of the Lambert Machine & Engineering Co., Cleveland, O., builder of the Lambert horizontal boring, milling, and drilling machine. The company has complete equipment and organization for manufacturing the Lambert machine on a large scale. The officers of the new company are O. J. Ashman, Cleveland, president; C. F. Michael, Bucyrus, vice-president; W. E. Matthew, Cleveland, secretary; R. B. Washburn, Cleveland, treasurer; and David Lambert, Cleveland, general manager of the machine tool division.

Reed-Prentice Co., Becker Milling Machine Co., and **Whitcomb-Blaisdell Machine Tool Co.**, whose sales organizations have recently been combined, and whose main offices are located at 53 Franklin St., Boston, Mass., have published a bulletin illustrating and giving specifications for the following products: Reed-Prentice 12-, 14-, 16-, 18-, 20-, 24-, and 27-inch geared-head lathes; Reed-Prentice 12-, 14-, 16-, 18-, 20-, and 24-inch engine lathes; Reed-Prentice automatic lathes; Reed-Prentice 3-, 4-, and 5-foot radial drilling machines; Becker vertical milling machines with rotating table and cone or gear-box drive; Becker universal milling machines; Whitcomb-Blaisdell 20- by 17-, 24- by 24-, 26- by 26-, 30- by 30-, 32- by 32-, 36- by 36-, and 42- by 42-inch planers; and Whitcomb-Blaisdell engine lathes (medium pattern) 16-, 20-, 24-, and 30-inch sizes; (heavy pattern) 14-, 16-, 18-, 20-, and 24-inch sizes.

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It is understood that all contributed articles pertaining to machine shop practice and machine design are submitted exclusively to Machinery; when accepted and published, payment is made at our regular space rates unless other terms have been agreed upon.

FOREIGN MACHINERY MERCHANTS PAGES, 508-509—ADVERTISERS INDEX, 539-540—PRODUCT INDEX, 510-536

The Editor's Talk With MACHINERY'S Readers

THE word "precision" took on a new meaning in the machine-building industries of America when they turned their great organizations and unequalled equipment to the production of war materials. New standards of accuracy and precision had to be set, generally speaking. Conditions in the field of war call for speed and mobility. There is then no time for fitting, trying or adjusting. The units must be right. Every part must be absolutely reliable. Failures and delays are fatal. Precious lives, hundreds, and even thousands of them, depend upon absolute precision and interchangeability. These were extraordinary requirements, unknown and unnecessary in ordinary manufacturing practice; but as soon as our manufacturers learned that great accuracy and precision were demanded, great accuracy and precision were delivered. They rose to the occasion. And it wasn't all plain sailing either, for many of the requirements imposed upon manufacturers by various departments of the government were unnecessary, and refinements that served no practical purpose were often insisted upon. It was a new business for everybody—for the men in the government as well as for the rest of us. The war is over, but some of the lessons it taught were priceless in value.

PRECISION requires gages, and accurate gages require lapping operations. Previous to the war, lapping was used and understood only by a few gage and tool makers. Now it has taken a definite place in machine shop practice, not only in gage making—although that is still the usual application of the process—but lapping is also used for many other operations, a typical example being the final sizing of die-casting dies. To show the many improvements in lapping practice during the past few years, MACHINERY has made a comprehensive review of this interesting practice, and the leading article in November deals with the subject from various angles. The abrasives used and the methods employed in charging laps are described, while the methods employed for lapping thread gages, snap gages, measuring wires, flat surfaces, ring gages, die-casting dies, etc., are explained in detail.

THE need for men adequately trained to fill positions as toolmakers, foremen, and superintendents is still keenly felt by our manufacturers. Under the old-fashioned type of apprenticeship training the boy was taken into the shop and advanced from department to department, getting his training in shop work from the busy foreman, and whatever points he could pick up himself from his fellow workmen. This method fails today to attract enough boys for the future needs of the machine-building industries. To meet the situation, many manufacturing concerns have developed apprenticeship systems along different lines. One, installed by the Taft-Peirce Mfg. Co., Woonsocket, R. I., is described in detail in this number of MACHINERY. This apprenticeship course or school gives the boy, in addition to the shop training, a real mechanical education, and may be looked upon, not as apprenticeship pure and simple, but as a school in which the boy acquires such fundamental knowledge of both the theoretical and practical principles underlying mechanical work that he should be able, eventually, to rise to an executive position of responsibility.

THE difficulties met with in testing gears have led to the design of numerous machines and mechanisms intended to show whether or not the finished gears meet the specifications. One of the most interesting devices for this purpose—used by one of the leading automobile manufacturers in the United States—is illustrated and described in November MACHINERY. The design of this fixture involves some very interesting principles, and experts on gear cutting and gear testing have pronounced it one of the best devices of its kind. Silence in gearing can be produced only by accuracy in the production of gearing, and accuracy can be insured only by proper testing means; hence the importance of devices of this kind.

EACH month MACHINERY has the privilege of recording one or more of the great advances in the field of metal-working machinery. The November number contains a description of an ingenious automatic machine built and developed by Mr. Frederick Muller of the Pratt & Whitney Co., for the production of formed milling cutters with helical flutes, these cutters having been given the trade-name "Curvex" milling cutters. In the past, no method had been evolved whereby formed milling cutters could be produced commercially with helical flutes. The special machinery described is the result of an exhaustive study of the conditions which must be fulfilled in order to manufacture formed milling cutters having helical flutes, and will be of great interest to both machine designers and shop men. Every day marks an advance.

NOVEMBER MACHINERY 1920

Modern Lapping Practice

A Comprehensive Review Covering Recent Developments in Lapping Practice Including the Abrasives Used and Lap-charging Methods

Lapping Thread Gages, Snap Gages, Measuring Wires, Flat Surfaces, Ring Gages, Die-casting Dies, T-slots, etc.—By Edward K. Hammond

Lapping is no longer an art used and understood by only a few gage- and tool-makers; it has taken a definite place in machine shop practice, owing to the increased demand for work of the highest accuracy. One of the most common applications of lapping is in the final operation on various types of gages to obtain their exact size; but the use of laps is no longer restricted to such work. A typical application is for the final sizing of such work as die-casting dies. Therefore, a comprehensive review of this subject, covering recent developments, is an important addition to current literature on machine shop practice.

THE unusual demand for different types of precision gages for handling war work led to the development of numerous improved methods of lapping, and it is the purpose of this article to present a comprehensive review of the most improved practice in performing lapping operations. Laps may be used for increasing the inside diameter of holes or for reducing the outside diameter of cylindrical pieces to the specified size; tools of this type may also be employed on flat surfaces and on pieces of certain other shapes.

The term "lap" is used to denote a tool made of a fine grade of gray cast iron, brass, or some other fairly soft metal, which may be charged with an abrasive to grind the work down to size. Laps made of box wood or hard maple are extensively employed on certain classes of work, especially for imparting a final finish after the work has been brought to size. Various abrasive materials are used for charging laps, among which the aluminous oxide abrasives, alundum, made by the Norton Co., Worcester, Mass., and aloxite, made by the Carborundum Co. of Niagara Falls, N. Y., find the most general application for lapping when rapid cutting is required. Laps charged with diamond dust are also used for this purpose, while emery is the most generally used abrasive for charging laps that are used for imparting a final finish where a high polish is desired.

The form of the lap varies according to the work on which it is to be used. For instance, a lap for increasing the inside diameter of a hole will be of cylindrical form, while a lap for reducing the outside diameter of a cylindrical piece to the required size will have a hole into which the work is inserted. In either case, about 0.002 inch must be allowed on the diameter of the lap to form a clearance space for the abrasive material, which projects out from the surface of the lap.

In order to understand the way in which a lapping operation is performed, it should be borne in mind that the lap is made of soft metal, while the piece to be lapped is usually made of hardened steel. The abrasive will always embed itself in the softer metal, so that the harder the material to be lapped the harder the metal from which the lap may be made. On the other hand, the harder material will often be charged to a certain extent, unless the lap is very soft. For this reason lead and wood are often used in making finishing laps, as they tend to "uncharge" the lapped surface and produce a high polish on the work. On the more accurate grades of work, the harder laps are only used for rough-lapping.

The lapping abrasive is mixed with oil, equal parts of kerosene and lard oil being one mixture that gives satisfactory results. The abrasive and oil are mixed together and then applied to the surface of the lap; and the abrasive gradually becomes embedded in the lap until its entire working surface is completely charged. Either the work or the lap (according to conditions) must be rotated at a number of revolutions per minute which will give a surface speed of approximately 5000 feet per minute. At lower speeds, it is found that an abrasive material will not give satisfactory service in cutting hardened steel. Experience enables the operator to develop a very fine sense of touch, and this faculty is an absolute necessity, because it must be borne in mind that the lapping operation is depended upon to remove a very small fraction of a thousandth of an inch from the diameter of the work, so that the operator must learn to determine where the very slight high spots are located, and continue the lapping at such points until a uniform result is secured

Lapping Fortney "Mini-plug" Gages

The name "mini-plug" has been applied to plug gages made by the Fortney Mfg. Co., 120 Malone Ave., Belleville N. J., owing to the extremely small sizes in which these tools are made. The range runs from 0.007 inch up to 1.000 inch in diameter, and the gages are guaranteed to be accurate within 0.00005 inch. To produce tools of this type within such close limits of accuracy, means that the greatest care must be taken in lapping the work during the process of manufacture. The gages are first reduced to within from 0.0005 inch to 0.00075 inch over size, according to the diameter of the work. A pair of aloxite oilstones is used for this purpose, between which the work is rubbed while it is rotated by power; in using comparatively new stones, powdered aloxite and oil will be found to aid their cutting action

When the micrometer indicates that the work has been brought down close enough to the required size, the lapping operation is started. The gage is chucked in a horizontal spindle machine of the form shown in Fig. 1, and a lap charged with No. 65A aloxite is moved back and forth along the length of the surface to be finished. The machines used for performing these lapping operations are of quite simple construction. They are made of electric motors for sewing machines, built by the Hamilton-Beach Mfg. Co., of Racine, Wis., which have a foot-pedal control for the switch. In equipping these machines for lapping, the driving pulley was removed and a drill chuck mounted on the armature spindle in its place, so that either the cylindrical work or the lap may be held in this chuck, according to whether the inside diameter of the hole or the outside diameter of the work is to be lapped. The operator is able to start or stop rotation of the spindle by means of the pedal control, and the speed of rotation may be regulated within sufficiently close limits by retarding the revolution of the drill chuck with the thumb and index finger.

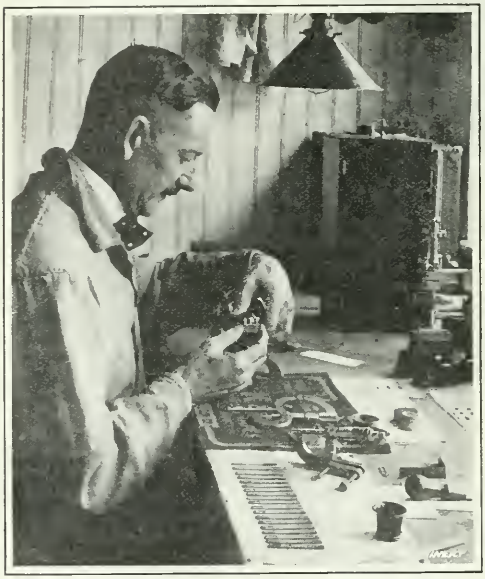


Fig. 1. Reducing the Outside Diameter of a "Mini-plug" Gage in a Lapping Machine

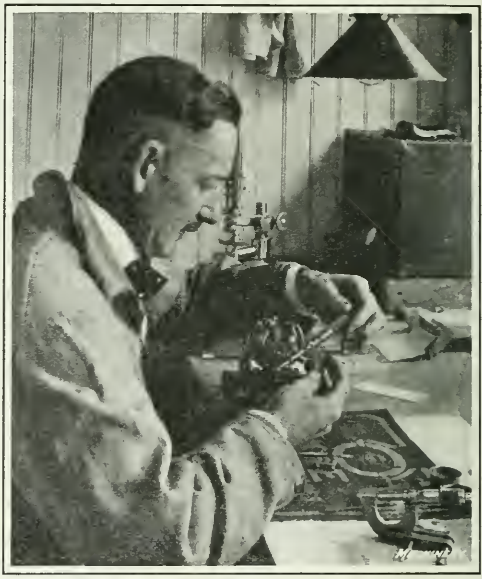


Fig. 2. Measuring Diameter to ascertain where Additional Lapping is Necessary

Making the Laps

For lapping the outside diameter of plug gages and other cylindrical-shaped work, a split lap is used, which is of the form shown at *A* and *B* in Fig. 3. It will be seen that each of these laps has four different openings to provide for lapping work of various diameters. The method of procedure in forming the openings will vary according to the diameter. For holes of considerable size, the easiest method is to clamp the two halves of the lap together, and next drill and ream the hole to slightly less than the required diameter. Then when the hardened piece of work is put between the two halves of this lap, the abrasive will start to "bite back," because the lap is softer than the work. In this way, the size of the opening will be increased; but very soon a quantity of the abrasive will become embedded all the way around the opening in the lap, and from that time on, the action will be reversed so that the abrasive material will grind down the hardened work until the required size has been reached.

The lapping operation is continued until the diameter of the work has been reduced to the specified size, as indicated with a Prestwich fluid gage, Fig. 4, which is used in conjunction with a master plug, the size of which has been verified on a Pratt & Whitney precision measuring machine. For making very small sizes of split laps, it is not feasible to drill and ream the opening. In making such tools, the method of procedure is to use a very thin saw to cut a small impression in the face of each half of the lap, and after this has been done, the work is chucked and the lap applied to it in the usual way. Owing to the back-biting action of the abrasive, to which reference has already been made, the opening in the lap will soon be rounded out to the required shape and size.

From the illustrations of split laps shown at *A* and *B* in Fig. 3, it will be seen that the two halves of the lap are held together by screws, with a nut and washer on each screw to provide for drawing the two halves of the tool inward against the work. At the time the lap is first applied to the work, the diameter of the piece that is being lapped is considerably over size and the two halves of the lap fail to come together; but as the operation approaches completion, the diameter of the work is reduced, and the nuts are accordingly tightened in order that the abrasive may be applied to the work with the necessary amount of pressure. This tightening of the screws is continued until the size of the work has been reduced as much as required. Despite the protection which the abrasive affords against the wearing of the lap, there is a tendency for the size of the opening to increase, and this is offset by occasionally removing metal from the faces of the two halves of the lap which come together at the split. After compensation has been made in this way, the lap has to again adjust itself to the work, until the opening has been brought to the proper size. It is of interest to note that when a new lap is first used, it does not cut very freely, because the abrasive has not become embedded in the lap. While the abrasive is being carried around by the work, it has more of a cutting influence on the lap than on the piece which is being reduced to size. It is only after the abrasive has been embedded, so that it remains stationary while the work revolves, that an efficient cutting action can be expected.

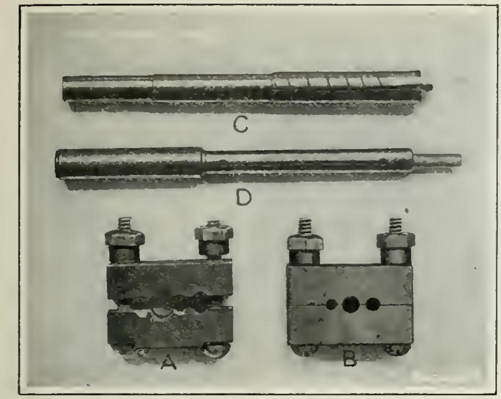


Fig. 3. (A) and (B) Outside-diameter Laps. (C) and (D) Inside-diameter Laps

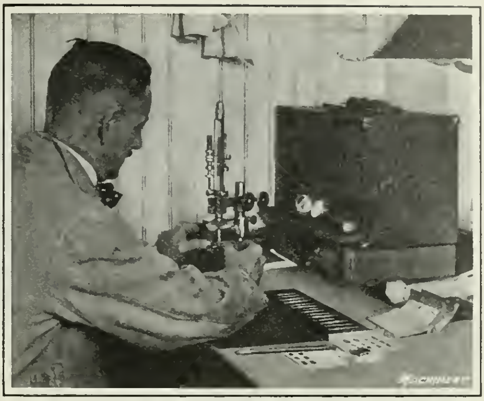


Fig. 4. Checking the Accuracy of Lapped Gages by Means of Prestwich Fluid Gage

Laps for Operating in Holes

At *C* and *D* in Fig. 3, there are shown two types of laps for use in sizing the inside diameter of a ring gage, or any similar piece of work. The principle of operation of both of these laps is the same, although the result is obtained by different methods. It will be evident that the lap shown at *C* is split from the end, so that a small wedge may be driven into the split to provide for expanding the lap as the size of the opening in the work is increased. This lap is made with a spiral groove running around it, of a somewhat similar form to the oil groove in a bearing; and the function of this groove is also the same as that of a bearing oil groove, namely, to assist in distributing the emulsion of oil and abrasive over the surface of the work that is to be lapped. In making a lap of this type, care must be taken to prevent a tendency for the tool to produce a bell-mouthed opening in the work. This is done by turning the body of the lap to a taper of about 0.001 inch, with the small diameter at the open end of the split. With a lap made in this manner, driving in the tapered wedge results in expanding the lap in a way that brings it to approximately a true cylindrical form. But regardless of the amount of care that is taken in making the lap, dependence must still be placed upon the skill and experience of the man who uses the lap to bring the opening in the work accurately to size and to have it of a uniform diameter from end to end.

A certain amount of bell-mouthing is practically inevitable, as the loose abrasive tends to crowd in as the lap passes through the end of the hole; but a slight rounding of the edge is seldom objectionable, as it removes the sharp corner at the end of the hole. However, it is common practice to leave a small lip or hub at the end of a ring gage or similar piece, which is removed after the lapping operation has been completed, in order to remove the bell-mouthed end of the hole.

The lap shown at *D* is designed on the same principle as the one which has just been described, but the method of attaining the result is somewhat different. It will be seen that two transverse holes have been drilled through the body of this lap, and a very fine scroll saw is then used to cut a slot connecting these two holes. Through the end of the lap body, there is an axial hole which has been reamed to a slight taper, and by pushing a tapered pin into this hole, provision is made for expanding the lap as the size of the opening in the work is increased. With a lap of this design expansion results in making the diameter slightly larger at the center, with the size decreasing toward the two ends of the body. The departure from a truly cylindrical form is very slight, and the skill of the operator enables him to produce perfectly accurate work with such a tool. Both of the laps shown at *C* and *D* are made of brass. This material was selected because it is soft enough to become readily charged with the abrasive, and yet it is not as brittle as cast iron. If an attempt were made to produce a lap of this shape from cast iron, the torsional and bending stresses would be very likely to cause the lap to break before it had given a reasonable amount of service.

Lapping Thread Gages

After they have been machined as close as possible to the required dimensions, both male and female thread gages have to be lapped to attain the high degree of precision which is required in tools of this type. A little thought will make it apparent that the lap for working in a female thread gage will consist of a threaded plug charged with suitable abrasive, which is given a reciprocating rotary movement inside the work; similarly, the lap for reducing a male thread gage to size consists of a threaded ring which is screwed back and forth over the gage. There are various methods of applying the required oscillatory rotary movement for handling both of these classes of lapping: but one of the most convenient and efficient means provided for the purpose is a small lapping machine of the type shown in Fig. 5, which is built by the H. E. Harris Engineering Co., of Bridgeport, Conn. It consists of two pulleys loosely mounted on the spindle, which are driven

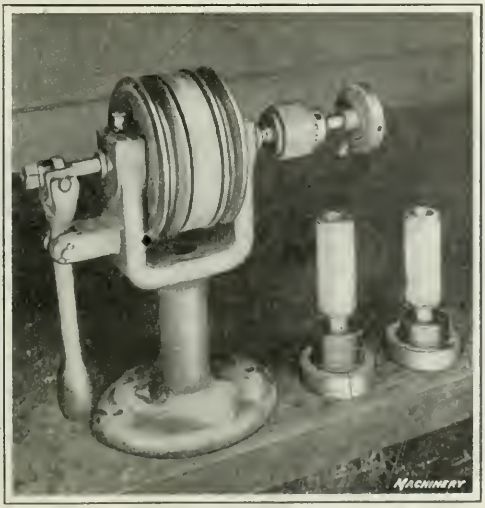


Fig. 5. Machine for lapping Thread Gages, etc.

in opposite directions by an open and a crossed belt. Between these pulleys there is a friction disk keyed to the shaft, and by means of the lever at the left-hand side of the machine, the operator is able to engage the spindle with either the forward or reverse drive.

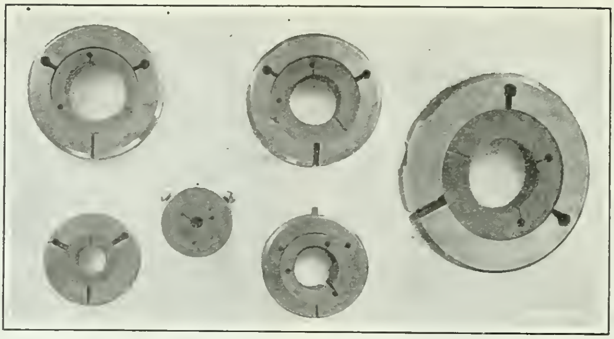


Fig. 6. Thread Gage Laps, showing Split Construction of Lap and Holder to afford Adjustment

A machine of this type can be used for lapping either male or female gages. In the former case, a drill chuck is mounted on the lapping machine spindle and the thread gage is carried by this chuck. The operator holds the clutch lever in his left hand and the lap in his right hand; then it is an easy matter, by constantly reversing the direction of rotation of the spindle, to screw the lap back and forth over the threaded portion of the gage. Exactly the same method of procedure is followed in lapping female gages, except that in this case the lap is mounted in the drill chuck and the gage is held in the operator's hand. The method of performing the operation is identical in both cases. After he has attained the necessary experience and dexterity in using a machine of this kind, the operator will be able to concentrate the action of the lap on that portion of the gage which must be reduced in size, without lapping down adjacent threads which have already been brought to the required dimensions. The machine is mounted on the work-bench at about 8 inches from the forward edge, so that an arm rest is provided on which the workman can support his elbows. In work such as thread gage lapping, it is very important to eliminate the fatigue factor as far as possible, because the results obtained are largely dependent upon the workman's sense of touch, and this will become dulled during the late hours of the day, if he becomes unduly fatigued.

Design of Thread Gage Laps

There is considerable diversity of practice both in making the laps and in selecting the types of abrasives with which they are charged. A brief consideration of this point might lead one to the conclusion that it is strange for two men engaged in lapping thread gages of precisely the same design, and made of the same kind of steel, to be able to attain equally satisfactory results with laps made of different materials and charged with quite different abrasives; but after giving the subject more mature consideration, the reason for such a situation will not be difficult to discover. Obviously, in the performance of an operation like lapping, the personal equation plays an important role, and as one man's sense of touch and method of procedure in doing his work is likely to differ considerably from that of the man working next to him, it is entirely conceivable that differences of practice, both in selecting materials for making the laps and in the choice of abrasives for charging them, may be the means of offsetting such differences of temperament among men employed in the lapping department. During the war, when the H. E. Harris Engineering Co. was engaged in the manufacture of thread gages, it was found good practice to provide each experienced operator with the kind of laps and abrasive materials for which he expressed a preference, and this was particularly true in the case of men who acquired their early training in other plants.

Materials Used in Making Thread Gage Laps

Various materials may be successfully employed for making thread gage laps, some of those which are most commonly used being machine steel, gray cast iron, copper, and brass. As previously stated, laps for operation in female thread gages are plain threaded plugs. Owing to the desirability of providing means of adjustment, laps for use on male thread gages are of slightly different design. Reference to Fig. 6, which shows a number of these tools, will make it apparent that the lap consists of a threaded ring which is split clear through in one place and partially split in two other positions at 120 degrees from the first one. This lap is placed inside of a holder which is similarly split and provided with clamping screws that can be tightened to compress the holder on the outside of the lap, thus causing it to contract sufficiently to compensate for wear. In the case of small sized laps, instead of having the holder split, a practice is made of placing radial screws in the holder, which can be tightened up on the lap ring to produce the same compressive effect that is produced by a different arrangement of clamping screws used on larger sized holders. Adjustment provided in the lap affords a means of regulating its size so that an experienced mechanic is able to tell by the "feel" whether the tool is cutting properly. No attempt is made to obtain any definite relationship between the size of the lap and the finished size of the work, as wear of the tool and breaking down of the abrasive on its surface would make such a condition of only temporary duration. All sizes of holders are knurled on the outside in order to provide a firm grip for the operator.

Abrasives for Charging the Laps

For average conditions of operation it will probably be found that a machine steel lap will give the most favorable results, and it can be charged with either fine diamond dust, carborundum, flour of emery, flour of rouge, or flour of crocus. In any case it is important for the abrasive to be reduced to an impalpable powder which is mixed with oil before

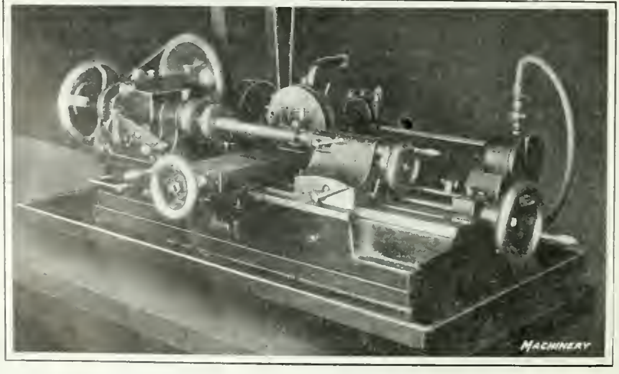


Fig. 7. Precision Lathe equipped with Thread-milling Attachment which is utilized for lapping with a Rotary Lap

using. Some men of wide experience in lapping do not depend upon the fineness of commercial abrasives without subjecting them to a special refining treatment. One good way of preparing the abrasive is to mix it with kerosene oil until the emulsion so produced has about the consistency of milk. After shaking, any coarse particles will settle to the bottom more rapidly than the finer ones; and by allowing the emulsion to stand for a sufficient length of time for the abrasive to settle to the bottom, the fluid can be decanted off. Care is taken to use only a portion of the abrasive taken from the upper layer. In line with the policy of allowing operators to express their preferences for a given type of lap, the H. E. Harris Engineering Co. found that it was also desirable to have each man prepare his own abrasive in order that he might make it of exactly the degree of coarseness with which he had grown familiar.

Rotary Laps for Small Work

Lapping is a modification of the process of grinding, and in order to obtain efficient results, it is necessary for the abrasive material to be passed over the surface of the work at a suitable cutting speed. On small sizes of thread gages, it may be found that the surface to be lapped is so close to the center of the rotation that difficulty is experienced in attaining the necessary surface speed for the lap to provide an efficient cutting action. To overcome this difficulty, the H. E. Harris Engineering Co. adopted the use of rotary laps so that the work and the lap could be revolved in opposite directions, thus greatly increasing the so-called "surface" speed between the abrasive and the work. The lap used for this purpose is a steel disk with its edge formed to fit into the thread of the gage to be lapped. To use a tool of this type, it is necessary to impart a longitudinal feed movement to the lap, as well as to rotate both the lap and the work, so that the lap may follow the thread which it is desired to reduce to size. As in other cases of thread gage lapping, a reciprocating movement is employed so that the lap passes continuously back and forth over the threaded surface of the work while the operation is being performed.

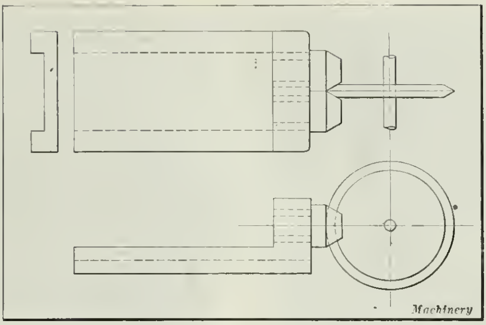


Fig. 8. Fixture for charging Rotary Laps of the Type used on the Machine shown in Fig. 7

A precision lathe equipped with a thread milling attachment is utilized for this purpose, the machine being shown in Fig. 7 set up for the performance of a lapping operation. The equipment used on the machine is entirely similar to that employed for thread milling, except that the lapping spindle is provided with a pulley carrying a belt running up to a large driving pulley on the overhead works, to impart the necessary speed of rotation, which is very much higher than that utilized in thread milling. Special means must be provided for charging a lap of this kind. The tool used for this purpose is shown in Fig. 8, and consists of an arm which carries two bevel-faced wheels that are so formed and mounted that the two faces of the wheels bear against the lapping surfaces of the steel disk. The abrasive generally used on a lap of this kind consists of diamond dust which is prepared according to instructions that will be given in a later section of this article.

In some shops lapping with diamond dust has fallen into disrepute, because the greater cost of the abrasive did not seem to be justified by the results obtained, either in the speed of cutting or in the perfection of finish. Primarily, this has been due to the fact that an attempt was made to force the lap to cut too fast. In order to obtain the best results with diamond laps, very light cuts and high speeds should be used. Diamond dust is not supposed to be broken down in cutting, as is the case with other abrasives; it does not break down readily, and the result of crowding the work is to dull the cutting edges of the diamond chips. An example similar to this difference between diamond dust and other abrasives is seen in grinding wheel-truing devices. A diamond wheel-truing tool depends upon its sharp cutting edge, while an abrasive truing wheel is supposed to break down while truing and thus present new sharp edges to the grinding wheel that is being dressed.

Pratt & Whitney Co.'s Practice in Lapping Thread Gages

At the Pratt & Whitney Co.'s plant in Hartford, Conn., the methods used for lapping thread gages are similar to those which have already been described so that further

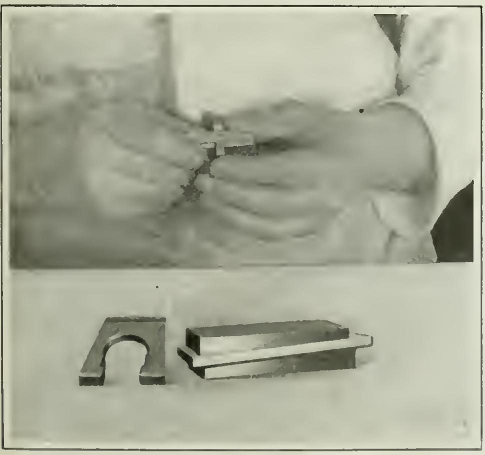


Fig. 9. Adjustable Parallel Lap used for lapping Pratt & Whitney Snap Gages

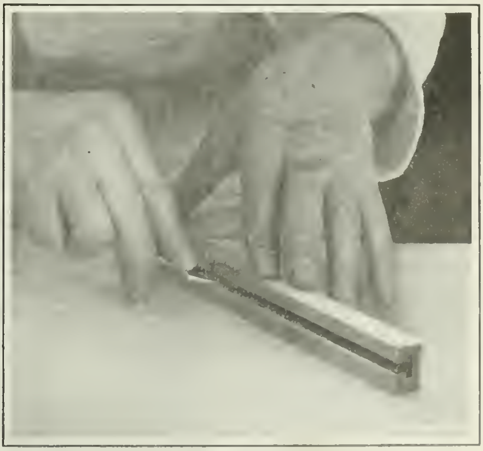


Fig. 10. Use of Local-action Lap for finishing the Vertical Walls of a T-slot

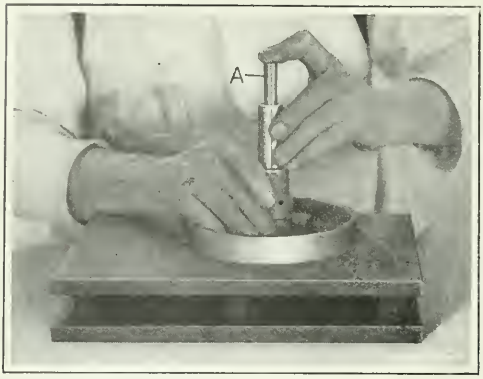


Fig. 11. Surface Lap and Fixture for facing End of Gage A Perpendicular to its Axis

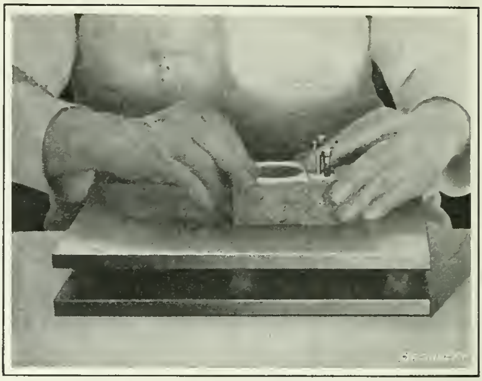


Fig. 12. Use of a Surface Lap for reducing a Large Flat Surface to the Required Condition

details are unnecessary. However, it will be of interest to note that this company has found that the best results are obtained with laps made of cold-rolled steel or machine steel, the former material being preferable, because it is softer and easier to charge with abrasive. The tool-rooms of this plant have tried to use laps made of cast iron, but for thread gages little success has been attained because of the difficulty experienced in obtaining full threads that will stand up without a tendency to flake off and wear with undue rapidity at the tops of the threads. In this plant it is a practice to perform the thread gage lapping operations at two steps, a roughing cut being taken with a lap charged with a No. 2 F or 3 F carborundum mixed with a sufficient quantity of kerosene to form a fluid of about the consistency of cream. After this preliminary lapping operation has been performed, a finishing cut is taken, using a lap charged with No. 4 F Turkish flour of emery, or No. 65 F alundum, either of these abrasive materials being mixed with sperm oil or lard oil.

Testing the Accuracy of a Lapped Thread Gage

It is not within the province of this article to enter into a discussion of methods of measuring internal and external threaded work. Such methods have recently received considerable attention in the technical press. However, in passing, it may be mentioned that any recognized method of measuring is utilized, such as the three-wire system supplemented by a Prestwich fluid gage, to test the dimensions of the gage as the lapping operation proceeds, not only with a view to ascertaining when the work has been reduced to the required size, but also to find variations at different positions on the work, in order that the lapping action may be concentrated at the high points to provide for reducing the gage uniformly to the required dimensions.

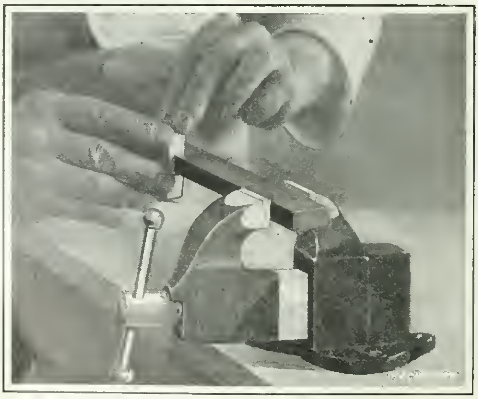


Fig. 13. Another Type of Local-action Lap used for finishing the Parallel Sides of a Bar

Lapping Pratt & Whitney Snap Gages

For lapping the measuring surfaces of snap gages, the Pratt & Whitney Co. makes use of an adjustable form of lap which not only has sufficient compensation so that the same lap can be utilized for finishing the surfaces on gages of a number of different sizes, but the compensation that is afforded also enables the lap to be adjusted to take up the very slight amount of wear that develops as a result of constant use. As shown in Fig. 9 it will be seen that these laps consist of two wedge-shaped members, with the inclined faces of the wedges opposed to each other. The lapping surfaces are on the outside and adjustment is obtained by sliding the two members of the lap relative to each other, so that the thickness may be increased or diminished to give the required distance between the lapping surfaces of the tool and the lapped faces on the work. After the lap has been set, it is secured in place through the use of C-clamps.

In cases where a greater degree of adjustment is required than that which is furnished by the inclined faces of the lap, such a result is accomplished by the use of shims or a filler block of the proper thickness, which is introduced between the inclined faces of the two halves of the lap; but it will be obvious that great care must be taken to have the shims or filler block of a high degree of parallelism, in order to avoid interfering with the accuracy of the tool. In handling this work, it is the practice to take a roughing and a finishing cut, the preliminary operation being performed with laps charged with 2 F carborundum, while the finishing operation is performed with laps charged with 4 F Turkish flour of emery. These wedge-shaped laps are made of cast iron, which experience has shown to be the best material for making laps for use on flat surfaces of considerable size.

The reason for dividing the operation up into two steps is to avoid the introduction of errors resulting from the tendency of the work to expand slightly while the roughing cut is being taken. By allowing sufficient time for the work to return to a normal temperature and size before taking the finishing cut, there is little chance of introducing an error, because the rise of temperature and expansion of the work while taking the light finishing cut are practically negligible factors. This practice of removing the bulk of the metal by a preliminary operation, and then taking a very fine cut while lapping the work to its final size, should be followed in all cases of internal lapping where the maximum degree of accuracy is required.

Surface Plate Laps

For lapping down surfaces of considerable area, use is made of what is known as a "surface plate" type of lap which consists essentially of the cast-iron surface plate with a charge of abrasive material that affords the required cutting action on a piece of work that is rubbed over the surface of such a tool. A description of the use of a large lap of this kind would be incomplete without emphasizing the fact that it is of the utmost importance to employ an irregular movement in rubbing the work over the surface of the tool, and the reason for so doing is not difficult to understand. It will be evident that if a mechanic formed a practice of rubbing a piece of work straight back and forth across the middle of the plate, a depression would soon be worn at one point, which would greatly impair the accuracy of the work.

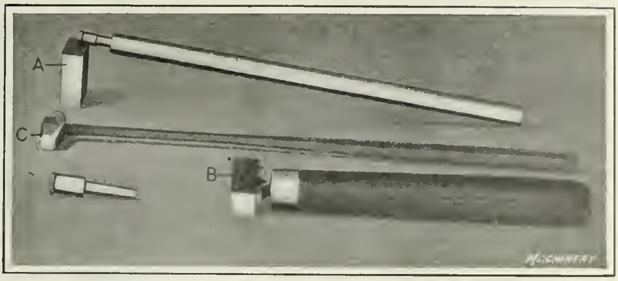


Fig. 14. Tools used for charging Laps with Diamond Dust

Probably two of the widest extremes in the range of work on which it may be required to perform a lapping operation are seen in the case of large pieces that are rubbed down on a surface plate and in the case of pieces of work with small grooves, etc., in which it may be necessary to lap down small sized surfaces to a high degree of accuracy. For the performance of these local lapping operations, use is made of what is known in the Pratt & Whitney tool-rooms as a "pencil" type of lap, which is made of a bar of copper about the size of an ordinary lead pencil, one end of the bar being flattened and bent over so that it lies in a horizontal position as shown in Fig. 10, when the lap is inclined in about the same way as a lead pencil would be while writing. There is little difference in practice in charging laps, regardless of their shape or size, but it is the general rule to take two cuts, the first of which is done with a lap charged with a No. 2 F carborundum, while the finishing cut is accomplished by using a lap charged with No. 4 F Turkish flour of emery.

It is the practice to mix the abrasive either with lard oil or sperm oil, and the men employed to perform lapping operations have small dishes of the oil and abrasives on their work-benches, into which they can dip with a small steel spatula and bring out a sufficient quantity of oil and abrasive to apply to the rotating lap. Experience has shown that it is also beneficial to occasionally apply a few drops of kerosene or gasoline to the lap, to afford a result somewhat similar to that of a cutting lubricant on a piece of work handled by a machine tool, the theory being that the kerosene or gasoline tends to wash away the very fine chips of metal that are abraded from the surface of the work by the lap.

The Norton Co. of Worcester, Mass., has had many years of experience in recommending abrasive materials for use in charging laps, and advises 2 F and 3 F alundum flour for charging thread gage laps and for other classes of gage lapping. In some cases it will be found desirable to use a 4 F grain, and for the very finest gage lapping operations the use of 65 F alundum is advised.

Lapping Die Openings with Diamond Laps

Die-castings are used in automatic counters made by the Veeder Mfg. Co., of Hartford, Conn., and this firm not only produces the castings that are needed to supply its own requirements, but also manufactures this product for sale to other manufacturers. Men who have had experience in the die-casting industry know that the dies used for this work must be extremely accurate, and in the Veeder tool-room a practice is made of lapping certain openings in the dies with laps charged with diamond dust. By this means, it is possible to hold the dimensions of such openings within 0.00005 inch or less. In this article information has already been given in regard to the performance of various internal and external lapping operations using carborundum, alundum, flour of emery, rouge or crocus as the cutting medium that is applied to the lap. These abrasives are highly satisfactory where lapping is only depended upon to remove about 0.0005 inch of metal to reduce the work to the finished size; but in the Veeder tool-room, although the work done by laps charged with diamond dust is a true lapping operation, the term "grinding" is quite generally applied to it, because the diamond lap is used to remove an appreciable amount of stock after the grinding wheel has finished its work. This is possible because the diamond lap cuts far more rapidly and freely than a lap charged with any of the other abrasives that have been mentioned. For laps charged with some cutting medium other than diamond dust, it is usually the practice to leave from 0.0002 to 0.0005 inch to be removed by the lap, while in the case of diamond laps, owing to the rapidity with which they operate, satisfactory results can be obtained by leaving as much as 0.002 to 0.006 inch of metal for lapping.

Method of Making Diamond Laps

Various metals may be used for making laps that are to be charged with diamond dust, but at the Veeder plant the standard materials are either machine steel or copper, steel being employed in the majority of cases. In making a lap, there is nothing unusual about the machine work, which consists simply of turning up a blank of the required shape and size. This blank must then be charged with diamond dust, after which it will be known as a "lap," and the procedure in handling the charging will naturally vary in the case of laps made of copper or steel. Copper being a softer metal receives the diamond dust more easily, and hence it is merely necessary to deposit on the face of a hardened steel block, shown at *A* in Fig. 14, a small amount of the dust moistened with oil to prevent it from flying, and after placing the cylindrical surface of the lap on this diamond dust, to roll it between the block *A* and the hardened steel face *B* of a tool provided for that purpose. From the illustration it will be apparent that the rolling tool is furnished with a handle of such a size and shape that the workman may grasp it in his hand and apply sufficient pressure to force the lap down on the diamond dust; this causes it to become embedded in the surface of the lap, as the copper is softer than either the face of the block or the rolling tool.

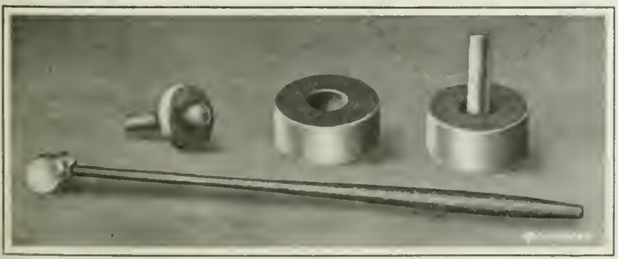


Fig. 15. Pestle, Mortar, and Hammer used in crushing Diamond Dust for Use in charging Laps

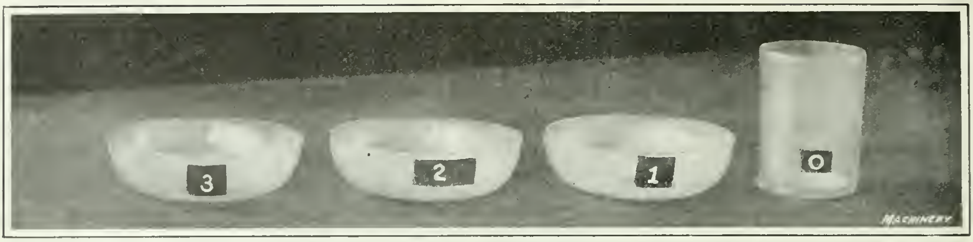


Fig. 16. Set of Glass Dishes used for "floating" Diamond Dust in Olive Oil. (The Illustration does not show the No. 4 Dish)

In charging steel laps, more trouble is likely to be experienced, owing to the greater hardness of the metal in which the diamond dust must be embedded. The charging of a steel lap is accomplished by first placing diamond dust on the face of block *A*, as previously explained, and then putting the lap on top of the diamond dust and tapping it with a small hammer *C*, the lap being turned slightly between successive blows of the hammer so that its entire face is exposed to the dust. After the work of charging has been started in this manner, the rolling tool *B* is used in the manner that has already been described, in order to provide for forcing in the particles of diamond which have already been partially embedded in the lap. A toolmaker who has not had experience in making diamond laps may ask the question: "How is one to ascertain when a lap has been thoroughly charged?" and this question would be answered by the single word "experience." However, it is noteworthy that there is very little danger of overcharging a lap, as the action of embedding the diamond dust is more or less self-compensating, that is to say, it is a very simple matter to start getting the dust to penetrate the face of the lap, but after the entire surface has been charged with abrasive, it has become so hard that the penetration of additional diamond dust is greatly retarded.

Preparing Diamond Dust for Use in Laps

Fig. 15 shows the type of pestle and mortar that is used for crushing diamonds to the degree of fineness that is required of the dust that is used for charging laps. Either white or black bortz diamonds are used for the purpose, and as this material is quite expensive, care must be taken to avoid all unnecessary losses. Two of the means used for this purpose consist of placing a few drops of olive oil in the mortar to retard the tendency of the diamond chips to fly out from under the pestle, and using a rubber washer surrounding the pestle and coming down over the top of the mortar in order to make it as difficult as possible for any chips of diamond to fly out. A little thought will make it apparent that during the process of crushing diamonds in a mortar, pieces of various sizes will be produced, and after the diamond dust has been reduced to what appears to be the required degree of fineness, it is necessary to grade it into portions containing particles of uniform sizes.

It is the practice in the Veeder tool-room to divide the diamond dust into five different grades which are designated by the numbers 0 to 4, respectively. This separation of the dust into portions of different fineness is accomplished by a process known as "floating" in olive oil. About one-half pint of oil is used to float fifty karats of diamond dust, and the separation of various portions is accomplished by decanting off the oil after allowing the particles of diamond to settle to the bottom of the container. Fig. 16 shows a set of dishes used for this purpose, and a very little thought will suffice to make it evident that owing to their greater weight, the larger particles of diamond dust will settle more rapidly than the smaller ones. The first separation is made in an ordinary drinking glass, and after the 50 karats of diamond dust have been thoroughly stirred in the olive oil, two minutes is allowed for the No. 0 particles to settle. Then the oil is decanted off into the No. 1 bowl in which three minutes' time is allowed for the No. 1 particles of diamond to settle before the oil is decanted off into the No. 2 bowl.

This process is repeated for making the three following separations, a period of ten minutes being allowed for the No. 2 sized particles to separate, twenty-five minutes for the No. 3 size, and forty minutes for the No. 4 size. Naturally the condition of the diamond dust used for charging laps will vary according to the work to be done, but at the Veeder shop practically all the lapping is done by either the No. 2 or No. 3 size. Occasionally, use is made of the No. 1 size of dust, but the majority of the particles of this size are returned to the pestle along with all of the No. 0 size so that they may be recrushed and reseparated. Similarly, most of the No. 4 size dust is too fine to be of use and so, with the exception of the very small amount which may occasionally be utilized for the finest classes of lapping, this portion of the crushed diamonds is discarded. Attention is called to the fact that in making this separation, the olive oil is never used more than once, as experience has shown that even after the No. 4 size of dust has been removed, there still is a considerable amount of residue left in the oil and if it were used repeatedly, it would become so heavily charged with this fine dust that the settling of the larger sized particles would consume a much longer time.

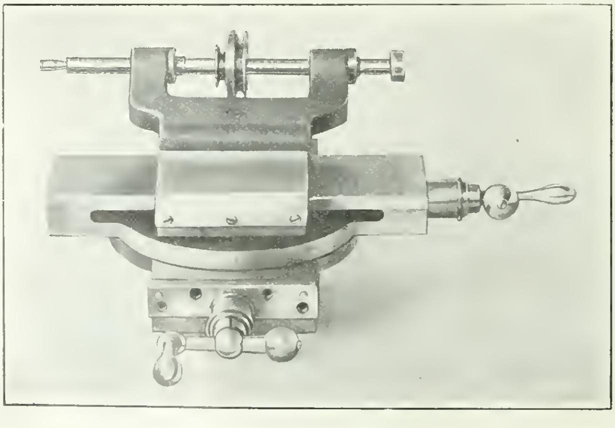


Fig. 17. Slide Spindle Grinding Attachment for the Bench Lathe, which is used in performing Lapping Operations

Precautions to Observe in Lapping Accurate Holes

In the performance of lapping operations, one of the conditions which must be carefully guarded against is to avoid having the holes formed with what is known as a "bell mouth." There are several important precautions that must be taken to avoid producing such a defect in the work, one of which is to charge all of the diamond dust into the lap so that it is an integral part of the lapping tool, and not to apply a mixture of diamond dust and oil to the lap while it is in action. In the case of emery and other classes of abrasive, this method is permissible because the cutting action is not nearly so rapid, but in the case of diamond dust the application of a mixture of the abrasive and oil to a lap would result in piling up diamond dust at each end of the opening, as the lap is reciprocated back and forth through the hole, and thus tend to produce a more rapid cutting action at the two ends of the hole than would occur at other portions, and make the hole bell-mouthed.

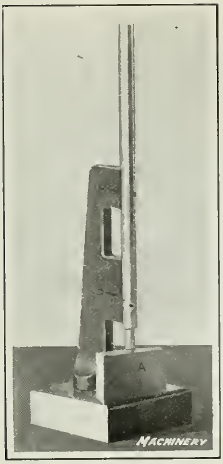


Fig. 18. Fixture for recharging Lap held in Slide Spindle

Another important condition is to use a lap which has the actual working surface considerably shorter than the length of the hole to be lapped. The lapping operation is performed with the work supported by a spindle fixture on a bench lathe and the lap mounted in a slide spindle grinding attachment shown in Fig. 17. With a lap of short length, greater precision can be attained because it is easier to attain a high degree of uniformity in the cutting action of such a lap. If the length of a lap were made equal to, or even greater than, the full length of the hole, so that reciprocation of the tool was unnecessary, the variations in the charging and the consequent rapidity of cutting action would make it difficult to obtain uniform results. The use of a slide spindle grinding attachment on the bench lathe is desirable for several reasons, chief among which are the convenience with which the lap may be reciprocated back and forth through an opening in the work and the ease with which the lap may be recharged when necessary.

It is a matter of general knowledge that the abrasive in a grinding wheel tends to become dull or to tear out of the bonding material. Similarly, the points of the abrasive in a lap become dull or the particles pull out of their anchorage in the metal. In either case, recharging is necessary at regular intervals, and this is accomplished by following a procedure similar to that explained for charging a new lap. But in the performance of a lapping operation, it is of the utmost importance to maintain uniform alignment between the lap and the work, and if it were necessary to remove the lap from the spindle for recharging, difficulty might be experienced in resetting it in the original position. With a slide spindle attachment, however, it is only necessary to remove a collar and pull the spindle through its bearings so that the entire spindle and the lap mounted in it may be handled as a unit. Fig. 18 shows a fixture used for holding a spindle and lap while recharging the end face of the lap. Here the use of a hammer is not required because the diamond dust is placed on the hardened block *A* and the spindle is slid up and down in the vertical vees *B* of the fixture so that its weight may impart the necessary momentum to cause the diamond dust to penetrate the end face of the lap when it comes into engagement with the hardened steel block on which the diamond dust is held. When recharging a radial lap, the hammer would be used for forcing the dust in the surface, in the manner previously explained in connection with the description of charging steel laps.

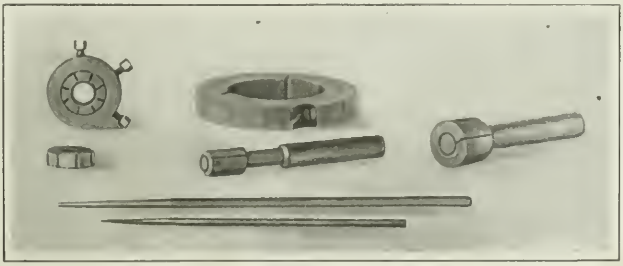


Fig. 19. Laps and Lap Holders for External and Internal Cylindrical Work

THE STEEL INDUSTRY AND THE METRIC SYSTEM

The Association of American Steel Manufacturers, which is composed of forty of the leading concerns in the steel industry and which represents 84.2 per cent of the total steel ingot capacity of the United States, has been canvassed with a view to obtaining from the different concerns their opinion as regards the compulsory adoption of the metric system in the United States. According to information given out by the Publicity Service of the American Institute of Weights and Measures, 115 Broadway, New York City, this canvass was made by the secretary of the association, J. O. Leech, in order to ascertain definitely the present attitude of the member companies on the subject. The result of the canvass was as follows: Thirty-seven companies voted against the compulsory adoption of the metric system in the United States; one company voted neutral; one voted in favor of the metric system; and one did not reply. The companies voting against the compulsory adoption of the metric system represent over 80 per cent of the total ingot capacity of the United States. The company voting neutral represents about 0.5 per cent, and the company that voted in favor of the metric system, 0.7 per cent of the total ingot capacity of the country.

It has been pointed out that a change from the English to the metric system would be especially difficult to make and very expensive if applied to the steel industry. All the standard sections are in inch sizes, and millions of dollars worth of rolls are in existence which would either have to be scrapped or changed to fit the new sizes.

* * *

IMPROVEMENTS IN RAILWAY OPERATION

Some of the railroads have made considerable improvements in the maintenance and operating conditions of their roads since the return of the railroads by the Government to their owners. The improvements that have been effected on the Pennsylvania system have been summarized in a report recently published. This report states that the number of locomotives undergoing or awaiting repairs has been reduced from a daily average of 1600, at the termination of federal control, on March 1, to 1000 at the beginning of September. The proportion of locomotives available for service has thereby been increased from 78 per cent of the total in March to 86 per cent in September. In the six months from March to August of the present year, 19,750 engines were repaired, as compared with 14,271 in the corresponding period of 1919, showing an increase of 38 per cent in the number of engines repaired. Similar improvements have taken place in the case of freight cars and in freight movement. A decided improvement has been made in the percentage of passenger trains run on time. In March, 77 per cent of the trains were on time as compared with 85 per cent in August. It is to be hoped that further improvements will take place along this line, as it should be possible to run even a greater percentage of trains on time.

Keeping Engineering Data for Future Use

By WILLIAM H. KELLOGG

A LARGE part of the time required for making up specifications and developing drawings for a job is consumed by the engineer or designer in gathering data, drawing rough sketches or lay-outs, and making calculations. After the drawings and specifications have been completed, the various sketches, preliminary drawings, and scraps of paper upon which calculations and memorandums have been made generally lie about the office until they are either forgotten, lost, or thrown away. While the greater bulk of such matter is probably of no future use, still there are nearly always some parts that would be useful on later jobs or for reference.

Many concerns have recognized the advantages obtained by preserving this material, and the writer has seen several attempts made to inaugurate systems by which data of this sort might be kept and properly recorded. The too common tendency in trying to accomplish something in this respect, is to make an inflexible system such as one involving the use of books in which computations and sketches are made. These books are kept on file after having been filled with miscellaneous matter of which only a small portion is ever used.

Kind of Information that should be Retained

Information of the kind under discussion, which might be of future use, could be readily filed in a vertical filing cabinet and recorded by means of a convenient card index. Each designer responsible for a job, or a division of one if the job is large, should be expected to compile all data consisting of important facts, sketches, memorandums sent or received in reference to the work, price sheets, quotations, photographs, clippings from catalogues, or anything that may aid in recollecting facts and ideas used in completing a job. Thus the material saved may be a scrap of paper torn from a notebook, a complete drawing, a patent specification, or a contract having some relation to the job. No designer, draftsman, or engineer connected with a job should make a sketch or calculation without including it in the available data, provided it is of sufficient value.

The writer has found that it is better to file letters pertaining to the engineering end of a job with such material rather than in the regular correspondence file under the name of the firm concerned. Some persons may not consider it so; however, the matter should depend upon the general practice of the concern involved. All correspondence belonging to the sales or other departments should, of course, be kept in the files of those departments.

Compiling Useful Information

The compilation of the data should not consist merely of collecting everything connected with a job, and so a judicious elimination of all unnecessary material should be made. No person is better fitted for this work than the designer himself. In deciding what material should be saved, questions similar to the following should be considered by the person responsible for making the decision:

"Is it likely or possible that another condition will arise in which the material can be used?"

"Is the calculation a long and tedious one, having a part or parts which might be of use in another job?"

"Are there any ingenious ideas contained which are not shown on the final drawings and which may be desired again?"

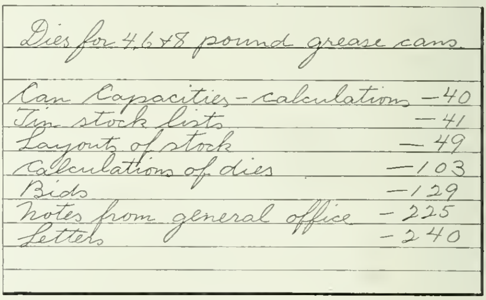
"Are any of the sketches a better portrayal of the completed job than the actual drawings?"

"Are there any statements recorded that were made by any of the persons responsible for the job which might be questioned at a future date?"

These are only a few questions among many that might be considered about any particular data.

Description of System for Filing and Indexing Material

The following system of filing the material is a simple one and consists generally of placing the data loosely in folders which are kept in the filing cabinet. These folders should be placed numerically, and the file number of a folder should be marked in a legible manner upon each piece of matter which it contains. The file number on the individual pieces of material should be marked in lead pencil or crayon so that it can be erased if desired, as one folder may become too full, and in such a case a sub-classification could be made more easily. A good way to mark each piece is to make a distinct circle upon it and place the number of the folder within this circle. The folder should be of the kind that permits serial numbering in regular order. A title should be printed on the outside of each folder telling the kind of matter the particular folder contains. It is also advisable to mark this index title with a lead pencil, and the designer may do this when he compiles the data.



Dies for 4,6 & 8 pound grease cans

Can Capacities - calculations - 40
Tin stock lists - 41
Layout of stock - 49
Calculations of dies - 103
Bids - 129
Notes from general office - 225
Letters - 240

Index Card used to record Location of Useful Data

A filing clerk may prepare the index cards and place the folders in the file; however, the index is an important part of this system, and the filing clerk should be made responsible for making the index entries accurately and completely. In many cases it will be advisable to have a heading title and a sub-title on the folder, and this will facilitate indexing. The heading title should be placed at the top of the index card, and this title should be descriptive of the job. The various data belonging to the job should be placed on the same card along with the number of the folder in which the particular data is contained. The key word of the heading title should be carefully selected, as it should be a word that will readily come to the mind of a person desiring to find some specific material.

The key word should, of course, be the first one on the index card, and these cards should be arranged alphabetically according to these words. As an example, suppose that a number of dies for producing tin grease cans are being designed. The index card prepared for this job will appear as shown in Fig. 1. All data should be filed as soon as convenient, because the sooner the material is filed the easier it will be to locate it, even while a job is still in progress. While the example shown represents a certain class of work, the system can be used on all classes.

Some of the Advantages Secured by the System

The elasticity of the system described is obvious, because the folders are placed numerically in the filing cabinet and then indexed alphabetically, either according to the job or under a general classification. When the system is new, any data can be found almost instantly, and as the amount of material becomes larger, complications are eliminated by careful cross-indexing, according to the needs. The cross-index is a time-saver when referring to the files. In regard to general classification, it will be found that the file is a handy place in which to keep such data as are used in a general way. As an explanation, some data may be useful for two or three different jobs, while others may be so general as to be applicable to almost any job. When any material becomes so general that it is constantly referred to, it should then become a part of the regular office data and be placed in the book of standard practice or posted for general reference. It should no longer be kept under this system.

It must be remembered that the system described has a different purpose from the well-known system of keeping the engineering standards of an establishment in a convenient form for reference, which usually consists of blueprints contained in loose-leaf books. It will be found, however, that this latter practice will be greatly aided and supplemented by the system being discussed. For example, machine parts that have such a similarity of design that existing patterns can be adapted for molding them can be so indexed that this fact will be known. Also, gears designed for special purposes can sometimes be used in a different application from that originally intended. Therefore, information about such gears should be readily accessible. There are, of course, numerous other machine parts which permit a general classification that will be of value.

* * *

DUTIES OF A FOREMAN IN UP-TO-DATE SHOPS

By GEORGE F. KUHNE

The foreman of today must not only have a good knowledge of the work under his supervision but must also know something about the human element. The "hire-and-fire" idea is not as common as it was, and, at the present time, a greater effort is being made to study the qualifications of each man in an organization. Psychology now plays an important part in solving employment problems. This does not necessarily imply that a man is judged by the color of his hair or eyes, but in a shop or elsewhere it means the judging of the worker's nature, aptitudes, weaknesses, etc. A foreman may say, "Oh, I haven't time for this, I'm too busy," but a good foreman will train an understudy so that more time can be devoted to a study of each man and his work.

If the best qualities of the men are to be brought out it is of first importance that each man be given the kind of work for which he is best adapted and for which he has a liking. The foreman can direct the work of his men to the best advantage only when he understands each individual. One man would resent being addressed in a certain manner, while another would not. A successful foreman will find many ways of gaining the confidence and friendship of his men. Perhaps he has a man in his department who has had trouble, such as sickness in the family; in such a case he has an opportunity to make a friend of the man by giving him advice and help. The foreman who knows his men and interests himself in their personal welfare will invariably find the workmen loyal to him as a representative of the company. This attitude on the part of the foreman will engender a cooperation in the men, and will ultimately result in increased production and benefit to both employer and employes.

It is impossible for the employment department always to place a new employe on work for which he is exactly suited. If a new man seems to be unsuited for a certain position, the foreman should make a careful study of the man's characteristics. He can then form an opinion as to what job the man can handle best and recommend that he be transferred accordingly. The foreman should become familiar, at least in a general way, with the work done in other departments, not only for his own advancement but for the mutual benefit to both employer and employes in circumstances such as those warranting the transfer of a "misfit" employe to a different department.

In summing up, let it be borne in mind that a successful foreman must study his job, his men, and each man's job. He must have a good reason for everything he says, and know just what to say and how to say it before he attempts to give instructions or orders. When this is done a "ten-league step" will be taken in the stride toward increased production. The foreman is the "balance" that weighs and adjusts differences between employer and employe; he must please both, keep on producing, and "smile."

* * *

STRENGTH OF HYDRAULIC CYLINDERS

The simple formula presented herewith for determining the thickness of hydraulic cylinders has been used satisfactorily for several years by a manufacturer of hydraulic machinery. It is known as Clark's formula for thick cylinders, and the writer believes that it deserves wider recognition among hydraulic engineers, designers, and others who have occasion to calculate the strength of cylinders.

Letting f equal the allowable stress, P the working pressure, D the outside diameter, and d the inside diameter, the formula is written

$$\frac{P}{f} = \text{hyperbolic logarithm } \frac{D}{d}$$

The solution of the following problem is given to show the application of the formula: If a cylinder having an inside diameter of 30 inches is subjected to an internal pressure of 3000 pounds per square inch, find the required thickness of cylinder, allowing a working stress of 8000 pounds per square inch.

Now according to the formula,

$$\frac{3000}{8000} = 0.375 = \text{hyperbolic logarithm of } \frac{D}{d}$$

On page 124 of MACHINERY'S HANDBOOK, 0.375 is given as the nearest hyperbolic logarithm of 1.45. Then

$$\frac{D}{d} = 1.45 \text{ or } D = 1.45 \times d$$

Therefore

$$D = 1.45 \times 30 = 43.5 \text{ inches}$$

which is the outside diameter of the cylinder. The thickness of the cylinder equals $\frac{43.5 - 30}{2} = 6.75$ inches

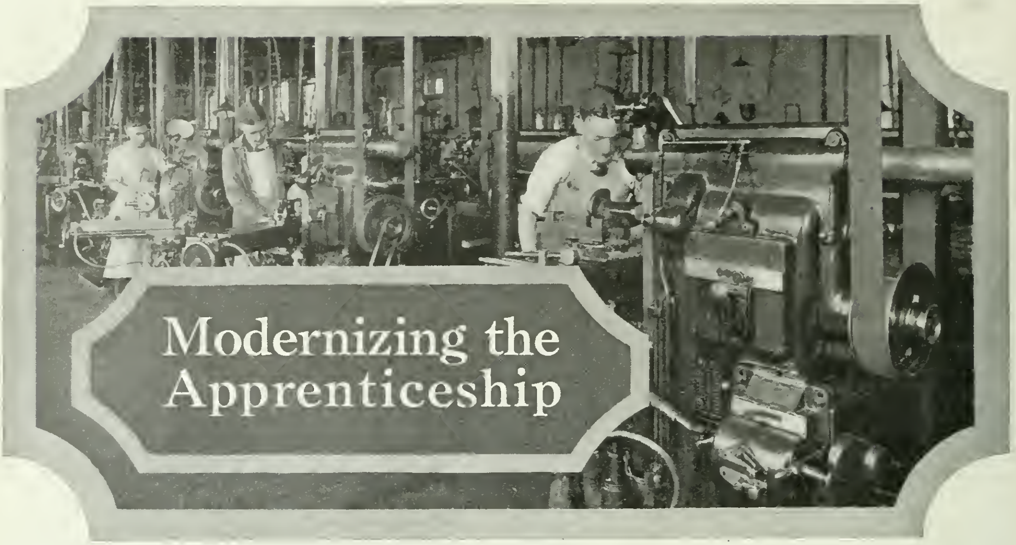
If the result thus obtained is compared with that obtained by Lamé's formula it will be found that Clark's formula gives a slightly thinner wall for the cylinder. It is generally acknowledged that Barlow's formula gives a thickness which is too liberal for ordinary purposes. As a check, using Lamé's formula for the given conditions,

$$f = 3000 \times \frac{21.75^2 + 15^2}{21.75^2 - 15^2} = 8400 \text{ pounds per square inch}$$

This stress of 8400, compared with the specified stress of 8000 pounds per square inch, shows that Lamé's formula suggests the use of a slightly thicker cylinder wall. Using Barlow's formula:

$$f = \frac{43.5 \times 3000}{2 \times 6.75} = 9660 \text{ pounds per square inch}$$

From this it will be seen that Barlow's formula gives a thicker cylinder wall than that suggested by either Lamé's or Clark's formula. W. B. G.



Modernizing the Apprenticeship

A Review of the Methods Used by the Taft-Peirce Mfg. Co., Woonsocket, R. I., in the Training of Apprentices Along Broad, Comprehensive Lines, Intended to Ultimately Fit them for Important Positions in the Mechanical Industries

By ERIK OBERG

THE old-fashioned kind of apprenticeship where the boy was merely taken into a shop and advanced from department to department, obtaining his training in shop work from instructions by the foreman and from what he could pick up from his fellow workmen, fails today to attract enough boys to supply our future needs for skilled mechanics. It is so easy today for a boy to go into a machine shop and earn good wages in operating a manufacturing type of machine tool that something more must be given him during his apprenticeship than mere shop training in order to attract him and hold him for a four-year apprenticeship, even at the much higher rates of apprenticeship wages that are paid today. This condition has been recognized by many manufacturing concerns and the details have been worked out in different ways according to the ideas of those having this matter in charge.

The Taft-Peirce Mfg. Co., Woonsocket, R. I., has developed an apprenticeship system along modern lines that gives the

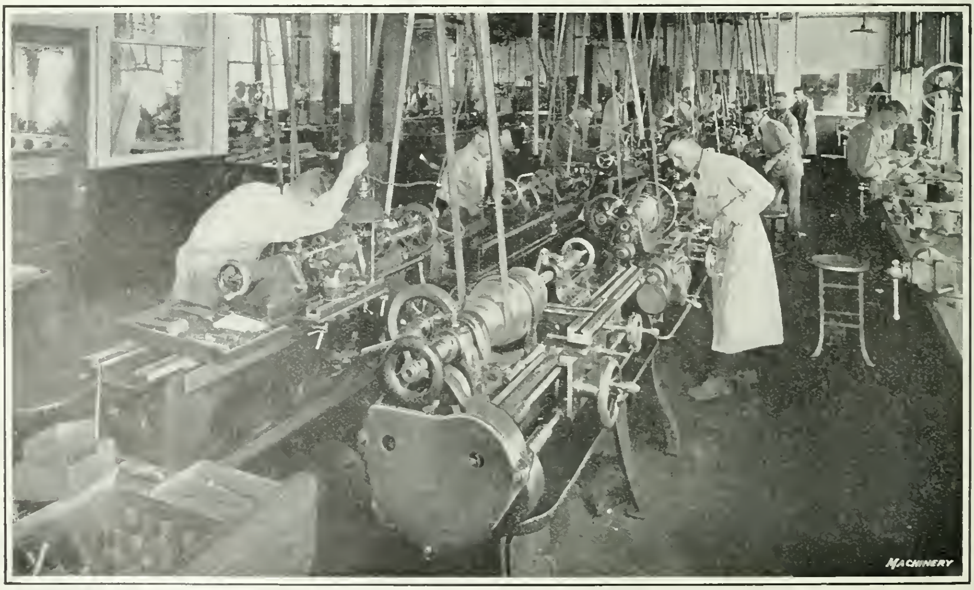


Fig. 1. Apprentices at Work in Lathe Department

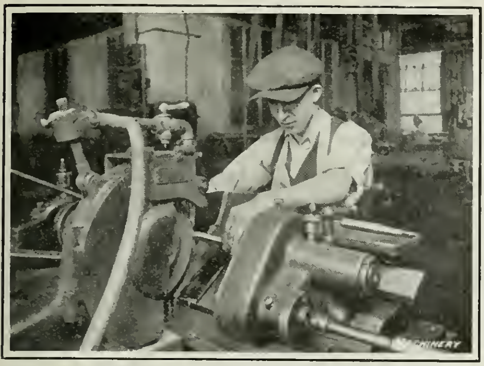


Fig. 2. Apprentice grinding Gage Blanks in Taft-Peirce Plant

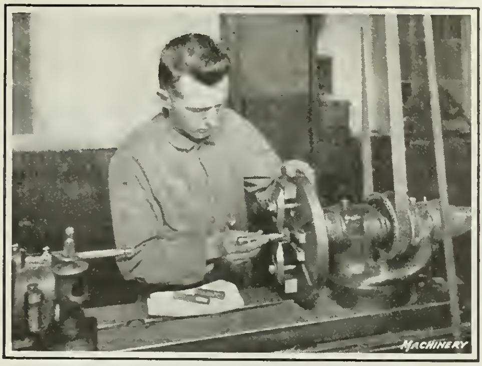


Fig. 3. Advanced Training in Tool-room Work

boy, in addition to his shop training, a liberal mechanical education, and the apprenticeship course may be looked upon not as an apprenticeship pure and simple, but as a school where a boy may acquire such fundamental knowledge of both the theoretical and practical principles that underly mechanical work, that he will be able in the future to rise to executive positions of responsibility in the mechanical trades.

Recognizing the fact that in these days a college education and often even a high-school education for a boy is beyond the financial limitations of the average parent, the Taft-Peirce Mfg. Co. has instituted an apprenticeship whereby any ambitious boy may acquire a comprehensive knowledge in those subjects that have special application to the mechanical trades, and have provided the opportunity for the boy to acquire this knowledge in the working hours during the four years of his apprenticeship. On account of the exceptionally varied line of manufacture in which the company is engaged, it is possible to give the apprentice a thorough and comprehensive training in practical shop work; but in addition to this, instruction is also given in such subjects as mathematics, mechanical drawing, shop management and industrial economics, together with the elements of chemistry and physics. The apprentice system is organized on this broad plan in order to make it possible, not merely to "grind out" toolmakers and machinists, but to qualify the apprentices that have the proper characteristics to ultimately become foremen, superintendents or designers.

The course is so arranged and handled that the boy need not possess more than average ability in addition to willingness to work to reach the goal thus defined. In addition to the desirable features involved in the training course itself, the hourly rates paid to the apprentice during the four-year course are such that he receives a substantial mechanical education while being paid wages which enable him to support himself by his work. It is the object of this article to describe in detail the manner in which this apprentice course is conducted in order that it may serve as a guidance in other plants where similar courses are contemplated.

General Principles of the Taft-Peirce Apprenticeship School

The apprenticeship at the Taft-Peirce Mfg. Co. is known as an apprenticeship school and is conducted very largely along the lines of a modern educational institution, with reports and records that make it possible to thoroughly check up the progress of the boy at any time during the apprentice course. The course covers a period of four years and, owing to the business of the company, is, of course, principally confined to the machinist's and toolmaker's trade, although in some instances a drafting-room course is also included. During their apprenticeships the boys are in charge of the supervisor of apprentices, C. K. Gurney, who, with an assistant, supervises the boy's work both in the shop and in the instruction room, keeps the records showing his progress, takes care of his transfer from department to department, and acts not only as an instructor in the school and shop work but also interests himself in all the affairs of the apprentice both inside and outside the works. One of the supervisor's duties is to give instructions in safe methods of working, and he is constantly on the lookout for the welfare of the apprentice during the years that the boy is in his charge.

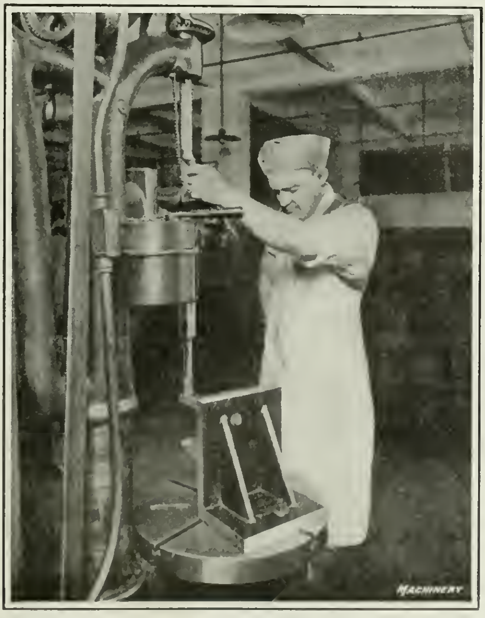
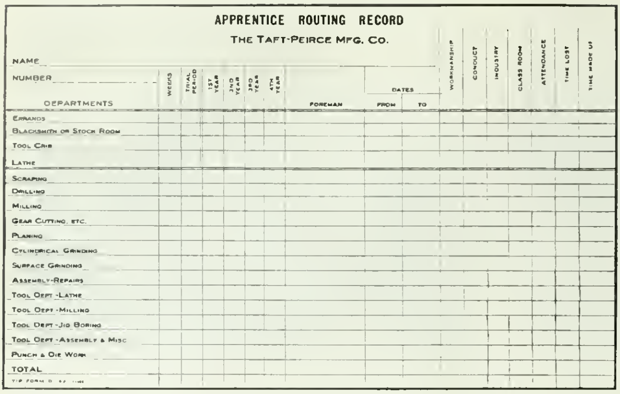


Fig. 4. The Apprentices receive Thorough Training in Every Department

Entrance Requirements to Apprentice Course

In order to be permitted to enter the apprentice course, the boy must be not less than 16 nor more than 19 years of age and must have a sufficient physical development to fit him for the machinist's trade and must have good eyesight and hearing. A boy is expected to have completed grammar school and should be mechanically inclined, as he cannot be successful unless he has a natural bent for mechanical matters. Generally, boys who smoke cigarettes or those who want to go to work merely in order to escape going to school are not accepted. A special application card has to be filled out giving the following information relating to the applicant: Name; address; name of parent or guardian,



APPRENTICE ROUTING RECORD

THE TAFT-PEIRCE MFG. CO.

NAME

NUMBER

DEPARTMENTS	WEEKS	TRIAL PERIOD	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	FOREMAN	DATES FROM	DATES TO	WORKMANSHIP	CONDUCT	INDUSTRY	CLASS ROOM	ATTENDANCE	TIME LOST	TIME MADE UP
ERRANDS																
BLACKSMITH OR STOCK ROOM																
TOOL CRIB																
LATHE																
SCRAPING																
DRILLING																
MILLING																
GEAR CUTTING, ETC.																
PLANING																
CYLINDRICAL GRINDING																
SURFACE GRINDING																
ASSEMBLY-REPAIRS																
TOOL DEPT.-LATHE																
TOOL DEPT.-MILLING																
TOOL DEPT.-JIG BORING																
TOOL DEPT.-ASSEMBLY & MISC.																
PUNCH & DIE WORK																
TOTAL																

Fig. 5. Record of Apprentice's Work

with address; boy's nationality; father's nationality; mother's nationality; father's occupation; boy's age, height and weight; whether using pipe, cigar, cigarette or chewing; whether living at home or boarding; where employed at present and by whom; previous employment; grammar school attended, date of graduation or grade finished; high school attended, date of graduation or grade finished; questions relating to health, such as whether the boy has any organic diseases, rupture or deficiency of sight and hearing, adenoids, etc.; reason for selecting this trade; and a note made by the interviewer as to the general appearance of the boy. Space is also provided for names of references.

After the boy has qualified through his answers to the questions on the application card and by the general impressions of the interviewer, he is usually required to take an examination in simple mathematics, including fractions, percentage, decimals, ratio and proportion, square root, mensuration, etc. In case of a high-school graduate, this examination is omitted. Should the number of applicants be unusually great, competitive examinations will be held.

After having been accepted for the apprenticeship course, the boy is placed on a three-months' trial period and is supplied with the tools necessary for his work during this three-months' trial. During this period he is paid at the rate of 22 cents per hour.

Compensation and Obligations During Apprenticeship Period

During the three months' trial period the boy is kept under close observation and if at the end of this period he is accepted for the full apprentice course, he is required to sign the apprentice agreement, to pay a fee of $25, and to purchase a set of tools at the cost of $15. The fee of $25 is required as an evidence of good faith and is intended to discourage those who only "want a job" or who wish to avoid going to school. In this way, the course is also made a more desirable one for those who have the required ambition to learn the trade thoroughly. The deposit of $25 is forfeited if the boy does not finish his term or is discharged because of violations of the rules of the apprenticeship agreement. On the other hand, if the boy completes his apprentice term in a satisfactory manner, the deposit is returned to him with an additional $125, so that he receives at the close of his apprenticeship $150 and a diploma signed by the officers of the company.

During the four years of apprenticeship the boy receives the following wages: Trial period and first year, 22 cents per hour; second year, 26 cents per hour; third year, 30 cents per hour; and fourth year, 35 cents per hour.

The Shop Course

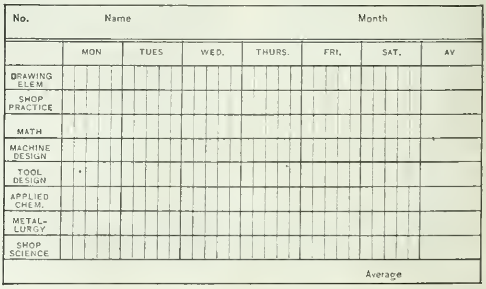
If a boy has had no previous experience in a machine shop he is usually placed in the tool crib for the first month in order to get acquainted with the names of the various kinds of tools that are used. If he has had previous shop experience, he is started immediately on production work in the machine shop. The four years are generally divided between the manufacturing departments and the tool-room, a boy serving two years in each. The first two years are devoted to the manufacturing departments, the division of the time being about as follows: Lathe work, 8 months; milling machine work, 6 months; drill press work, 2 months; surface grinding, 2 months; cylindrical grinding, 2 months; planer work, 4 months. In the tool-room the boy is generally kept on lathe work about 6 months, on milling machine work an equal length of time, on horizontal boring machines from 3 to 4 months, and on bench work and tool assembling from 8 to 9 months.

If an opportunity arises, the boy is generally put into the repair shop for one or two months during the first two years and is also placed for a few months on assembling work. During the last half of the fourth year his work is practically that of a journeyman toolmaker.

Sometimes the boys are given their first training in the special training school for machine operators maintained by the Taft-Peirce Mfg. Co., which training school was described in the September, 1918, number of MACHINERY, with special reference to the training of women for war work. At the present time no women are trained for manufacturing work, but the training school is still being maintained for machine operators and occasionally for the first training of the apprentices. If a boy should not happen to do as well in a shop as there is reason to expect, or if he appears to need a more thorough training than that which the shop foreman has time to give to him, he may be taken temporarily, at any time during his apprenticeship period, into the training school so that he may be under the direct charge of the supervisor of apprentices.

The Apprentice School Course

The underlying principle of the instruction in the actual apprentice school is that each boy must have individual attention; hence, the classes are divided so that there are only from five to ten boys in each class, and the boys thus placed in the same class do not necessarily need to be on the same lesson, as each boy is encouraged to go ahead as fast as he can. The classes are rearranged when some boys are so far ahead of their classes that it becomes more advantageous to place them in a more advanced class, so that, as far as possible, the boys in each class may be reasonably on the same level. The school instruction for each boy consists of four hours a week, divided into two 2-hour periods, one of which is between 7 and 9 in the morning on one day, and one from 1 to 3 in the afternoon on another day. Mathematics and other subjects are taught in the morning session, and mechanical drawing in the afternoon session.



No. Name Month

	MON	TUES	WED.	THURS.	FRI.	SAT.	AV
DRAWING ELEM							
SHOP PRACTICE							
MATH							
MACHINE DESIGN							
TOOL DESIGN							
APPLIED CHEM.							
METAL-LURGY							
SHOP SCIENCE							
						Average	

Fig. 6. Apprentice's Class-room Record

The mathematical course is a rather ambitious one and has been laid out with a view that it can be completed by the boys who show the greatest aptitude for this kind of training, while some of the others will not quite complete the course. During the first year the grammar school arithmetic is reviewed and its application to shop problems emphasized. Later, the solution of triangles, the use of formulas, and the application of mathematics to screw threads, gearing, feeds and speeds, spirals, the calculation of change-gears for screw cutting and for the cutting of spirals, and plain and differential indexing, is taught.

The mathematical problems solved by the boys in the advanced years of their apprenticeship are by no means simple. They include some of the rather complicated problems that are met by the designer of machine tools and machinery in general, such as calculations in connection with feed and reverse mechanisms; gearing center distances in cases of tumbler gears; the figuring of taper gibs for slides, etc.

In addition to the course in mathematics, an elementary course in chemistry, particularly relating to machine shop materials, elements of the metallurgy of iron and steel, shop economics, etc., is given. An important feature of the course is the teaching of the relation between labor cost and selling price, the boys being shown the different items that enter into the selling price of an article, it being explained to them that the direct labor cost is only a small item, the cost of materials, insurance, taxes, cost of buildings and machinery, upkeep of equipment, etc., add a large proportion to the final cost at which the manufactured product is finally disposed.

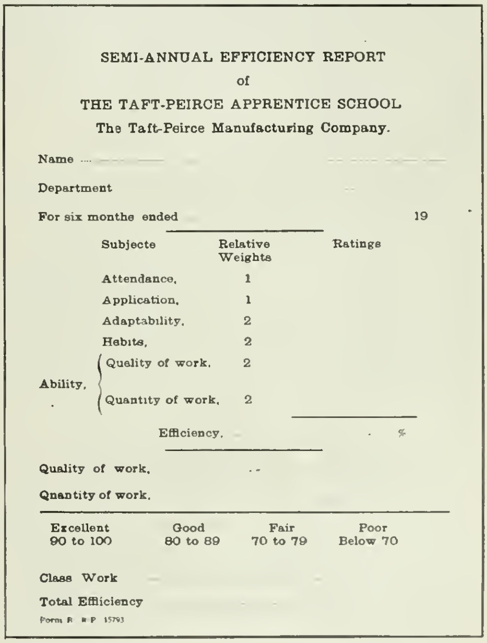
The drafting course consists of geometrical problems and the making of drawings from actual objects—both detail drawings and assemblies. The object of the drafting course is not to make draftsmen but to train the boy, by making drawings, in the ability to read drawings.

Sometimes a boy shows unusual aptitude for mechanical drawing and machine design while he may not show any particular talent for actual shop work. In that case, after he has finished his two years in the manufacturing departments in the shop, he may be placed in the drafting-room to finish his apprenticeship course there. In other cases, boys who show considerable inclination for drafting may be permitted to spend the first six months of the fourth year in the drafting-room, finishing their apprenticeship by another six months in the shop. This arrangement, however, is rather an exception than a rule because the purpose of the apprentice school is mainly to train shopmen who may ultimately become shop executives rather than machine designers.

Records Kept of the Progress of the Apprentice

Fig. 5 shows what is known as the "Apprentice Routing Record" which gives complete information as to the work that the apprentice has been doing during his whole time of apprenticeship, and the number of weeks that he has spent in each of the various departments of the plant. It records the dates when he entered and left the department, and the name of the foreman. In addition, space is provided for recording, by percentages, the mark received by the apprentice in each department in regard to workmanship, conduct, industry, attendance, and time lost and made up, together with a summary of his class-room record. The marking for workmanship, conduct and industry is made by the foreman in whose department the boy is working and is made out on a special form. The supervisor of apprentices generally asks for such a report from the foreman on each boy about once in two or three months. The foreman marks the workmanship, conduct, and industry by four graduations: excellent; good; fair; or poor—according to his estimate of the boy's work and conduct. The time lost is placed on the record in Fig. 5 from the time-clerk's report, which is filled out each morning and sent to the supervisor of apprentices, giving for each department the names of the boys, the number of hours that they lost, if any, and the cause, if known. The class-room record is filled in from a more detailed monthly record which is kept by the supervisor and his assistant, giving the percentage for each lesson, a blank providing for this record being used for this purpose, as shown in Fig. 6.

Every six months a semi-annual efficiency report of each boy is sent to his parent or guardian, the form for this report being shown in Fig. 7. On the back of this form, answers are also given to the following questions: Does he take hold of new work readily? Does he read drawings readily? Is he painstaking? Does he make many mistakes? Does he take good care of his machine and tools? Is he trustworthy without supervision? How does he compare with others in his class? A duplicate of this report is filed and together with the apprentice routing card (Fig. 5) constitutes a very complete record of the boy's performance; it is useful not only for use during his apprentice period, but for future reference, when the question as to his employment or promotion may be considered. On the back of the card Fig. 5 certain remarks are entered by the supervisor indicating, for example, the work for which the boy is most fitted, whether he shows executive ability, etc. A complete summary of the percentages for workmanship, conduct, industry, etc., is also entered on the back of the card, giving the average for each of the four years, as well as a complete average for the whole four-year course. It is evident that by such a complete record it is possible to notice immediately any deficiencies in the boy's training and to take steps in time to remedy any defects.



SEMI-ANNUAL EFFICIENCY REPORT
of
THE TAFT-PEIRCE APPRENTICE SCHOOL
The Taft-Peirce Manufacturing Company.

Name ....

Department

For six months ended 19

	Subjects	Relative Weights	Ratings
	Attendance,	1	
	Application,	1	
	Adaptability,	2	
	Habits,	2	
Ability,	Quality of work,	2	
	Quantity of work,	2	

Efficiency, %

Quality of work,

Quantity of work,

Excellent	Good	Fair	Poor
90 to 100	80 to 89	70 to 79	Below 70

Class Work

Total Efficiency

Form R P 15793

Fig. 7. Report sent to Parent or Guardian

General Conditions Relating to the Apprentice Course

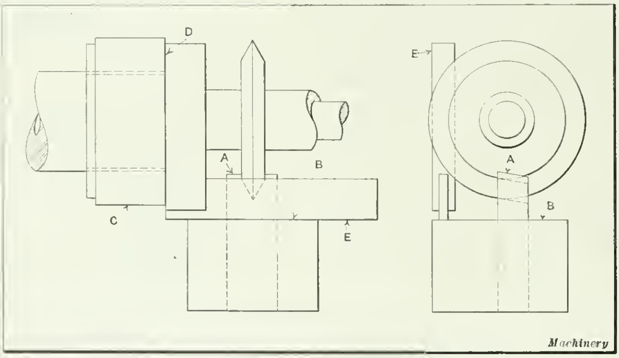
During their four years of apprenticeship the boys are strongly urged to subscribe for such journals as MACHINERY or the *American Machinist* so that they may be constantly informed as to what is going on in the mechanical world. In regard to class-room work, the boys are advised to do a certain amount of home study and reading as this is necessary in order to advance more rapidly. With a view to the boy's health and conduct, the apprentice is expected to refrain from the use of cigarettes at all times during the four-year course; the smoking of cigarettes may result in his discharge. The use of tobacco in any form is forbidden the apprentice within the premises of the plant.

It will be readily recognized that the principles upon which this apprenticeship course is based involve that which is best in the old-time plan of apprenticeship, such for example as actual work in the manufacturing departments in the plant under the direct authority of the shop foreman; while on the other hand, it introduces a number of new features aimed to provide the boy with a much broader training than was possible under the old plan. A combination of these two features, if applied on a large enough scale by all the larger manufacturing plants in the country, would tend to prevent the extreme scarcity of skilled men, and particularly the scarcity of suitable executives having the required mechanical skill, from which the industries suffer today.

* * *

SETTING A TOOL FOR TURNING SYMMETRICAL WORK

On lathes and similar machine tools, it may be required to set up a formed cutting tool in such a position that it will turn two sides of the work symmetrical with respect to a central plane that lies at right angles to the axis of centers on which the work is supported. As a case in point, consider the diagram presented in connection with the following description. Tool *A* is required to finish two inclined sides around the circumference of a disk so that they will be of the same lengths and inclined at the same angles to the central plane of the disk. The desired result is accomplished as follows: The front face *B* of the tool-block is carefully ground, and this block is then set up on a compound rest. A collar *C* on the front end of the spindle has its end *D* accurately faced with a lathe tool, after the collar has been screwed on the spindle.



Method of setting up a Formed Tool to assure having it turn Two Sides of a Piece of Work Symmetrical with Respect to a Central Plane

A steel square *E* is next utilized to test the accuracy of the tool setting. It will be apparent that with the face *D* of the collar *C* finished by a tool on the lathe, this face will be at an exact right angle to the spindle. The compound rest is next adjusted so that with the square *E* held in the position shown, a feeler made of cigarette paper cannot be withdrawn from under the square in any position along the face *B* of the tool-block or along face *D* of the collar. It will be noticed that face *B* of the tool-block is ground while face *D* of the collar is merely turned. Grinding would also be preferable for the face of the collar, but it is more important to be sure to have this face exactly perpendicular to the axis of the spindle, and the only way of being sure of obtaining such a relationship is by finishing the surface with the collar while it is in place on the spindle of the machine on which it is to be used.

* * *

According to *Reactions*, it has been found that an addition of 3 per cent of pure manganese to what is known as "railroad thermit" will materially prolong the life of thermit-welded wobblers on steel mill pinions, rolls, and large shafts. This addition of manganese produces a hard wearing surface. The wobblers must be thoroughly heated to about 1400 degrees F. before welding.

WORCESTER POLYTECHNIC SCHOLARSHIPS AWARDED BY NORTON CO.

The Norton Co., Worcester, Mass., has announced the establishment of a number of scholarships at the Worcester Polytechnic Institute. It is believed that there are many men among the employes who would be capable of assuming greater responsibility if they were able to secure a technical education which has been denied them through force of circumstances. The scholarships that will be awarded therefore will be given to applicants who are either employes, or sons or dependents of employes, of the Norton Co., and other things being equal, length of service will be taken into consideration. The scholarships are for the benefit of men who cannot afford to pay their own tuition at the institute. Applicants must also satisfy the entrance requirements of the institute or, if they are already students there, they must be in regular standing.

The scholarships will be awarded yearly for a term of one year. For the present year there are four scholarships, but for the period of nine years from 1921 to 1930, there will be six scholarships annually, and following 1930 there will be available such a number of yearly scholarships as the trustees of the Worcester Polytechnic Institute may consider advisable considering the income from the fund set aside for this purpose. The Norton scholarships will provide for tuition and laboratory fees in any of the courses in mechanical engineering, civil engineering, electrical engineering, or chemistry given at the institute. The acceptance of applicants is made by the directors of the Norton Co., upon recommendation of the service committee and the educational director of the Norton Co., but the awards of the scholarships will be made by the trustees of the Worcester Polytechnic Institute. When conditions permit, the Norton Co. announces that it will endeavor to offer summer work to students holding scholarships in order that they may become familiar, to a certain extent, with the product of the company and its manufacture.

* * *

INVESTIGATION OF GAGE TOLERANCES

The Sectional Committee that has been appointed by the American Society of Mechanical Engineers to standardize plain gages for general engineering work is endeavoring to collect all the information possible on the subject, and to this end has sent a questionnaire to members of the society and to firms in the machine-building field.

The questionnaire asks information as to the name of the firm and the product manufactured; the extent to which gages are used; the kind of gages used; the extent to which tolerances are used on the dimensions on the drawings of the products; and the classes of fits used—running fit, push fit, drive or press fit, or shrink fit, etc. The questionnaire further requests tables of allowances and tolerances used for the various fits, or if tables or formulas cannot be furnished, that the difference in dimensions between the mating parts for the loosest fit and the tightest fit allowed in each class be stated. The questionnaire may be obtained from H. W. Bearce, secretary of the Plain Limit Gage Committee, Bureau of Standards, Washington, D. C.

Dies for Flanges and Bearing Races

By J. BINGHAM, President, The B. J. Stamping Co., Toledo, Ohio

THE die illustrated in Fig. 1 produces flanges of the type shown beneath the die, in a single operation of the punch press. The operation consists of blanking the sheet metal from which the flange is manufactured, punching a hole through the center of the blank, and drawing the flange to the desired shape. The illustration shows the die and flange at the completion of an operation. The material from which the flange is made is ⅛ inch thick, the outside diameter of the blank being 8⅜ inches.

When punch *A* is withdrawn from the die at the end of an operation, drawing ring *B* is also raised until its upper surface coincides with that of the inner die ring *C*. This is accomplished by means of pins *D* which are actuated by a rubber buffer of the common type. The sheet-metal strip from which the blank is to be cut is laid on the upper surface of the outer die ring *E*, preparatory to the performance of an operation. Then as punch *A* descends on the downward stroke of the press ram, the blank is cut to size when the bottom edge of punch *A* passes the cutting edge of die ring *E*. The upper surface of die ring *C* is ⅛ inch, or the thickness of the blank, beneath the upper surface of die ring *E*, so that at the end of the first step in the operation, the blank rests on the top surface of die ring *C* and drawing ring *B*. The large hole is cut in the center of the blank by the central punch part *F* as the punch continues to descend, and since the bottom surface of part *F* is in the same plane as that of punch *A*, this punching step commences immediately upon the completion of the blanking.

The flange is drawn to the desired shape around die ring *C* as punch *A* continues to descend, pushing drawing ring *B* downward at the same time. The pressure between the drawing ring and the punch is sufficient to draw the blank from between die ring *C* and stripper *G*. This stripper is held on the top surface of die ring *C* on the return stroke of the press ram, by means of several expansion coil springs *H* contained in punch *A*, until the lower surface of punch *A* passes the upper surface of die ring *C*. When this occurs, the heads of the fillister-head machine screws *I* come in contact with the bottom of the counterbored holes in which they are contained and thus cause the stripper to be raised as the punch completes its return stroke. The flange is prevented from adhering to the punch as it is raised by coming in contact with the stripper. Drawing ring *B* is returned to its normal position as the punch and stripper ascend, and thus ejects the flange from the die.

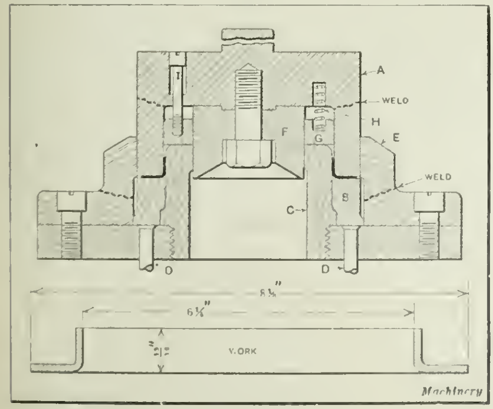


Fig. 1. Die employed in the Production of Flanges, with which Three Distinct Operations are performed

In order to effect economy and facilitate machining, the lower portion of punch *A* was made of tool steel while the upper portion was made of machine steel. These two parts are welded together at the point indicated by the heavy dotted lines. The die ring *E* was also made of two materials, the upper portion being tool steel.

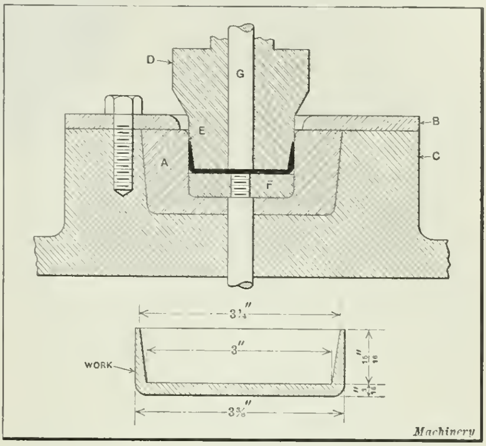


Fig. 2. Type of Punch and Die provided on Heavy-duty Punch Presses for the Manufacture of Roller Bearing Races

Die for Automobile Roller Bearing Races

Roller bearing races of various sizes for automobiles are satisfactorily produced on punch presses from steel plate ranging from 3/16 to ½ inch in thickness, by means of the punches and dies shown in Fig. 2. Owing to the purpose for which the parts are intended, a high grade of steel is used in the manufacture. Due to this fact, and to the thickness of the metal, a heavy-duty machine must be employed for the operation. The die illustrated is of the drawing type, and produces the shell illustrated beneath the die from blanks 3/16 inch thick and 4 inches in diameter, which are cut in a preceding operation. After the drawing operation has been performed, the closed end of the shell is blanked out on another machine, and the race hardened and ground.

In the operation performed by the punch and die illustrated, the blank is located on the drawing die *A* by means of the gage ring *B*, which serves a double purpose by also securing the drawing die in die-block *C*. The shell is formed as the blank is drawn into die *A* by punch *D*, when the punch descends on the downward stroke of the press ram. On work like this, surplus metal is provided in the blank, in this case a width of about ⅛ inch being allowed around the entire periphery. This surplus is sheared off by shoulder *E* on punch *D* as the shoulder enters die *A*, at which time sufficient metal has been drawn into the die to produce the shell. The shell is squeezed extra hard toward the end of the stroke, which causes the metal to flow up along the punch about 1/16 inch, and insures uniformity and compactness. If the shell remains in the die when the punch is withdrawn, it is ejected by means of the knock-out pad *F*. Rod *G* forces the shell from the punch in case it sticks.

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THE SMALL RAILWAY REPAIR SHOPS NEED MODERN MACHINE TOOLS

Some railroads transfer obsolete machine tools from the larger to the smaller repair shops because it is considered economical to use in the latter, machines which are no longer economical for shops handling a large volume of work. But an obsolete machine is inefficient and wasteful wherever it is, and even a small shop needs modern machines and tools—not as large a variety, but tools well designed and of high productive capacity.

As the function of both small and large repair shops is to keep locomotives in service, the powerful, rigid, conveniently controlled machine tools now used so generally in progressive machine-building plants will prove to be a good investment for railway repair shops generally, especially when compared with the light designs antedating the introduction of high-speed steel and still seen in too many railway shops. The cost of replacing these obsolete designs would be small compared to the saving effected by the use of up-to-date tool equipment. Many of these old machines have been in use more than twenty years, and some are actually considered worth shop room after even forty years of service. The continued use of such equipment means needless waste and is an indication of inefficient management, almost always on the part of financial executives. The shop executive will always buy good tools if he is allowed to.

Light cuts and slow speeds greatly decrease production, and the inaccurate work from many obsolete tools increases the time required for assembling machined parts. These old machines are also a source of discouragement to the men who must use them—a factor not to be overlooked. It is well known that locomotives are kept in repair shops longer than is necessary owing to the use of obsolete tools, and a careful study of conditions in representative repair shops shows that the loss from this source is even greater than is generally realized.

* * *

HIGH WAGES FORCE USE OF LABOR-SAVING MACHINERY

Manufacturers of labor-saving machinery and automatic machines, even in these days of mechanical progress, often find it difficult to induce some users to replace their old equipment with modern machinery. The present high wages, however, have made it evident to users of machine tools that the automatic and semi-automatic machine possesses great cost-saving possibilities. In one factory a textile machine part manufactured in quantities was produced in an antiquated way on eight engine lathes, each being operated by a boy. When boys could be hired cheaply there was no urgent need for a change in methods, although for the last ten years, at least, there have been machines on the market which made it possible to reduce the cost of production even at the wages paid boys prior to the war. But the cost of such labor has so greatly increased that the manufacturers referred to found it urgently necessary to study cost-saving, and discovered (perhaps by reading an advertisement) a type of automatic machine capable of producing their entire output on a single machine with one operator. The manufacturers figured that by producing one part every five minutes they would save money over the methods in use; but on actual trial the machine turned out one complete part each minute, enabling them to greatly increase their output with but one machine and at a fraction of their former production expense.

Well informed mechanics everywhere are familiar with similar instances, and the question of initial outlay, which holds many down to obsolete methods, must give place to the necessity of meeting competition in production costs. High wages will therefore continue to act as a stimulus to the introduction of labor-saving machinery and automatic devices in all manufacturing industries.

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HIGH-CLASS WORK NOT ALWAYS EXPENSIVE

Some time ago a manufacturer of universal joints was told by an automobile builder who bought his product that unless the quality of the universal joints improved, there would be no further orders. The manufacturer replied that he could not possibly make the joints any better for the price paid. The automobile builder—a man of long, practical mechanical experience—answered, "I will tell you how you can make those joints better, and how in making them better, you will produce them cheaper." He then proceeded to point out how much of the money spent in the manufacture of the universal joints was wasted through a mistaken manufacturing policy—namely, the effort to reduce production costs through speeding up the work to a point where accuracy and interchangeability were sacrificed, which resulted in a large proportion of the finished product being scrapped by the inspectors. The manufacturer assumed that if he were expected to produce universal joints of better quality, still more parts would be scrapped by the inspectors, and his costs would mount still higher. But the experienced automobile builder showed him that by applying a few simple principles of interchangeable manufacture, he could make all his parts alike from the start, within certain predetermined limits; and would not only cut down his waste to a minimum, but could also reduce his inspection force, and would have practically no joints returned by dissatisfied customers.

Some years later, the manufacturer of universal joints told his advisor that by applying the principles laid down for him in their talk he had been able not only to improve his product to a point where he never received complaints, but also to produce so cheaply that he now really was making money; whereas, when he turned out a lower grade product, he had barely been able to pay expenses and stay in business.

The Swedish Machine Tool Industry

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THE machine tool industry in Sweden is very dull at present, and there is no immediate prospect for improvement. Very few machine tools are being manufactured, either for export or for the home market. Most of the plants are operating with reduced forces and short hours, doing just enough work to keep open. Practically everything that is being manufactured now in the various machine industries in Sweden is being made for stock, with the exception of a few standard lines, such as ball bearings. One of the reasons for this inactivity is the financial difficulties with which the machine tool as well as the other manufacturers of the country are confronted. Credit is not easily obtained, and the banks refuse loans under almost any conditions.

Obviously, there is very little market for American machine tools in Sweden at the present time, as even the Swedish and German makes of machines, which can be obtained at lower prices, have no sale. The orders that have been placed have been spasmodic. It may be said that until the constantly rising labor costs force the adoption of American methods of efficiency in manufacturing, there will be no market for high-production machinery in Sweden.

The Russian Soviet Government has recently placed an order for locomotives in Sweden, which has somewhat stimulated business, but conditions in Russia are so unstable that the value of these Russian contracts is doubtful, and cannot be considered as a permanent factor in improving business.

A notable post-war influence is perceptible in the quality of the Swedish machine tools now on the market. The grade of machinery known as "war machinery," which was produced rapidly to meet the acute demand during the war period and was of inferior quality, has disappeared. These poor-quality machines may be said to have disappeared in direct proportion to the decrease in demand. Better materials are now being used in the construction of machines. The small firms that sprang into existence during the war have almost all gone out of business, and the regular machine tool manufacturers are turning out machines of a quality comparable with those made in pre-war days.

Tendency toward Specialization in Manufacture

In general, industry in Sweden is waking up to a realization of the economies that can be effected by specialization, and there is a tendency for manufacturers to devote their energies and manufacturing facilities exclusively to the production of one line. It is possible in this way to reduce the cost of production materially. The fact, however, that the Swedish home market is so small that all industries of importance have to depend on exports has caused much discussion as to the advisability of this specialization. To depend almost wholly on export trade is precarious, considering the changes that have taken place in tariffs on imports in all countries; cases are known where tariffs have increased to such an extent as to make importation impossible.

Prices of Machine Tools

It is a fact of considerable interest that the prices of high-grade machine tools in Sweden are practically the same today as they were in January, 1919. Swedish manufacturers of such machines are neither willing nor able to reduce prices in order to sell their machines. As previously mentioned, pre-war quality is being maintained and in order to do this, it is necessary also to maintain prices at the present level. A general idea of the prices of machine tools in Sweden will be obtained from the following figures, which are based on present exchange (1 krona = 20 cents):

High-grade 28-inch lathe	$3280
High-grade 20-inch lathe	$2000 to $2200
High-grade 16-inch lathe	$1400
Cheaper grade 16-inch lathe	$ 720
German high-grade 2½-inch turret lathe	$2400
(This price was quoted when the exchange for the German mark was about 2.4 cents to 1 mark.)	
Swedish 2-inch turret lathe (cheaper grade)	$1340
Swedish 1¼-inch turret lathe (same make as 2-inch lathe)	$ 645
Plain manufacturing milling machine, size of table, 12 by 6 inches	$2470
High-grade vertical milling machine, size of table, 42 by 11 inches	$1400

German Competition

There is very little German competition in the machine tool line. This is due to the uncertain deliveries of German machine tools, and to the failure of German manufacturers to live up to the terms of their contracts as regards price. In most cases where contracts have been signed with German manufacturers, stating specifically that machines were to be made at a fixed price, the German makers have informed the buyers, when the machines were ready to be shipped, that the price had risen in the meantime, and that they were unable to supply the machines at the price quoted. In many instances, when the buyer agreed to pay the increase he was told that the machine had been disposed of, and he would have to wait for another machine to be made at a still higher price. The writer knows of cases where prices have been advanced again and again. This practice has injured the reputation of German manufacturers throughout the whole of Scandinavia. Several Scandinavian chambers of commerce have blacklisted German firms employing such practices, and it is surprising to see how many German manufacturers of high reputation previous to the war are on this list.

Labor Conditions

There are no serious labor troubles in Sweden at present. Wages are high, judged by pre-war standards, but the increase is offset by the cost of living, which rather than decreasing, has been steadily advancing in the last eighteen months. The average toolmaker is paid up to 50 cents an hour (at the present exchange rates) and machinists (both skilled and unskilled) receive 40 cents an hour.

No serious strikes have occurred since the enactment of the eight-hour law early this year. However, this law has had an injurious effect in some respects. According to its provisions an employer cannot ask an employe to work nor can an employe work voluntarily more than eight hours a day. If it is desired to operate a plant more than eight hours, special permission must be obtained from a governmental bureau, and over-time rates must be paid. This results in checking production and increasing the cost of manufacture, as well as in limiting the amount a workman can earn. Naturally, it is looked upon with disfavor both by the employers and by the employes. There is strong agitation for a repeal of the law, and it is likely that if it has not already been changed, it soon will be. Whatever steps are taken that will result in increased production will benefit not only the machine tool industry but business as a whole.

TESTING HIGH-SPEED STEEL STOCK

It is important that every bar of high-speed steel used in the manufacture of high-grade tools be subjected to a rigid test. The most careful machine work and hardening will not save a tool from the scrap heap if the steel is defective. Obviously, it is impossible to manufacture tools of a uniform quality from high-speed steel if the steel itself is not uniform. By uniform high-speed steel is meant a steel that is free from pipes, seams, cracks, segregated carbides, decarburization and fiber—a steel that will harden quickly and uniformly with a smooth velvety grain that is almost amorphous. That a steel should harden is not sufficient; the grain must be smooth and even, and the steel must be tough as well as hard. An even grain will not compensate for a pipe down the center; hardness combined with a woody structure means brittleness; and the value of the finest grain is absolutely nullified if the characteristic shiny crystalline ring of decarburization is present.

After exhaustive tests and experiments, the Fastfeed Drill & Tool Corporation, Toledo, Ohio, came to the conclusion that the only way to test high-speed steel properly was to harden it, and this method is used in testing every bar of high-speed steel that enters the Fastfeed plant. The procedure, as stated by Mr. Traphagen, metallurgist of the company, in a paper on "The Selection of High-speed Steel for Tools," read before the American Steel Treaters' Society convention in Philadelphia, is as follows: As soon as steel enters the receiving room it is placed on a special rack, and it does not leave the rack until it is either accepted or shipped back to the mill. A piece from each bar is hardened by preheating slowly and thoroughly at 1650 degrees F., and then heating quickly in a furnace maintained at 2400 degrees F., after which the piece is quenched in oil until cool. The hardened piece is then broken transversely and longitudinally, and the fractures are examined carefully with a small low-power lens.

If the piece breaks easily, suspicion is aroused, and either fiber or excessive carbides are looked for, as one or the other of these defects is generally found in brittle steel. If the steel is decarburized, the shiny crystalline ring will be seen at a glance; this is a condition which is frequently encountered. A pipe may not be detected in the transverse fracture, but the longitudinal break quickly reveals it. If the tungsten content is low, it is generally found that the structure is coarse and crystalline when hardened at the high heat of 2400 degrees F. Woody fibrous structures are very common, and always show up in the longitudinal fracture; in the transverse fracture they are often masked.

A bar is never rejected on a single test. If the sample from one end of a bar is defective, a piece is cut from the other end, and if that also fails a piece is cut from the middle of the bar and tested. In order to eliminate the possibility of incorrect heat-treatment, at least two, and often three men harden the samples on different days, without knowing where the samples come from. It is possible for an error to creep in in one hardening, but the average results obtained by different men on different days, where the defect appears again and again, is positive proof that the steel is faulty. The test must be fair, and no amount of retesting is spared if there is the slightest doubt that the results are not correct.

In order to determine if a clean, smooth, uniform structure is conclusive proof of the value of a steel, dozens of drills were made up from steel possessing these properties and subjected to tests in a heavy-duty drilling machine. They were jammed through foot after foot of heat-treated forgings, using very little lubricant. After standing up under this test they were taken out and bounced on a concrete floor time and again, to test for toughness, after which they were again placed in the drilling machine and the whole test repeated. These tests, together with many official competitive tests, have proved the value of fracture tests in selecting high-speed steel for drills and other tools.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS' ANNUAL MEETING

Satisfactory progress is reported in the plans for the 1920 annual meeting of the American Society of Mechanical Engineers to be held in the Engineering Societies Building, 29 W. 39th St., New York City, December 7 to 10. In its selection of "Transportation" for the subject of the keynote session, the Committee on Meetings and Program feels that it has chosen the most important problem in post-war reconstruction. It is planned to subdivide the subject into a consideration of railroads, waterways, motor trucks, and terminals. Under railroads a subdivision will be made of short-line feeders and interurban trolley transportation. Men who will be able to enunciate the principles governing the solution of each of the problems in these subdivisions have been selected by the committee. The morning of December 9 will be devoted to the subdivisions, and in the afternoon the problem of transportation will be analyzed by a noted expert. This analysis will be followed by an open discussion on all phases of the subject. This entire session will treat with the problems of transportation from the economic as well as the engineering point of view, and it is confidently expected that the points brought out at the meeting will be of great value in educating the engineering profession and the public as to the exact requirements for a solution of this pressing problem.

A number of valuable papers sufficient to make up two general sessions have been received by the committee. Some of the subjects are: "Design of Large Center-crank Shafts," "Calibration of Nozzles," and "Strength of Gears." The subject of "Appraisal and Valuation" will also receive consideration at this meeting. A committee appointed by the president of the society will go over all of the papers previously presented before the society on this subject and prepare a résumé for presentation at the session. Additional papers will be procured where necessary in order to round out the subject. The sub-committee in charge of the Woodworking Session has prepared a tentative program which will prove of great value to all those interested in the adaptation of engineering principles to woodworking.

Initial sessions will be held by six of the newly formed professional sections. The Management Section is to devote its meeting to a consideration of the life and work of Henry L. Gantt. The Professional Section on Fuels will present four papers, the subjects and authors of which are as follows: "Fuel Supply of World," L. P. Breckenridge; "Low-temperature Distillation of Coal," O. P. Hood; "Fuel Conservation versus Money Conservation," D. M. Myers; and "Form Value of Energy in Relation to its Production, Transportation, and Application," Chester G. Gilbert and Joseph E. Pogue. The subjects of the three papers to be presented at the Railroad Section's session are as follows: "Static Adjustment of Trucks on Curves," "Increasing the Capacity of Old Locomotives," and "Modernizing Locomotive Terminals."

The Professional Section on Power is planning a symposium on Centralization of Power. It is proposed to discuss the mechanical phases of the centralized power circuit and the super-power plants to be built in connection with it. The Section on Textiles has presented its program, which covers the following subjects: "Humidity Control in Textile Plants," "Power Application to Finishing Plants," "Textile Fabrication for Mechanical Purposes," "Ventilation of Dye Houses." The Machine Shop Section will present papers on shop problems, among which is announced a paper by Earle Buckingham on "Side Cutting of Thread Milling Hobs."

Other subjects included in the tentative program are: "Foundations for Machinery," W. W. Akimoff; "Tests of Rear Axle Worm Drive," K. Heindlhofer; and "Constitution and Properties of Boiler Tubes," A. E. White.

An important and valuable feature of this next annual meeting will be the memorial session to be held for Past-President Dr. John A. Brashear.

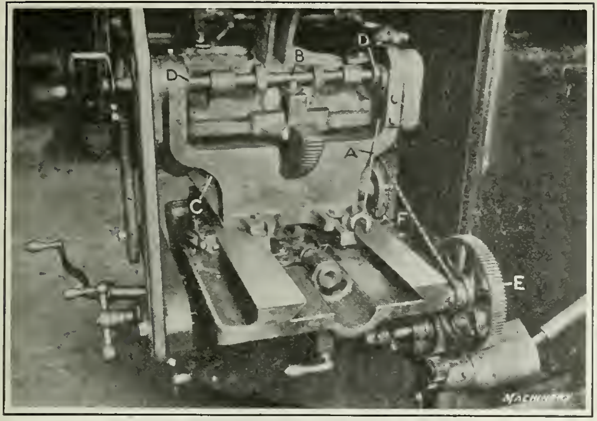

Fig. 1. Milling Machine equipped with Hinged Fixture for Use in performing Gang Milling Operations on Circular Segments

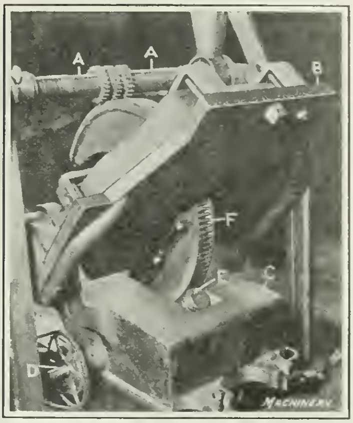

Fig. 2. View of Milling Fixture with Table Elevated, showing Special Feed Gearing

Milling Fixture for Circular Segments

Features of Construction of a Hinged Milling Fixture Designed for Use in Performing Gang Milling Operations on Circular Segments

IN gang-milling the circular segments of horn slides used on bevel gear cutting machines, Gould & Eberhardt, Newark, N. J., employ a hinged type of milling fixture which has a number of interesting features. The horn slide on which this milling operation is performed is shown in Fig. 3, and the surfaces thus finished are the two circular segment slots and the sections between these slots, as indicated by finish marks on the curved section of the casting. It will be seen from Fig. 2 that the gang of cutters employed for this milling operation consists of three straddle-milling cutters for finishing the bottoms and taking the side cuts, and two plain milling cutters for milling the outside surfaces of the circular segment, that is, the surfaces of the sections between the slots having a radius of 11⅛ inches. (See Fig. 3).

The operation is performed on a No. 4 Cincinnati milling machine, the fixture being bolted to the table as shown in Fig. 1. This illustration is a view of the front of the machine, showing the method of transmitting power for feeding the work past the cutters from the regular feed-gears of the milling machine. Fig. 2 is a view taken from the rear of the machine, and shows the fixture near its extreme tilted position, as well as the gang of milling cutters and the sleeves *A*, which serve the double purpose of locating the cutters laterally relative to the work, and of gaging the vertical distance between the arbor and the table of the machine. This distance is determined by means of gage *A*, Fig. 1, the U-shaped end of which fits over the aligning shaft *B*, so that when the gage is swung to a vertical position it will just pass under the sleeve. For the completion of this milling operation, a roughing and two finishing cuts are required, so that after the roughing cut has been taken, the table must be elevated sufficiently to permit the cutters to finish the surfaces. The amount of elevation thus required is determined by the use of sleeves of smaller diameter.

The machines upon which these slides are used are made in a number of sizes, so that in designing a fixture to accommodate the various horn slides required for these machines, provision was made for employing one base *C*, to which a hinged table *B*, Fig. 2, of the proper size for handling the particular casting to be milled may be attached. The method of hinging the table to the base of the fixture

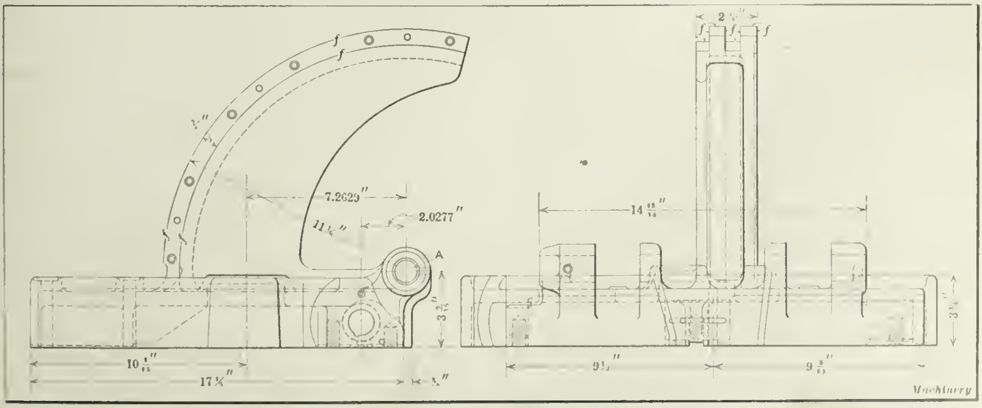

Fig. 3. Horn Slide for Vertical Gear-cutting Machine, in which a Gang Milling Operation is performed as shown in Figs. 1 and 2

may be seen quite clearly in Fig. 1, in which are shown the two bushings *D* that are fastened in the bearings of the base and that support the swinging table by means of similar bearings in that member.

In mounting the work on the table of the fixture, it is seated on its previously finished base and located by the aligning shaft *B*, Fig. 1, which fits the finished holes in the bearing bushings and the holes *A*, Fig. 3 in the work. With the work thus located on the table, it is secured to it by the use of regular clamping straps. The special equipment necessary to transmit the table feed movement to the fixture consists of a gear *E*, Fig. 1, which has a sprocket wheel on its hub by means of which sprocket wheel *F* on the bevel gear shaft of the fixture is driven by a sprocket chain. A better idea of the method of transmitting the feed to the fixture may be had by referring to the rear view, Fig. 2, where the sprocket wheel is clearly shown, as well as the bevel gear shaft *D*, which extends through the base of the fixture and carries a bevel gear meshing with a similar gear cast integral with the worm *E*. Segment gear *F* is attached to the swinging table of the fixture, so that as power is transmitted from the feed-shaft of the milling machine, the table may be swung radially from its pivotal support and thus pass the work under the cutters.

It has previously been mentioned that three cuts—a roughing and two finishing cuts—are required to finish the surfaces. The reason for taking the second finishing cut is that considerable spring is produced in the arbor during the first finishing cut (and also in the roughing cut) due to the length of the arbor and the nature of the work. It is almost impossible to provide an additional support for the cutters between the milling machine spindle and the outboard support of the arbor, since on its extreme upward movement the swinging table of the fixture and the work which it carries would interfere with any such means of providing a more rigid support for the arbor. The second finishing cut, therefore, is taken merely to correct the inaccuracies produced by the springing of the arbor during the first finishing cut.

The rate of feed for the roughing and first finishing cuts is 0.006 inch per revolution of the cutters, and for the second finishing cut 0.016 inch per cutter revolution. The cutters revolve at a rate of 36 revolutions per minute during the first two cuts and at 54 revolutions per minute during the final finishing cut. The total time required to perform this milling operation is 3½ hours per piece which is divided as follows: 1½ hours for the roughing cut; 1¾ hours for the two finishing cuts; and 15 minutes for loading and unloading the fixture.

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NEXT FOREIGN TRADE CONVENTION TO BE HELD IN CLEVELAND

At the seventh annual meeting of the National Foreign Trade Council held in New York City, it was decided to hold the eighth annual foreign trade convention in the spring of 1921 in Cleveland, Ohio. Previous national foreign trade conventions have been held in Washington, D. C., St. Louis, New Orleans, Pittsburg, Cincinnati, Chicago, and San Francisco. In deciding upon Cleveland as the place for the next convention, the council took into consideration the fact that the most productive industrial district of the United States lies within an area bounded by Buffalo, Pittsburg, Dayton, Cincinnati, Indianapolis, Chicago, and Detroit, and that Cleveland may well be considered as a central point within this area. Practically every conceivable article made for export is manufactured in large quantities within the area described. This area is the center of the iron and steel, automobile, truck, tractor, rubber, coal, and machine tool manufacturing industries in the United States. While New England and eastern Pennsylvania also occupy an important place as manufacturing centers, the total production of any one of the manufactures mentioned in this part of the country does not equal the production in the area described.

CASEHARDENING BY CYANOGEN GAS

The development of a process of casehardening parts by cyanogen gas is described in a paper recently presented before the Pittsburg branch of the Heat Treaters' Research Society by William J. Merten, metallurgical engineer of the Westinghouse Electric & Mfg. Co. The author first called attention to the fact that iron and low-carbon steels absorb carbon from carburizers very readily when in contact with these carbonaceous materials at temperatures above the upper critical point of the metal.

The quantity of carbon so absorbed depends upon: (1) The temperature of the steel; the higher the temperature, the faster and deeper the penetration of the carbon. (2) The character of the carburizer; this is a very important factor in successful casehardening. The elementary carbon is only of secondary importance. Oxygen and nitrogen compounds, which are added to or are present in the energizers that form carbonaceous compounds with solid carbon, are necessary to generate nascent carburizing mixtures of carbon monoxide and cyanogen gases. (3) The percentage of carbon present in the steel being casehardened. This also has a marked influence on the affinity of the material for more carbon up to saturation; that is, a low-carbon steel absorbs carbon faster than a high-carbon steel. (4) The presence of chromium, tungsten, or manganese. These elements accelerate the absorption of carbon, since they form double carbides with the iron. Nickel and silicon, however, retard absorption; the fact that they form solid solutions with iron may be the cause for this retardation.

From the statement made regarding the second of the foregoing factors, which emphasizes the necessity of nascent carbonaceous-gas formation for the penetration and absorption of carbon, it is readily conceivable that if a properly heated piece of steel is brought into contact with pure nascent gas, continuously generated in a separate unit or chamber, and preferably under pressure, the conditions for penetration would approach the ideal. A process of this kind is presented in the following, but, before describing it, a survey of the processes now in vogue, with their disadvantages and deficiencies, will be given.

Present-day Methods of Casehardening

The most common method of casehardening is to pack steel parts in a metal box filled with carburizing materials and submit the tightly closed box and contents to a sufficiently high temperature for an adequate length of time to obtain the desired depth of case. This process is simple, and assures fair success if properly conducted in accordance with a prescribed procedure, which has been found by experiments to give definite results under specific conditions.

The disadvantages of this process are manifold, some of the more important being: (1) The uncertainty of proper reaction within the closed box. (2) The difficulty in duplicating results as predetermined, because of the non-uniformity of carburizers. (3) The long exposure of the steel to a heat that is not well controlled, which results in a questionable structural condition. (4) The high cost of operation due to the inefficient heating method, the cost of boxes, and their rapid deterioration by oxidation or scaling.

A second method of casehardening is to immerse steel articles in a cyanide bath heated to about 1580 degrees F. This process is convenient and effective only on small articles and where the required depth is not more than from 0.005 to 0.015 inch, or where a mere surface hardening is wanted. This is a fast case-forming method, being accomplished in from ten to fifteen minutes. The outstanding disadvantage of this process is the impossibility of producing uniform cases. The parts that are deep in the melted bath do not receive the same depth of penetration as the parts near the surface because the evolution of the cyanide gases at or near the surface favors penetration. It is hardly feasible to have pots with a sufficient surface area to accommodate the casehardening of a plant.

A third method of casehardening consists of either dipping a cherry-red piece of steel or tool into a container of powdered cyanide salt, such as potassium cyanide, sodium cyanide, or ferro- and ferri-cyanides, or sprinkling the powdered salt on the red-hot steel surface, and putting the steel back in the fire. The casehardening produced in this way is superficial, and resistance to excessive wear cannot be expected.

In a fourth method, the carburizing gases are passed over a piece of steel heated in a retort. This process is applicable to parts that are intricate in design. All the processes referred to serve the needs of the different industries more or less satisfactorily. Box casehardening is dirty and wasteful and sometimes unsatisfactory. Casehardening by firing in fused cyanide salt is inefficient, unreliable, dangerous, and costly. Retort casehardening with carbonaceous gases is a step in the right direction, but it leaves something to be desired on account of the selection of the carbonaceous gases and the method of application.

Casehardening by Cyanogen Gas

The next process to be discussed, although still in the experimental stage, appears to present opportunities for efficiency, preservation of the product, simplicity of operation, assurance of uniformity and duplication of results, speed of operation, reasonable cost, and a wide range of utility. This process may be called "regenerated cyanogen-gas casehardening." It has long been recognized that cyanogen is the most efficient carburizing gas, that the case obtained is of a greater uniformity, is more rapidly produced, and is deeper, than one produced by carbon monoxide. However, the highly poisonous character of the substance has been a serious objection to its use, and resulted in the tendency to lead the gas wastefully to the stack, instead of controlling it to obtain maximum efficiency.

The principle upon which the new process is based is the casehardening of steel and iron-alloy articles in cyanogen gas evolved from a container filled with an alkali cyanide salt, heated by electrical energy or other means to accomplish the vaporization or boiling of the salt. The parts being treated are independently heated out of contact with the fused cyanide salt. The advantage of this will readily be appreciated on recalling the fact that casehardening is produced by contact with gaseous and not with solid carbon, and more especially with cyanogen gas. The depth of penetration is then only a function of the uniformity of the temperature of the article treated and the duration of treatment. Nascent cyanogen gas has a speed of penetration of four or five times that of carbon monoxide.

The furnace used in this process embodies the regenerative principle, since the excess gases not absorbed by the steel are forced under pressure into the fused cyanide bath and reheated. This causes a vigorous stirring of the bath, and the cyanogen gas is evolved with more energy and in larger quantities, and more vigorously attacks the steel surface, causing accelerated and deeper penetration. This regenerative type of furnace is a means of using the rather expensive salt economically, as the nitrogen gas on returning will combine with the sodium, and carbon in some cheap form such as charcoal can be added to the liquid as required, thereby retaining the original supply of cyanide salt intact. Therefore, this process may compete with the present box or packing carburizing processes. Sodium cyanide melts at 1112 degrees F. and boils at 1472 degrees F. Thus, the temperature of the pot must not be less than the latter, and to absorb this gas effectively, the steel must be at a temperature above the upper critical point, or about 1650 degrees F.

Advantages Obtained by Casehardening with Cyanogen Gas

Some of the advantages of this process are as follows: (1) The temperature control is more perfect, since a pyrometer is inserted directly into the heating chamber. (2) A finer, more uniform, and deeper case is secured than by any other process, and as less time is required, the cost is less. (3) The elimination of the use and storage of carburizers and carburizing boxes.

The advantage of cyanogen gas for casehardening has never been fully appreciated nor has the maximum efficiency been obtained during previous tests, as the temperature was at or below the boiling point of sodium cyanogen, which is considerably below the upper critical point of the steel. But, even in this unfavorable condition an exceptionally high speed of penetration has been noted. While some of the less important features of this process are still speculative in character, because of the experimental stage of the development, the method is based upon well-known principles, and the conclusions have been drawn from a careful study of general casehardening practice.

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ANNUAL CONGRESS OF NATIONAL SAFETY COUNCIL

The ninth annual congress of the National Safety Council was held September 27 to October 1, inclusive, at Milwaukee, Wis. This was the greatest convention of its kind in the history of the safety movement, not only in the numbers that attended, but in the diversity of interests that were represented, and in the actual work accomplished. More than 3100 persons were registered, the delegates being men from the various industries, educators of all types, municipal officials, chamber of commerce and other trade association representatives and newspaper and magazine correspondents.

The convention was opened by a mass meeting, which was unusually successful due to the large attendance and the high pitch of enthusiasm and interest awakened by the speakers, Marcus A. Dow, general safety agent of the New York Central Railroad Co., and Dr. Franklin C. Wells, medical director of the Equitable Life Assurance Society of the United States. Among other speakers who addressed the convention at following meetings were Samuel O. Dunn, vice-president of Railway Mechanical Engineer and president of the Associated Business Papers; James Newton Gunn, vice-president of the United States Rubber Co., and president and general manager of the United States Tire Co.; Dr. Otto Geier, president of the American Association of Industrial Physicians and Surgeons; and Judge George E. Mix, of the Municipal Court of St. Louis.

At a special meeting 1400 boys, each picked as the representative of his class in the Milwaukee schools, were addressed concerning safety problems and their part toward solving them. A similar meeting was held for 1200 principals and school teachers representing practically every public, parochial, and private school in Milwaukee. At the meeting of the education section, Fred G. Lange, director of safety of the Industrial Commission of Ohio, reported that every school in this state began the teaching of safety to the students at the beginning of the sessions this fall.

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LARGEST WELDED TANK

What is perhaps the largest welded tank ever built was recently completed by the Welded Products Co. at Birmingham, Ala., for the Liquid Carbonic Co. The tank is 22 feet in diameter and 30 feet high. It is made of ¼-inch steel plates, joined at the seams by oxy-acetylene welding. The big tank has satisfactorily withstood the required tests, and has been found to be gas-tight in all of the welded seams. Oxy-acetylene welding has been used with remarkable success in tank construction, and has for some time been used for many large tanks for gasoline storage and other uses. The welded construction is claimed to have proved thoroughly satisfactory and to be very much cheaper than riveted tanks of the same capacity. The welded tank is also said to have a distinct advantage in the fact that it is not so susceptible to rust as the riveted tank.

The German Machine Tool Industry

From MACHINERY'S Special Correspondent

Berlin, October 7

BUSINESS conditions in the machine tool industry are very unsatisfactory. Dealers do not buy, as they have large stocks on hand. The manufacturers of machine tools run their plants only from four to six hours a day, and in some cases they have shut down entirely. There are difficulties in every direction—lack of coal, lack of raw materials, a great decrease in the export trade, which threatens to come to a standstill, special export taxes, and labor troubles.

The Special Export Tax

The special export tax is very serious, and the president of the Association of German Machine Manufacturers, which is a general association including all the specialized associations of builders of different kinds of machinery, such as the Association of Machine Tool Builders, recently stated that this tax alone might mean the ruin of the whole German machine tool industry. This special export tax, which has been fixed at 6 per cent on the total invoice of machine tools, is being raised for the purpose of providing miners and other workmen employed in fatiguing occupations with extra rations of food, and the proceeds from the tax will be spent on social welfare. It is, therefore, also known as a "social" tax. It has been reduced on some classes of goods for export, but there is no prospect of its being reduced or eliminated in the case of machine tools.

German Manufacturers no Longer Able to Compete on Price in World's Markets

While there are no specific figures available showing how the prices of machine tools abroad compare with those at which German manufacturers could sell in a competing market, the conditions in some other machine building and tool making industries will indicate the situation. In one case, woodworking machinery is being sold by a Swedish firm in Sweden at a price corresponding to 11,890 marks, while a similar machine offered by a German manufacturer is sold in the domestic German market for 13,325 marks, and to this price 20 per cent would have to be added for freight and duty were the machine to be sold in competition in Sweden. In another case a machine is built in Sweden at a price corresponding to 16,400 marks, where the domestic German price is 21,000 marks, to which 20 per cent would have to be added for freight and import duty.

Comparing with prices in the United States, band saws are being sold in the domestic American market at prices corresponding to approximately 9120 marks, where the German domestic price is 13,950 marks. One type of wood planer is sold for 14,000 marks in the United States, and 16,500 marks in the German domestic market; molding machines for wood—11,400 marks in the United States, as against 13,900 marks in Germany. It is evident that on this basis it is not possible for the German machine builders to compete in the world's markets.

In tools the conditions are similar. The foreign business has ceased to a considerable extent, if not altogether. Files, for example, are offered in other industrial countries at one-third less than the German prices. Out of 174 firms with 12,500 workmen in one tool and hardware district of Germany 100 firms with 8000 men work exclusively on stock, and there is no improvement in the situation at present.

International Fair in Frankfort on the Main

The machine tool exhibition at the Frankfort Fair was of smaller dimensions than that at the Leipzig Fair last spring, but there was much to be seen in regard to new developments. The German machine tool manufacturers at the present time are making a distinct effort to reduce the time in machining work by increasing cutting speeds and feeds as well as by speeding up the operations. Among the more interesting machines exhibited were automatic sharpening machines for metal slitting saws by Fontaine & Co., Frankfort, and electric welding machines by the Mollwerke of Chemnitz. The Griesheim-Elektron firm also exhibited welding and cutting machines of novel design. Among these was a series of small, extremely handy machines, as well as a type known as a "longitudinal" cutting machine so arranged that by operating a small handwheel, plate after plate could be cut off in desired widths or thicknesses in a remarkably short time. The same firm also exhibited machines for cutting out circular and special shapes. Measuring tools were exhibited indicating the great progress that has been made in the optical type of measuring instruments and testing devices.

New Business Enterprises

There has been a considerable amount of foreign capital invested in Germany recently. The Berndorfer Metallwarenfabrik Arthur Krupp, Ltd., has been sold to a French group of financiers. Siemens & Halske, Ltd., have redoubled their capital, and it is reported that a very large part of the new stock has been taken over by American capitalists. The amount placed in America will be used for buying raw materials, particularly copper, there.

The Schneider interests of Paris have obtained control of a great many industrial works in Austria, among others the Skodawerke of Pilsen, and the Rustonwerke of Prague. These firms will be combined into a firm known as Union Europeenne Industrielle et Financiers with headquarters in Paris.

A large company has been formed under the name of the American Steel Engineering & Automotive Products, Ltd., (abbreviated "Amstea"). This company, it is stated, intends to import American steel into Germany and also to promote German exports.

Decreased Efficiency of Workmen

The following figures on the decreased efficiency of workmen and on the increase of manufacturing costs in a German machine tool plant may be of interest. In the foundry, in 1914, the average annual output of castings per molder was approximately 42 metric tons; in 1919 it was 22 tons. Meanwhile, the average wages in the foundry increased from 34 marks per week to 248 marks per week. In the machine shop, in 1913, the average amount of material machined per man per year was about 7270 kilograms; in 1919 it was only 2218 kilograms. The rise of wages for machinists was four-fold. In July, 1914, a skilled man earned 0.80 mark per hour; at the beginning of 1920 he received 3.30 marks per hour; but the purchasing power of the wages in consequence of the depression of the money dropped so that a wage of 3.30 marks per hour in 1920 scarcely corresponded to an hourly rate of 0.33 mark per hour in 1914.

In the shops of the Allgemeine Elektrizitätsgesellschaft, wages of unskilled labor rose in a greater degree than those of skilled labor. In 1914 skilled men received 0.76 mark per hour, and at the beginning of 1920, 4.25. Unskilled labor in 1914 earned 0.40, and in March, 1920, 4.10 marks. The minimum weekly living expenses for a workman's family of four members amounted in February, 1920 (average in 200 German cities) to 295 marks.

Machining Airplane Engine Parts

Tooling Equipments and a Special Indexing Work-holding Fixture Used in Connection with the Turret Lathe Practice of Alfred Herbert, Ltd., Coventry, England

THE articles on turret lathe practice that have been published in recent numbers of MACHINERY dealt with the practice of the manufacturers of machines of this type which are built in this country. The present article contains a description of the tooling equipments provided for machining several airplane engine parts on turret lathes manufactured by Alfred Herbert, Ltd., Coventry, England. The method of mounting the work in the machine for the different operations, and the various steps in each operation will be described in detail.

Tooling Equipments Required in First and Second Operations on the Nose-piece of an Airplane Engine

The airplane engine nose-piece illustrated in Fig. 1 is a steel drop-forging which is machined all over in four operations performed on turret lathes. The machining of this piece requires the use of a large number of tools and is an excellent example of modern turret lathe practice. In deciding upon the methods to be employed in the production of such a part, it should be remembered that drop-forgings usually have a hard skin which rapidly destroys the cutting edge of tools. For this reason it is advisable, when possible, to drill the various holes in the part instead of having them formed in the forging operation. The increased life of the tools more than compensates for the additional metal. For the same reason it is often more economical to produce a part of this type from a blank cylindrical piece of steel instead of from a forging, even though the time consumed in machining the part is somewhat longer. Forming tools should never be used in cutting through the scale, and a primary roughing cut should be taken on surfaces which are to be machined by a tool of this type.

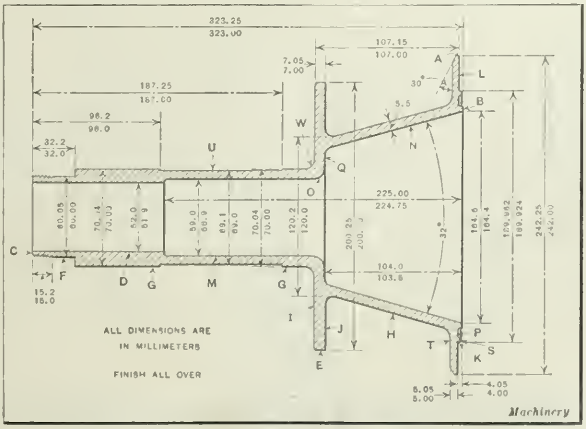


Fig. 1. Dimensioned Drawing of Airplane Engine Nose-piece

A lay-out of the tooling equipment used in the first operation on the part is shown in Fig. 2. The dot-and-dash lines indicate the outline of the exterior surfaces of the part as it comes from the drop-hammer. The various steps in this operation are taken in the following sequence: (1) The work is mounted on the machine, being held in a 15-inch Coventry chuck provided with hardened jaws that grip it along surface *A*. It is located in the chuck by means of surface *B* coming in contact with the heads of three set-screws in the jaws, which are provided for this purpose. (2) A spot is drilled in end *C* by the flat starting drill which is held in a split bushing mounted in the holder in Face 1 of the turret. (3) Hole *D* is rough-drilled by the drill mounted in the holder in Face 3 of the turret. This drill is 1⅞ inches in diameter so that the hole is drilled about 3.3 millimeters less in diameter than the minimum dimension given for hole *D* in Fig. 1. (4) The hardened bushing mounted on the end of the holder in Face 5 of the turret is inserted in hole *D* to provide a support for the small end of the work during the remaining steps performed on this machine. (5) Surface *C* is rough-faced and surface *E* rough-turned by tool *a* which is mounted in the square turret. (6) Surface *G* is rough-turned from surface *C* to surface *I*, and surface *I* is rough-faced by tool *b* which is mounted in the square turret. (7) Taper surface *H* is rough-formed by the forming tool *c* which is mounted in a tool-holder on the rear of the cross-slide. (8) Surface *E* is turned to a diameter of 8.010 inches in order to adapt it for mounting in the chucking fixtures used in succeeding operations; surface *I* is faced; and surface *F* is turned; all of these cuts being taken by tool *d* which is mounted in the square turret. (9) The work is removed from the machine.

The tooling equipment used in the second operation on the forging is illustrated in Fig. 3. A special face-plate fixture is provided for mounting the work on the machine. This fixture contains a recess into which surface *E* of the work is seated, the work being held in the chuck by means of three clamps which bear against surface *J*. The order of the various steps in this operation is as follows: (1)

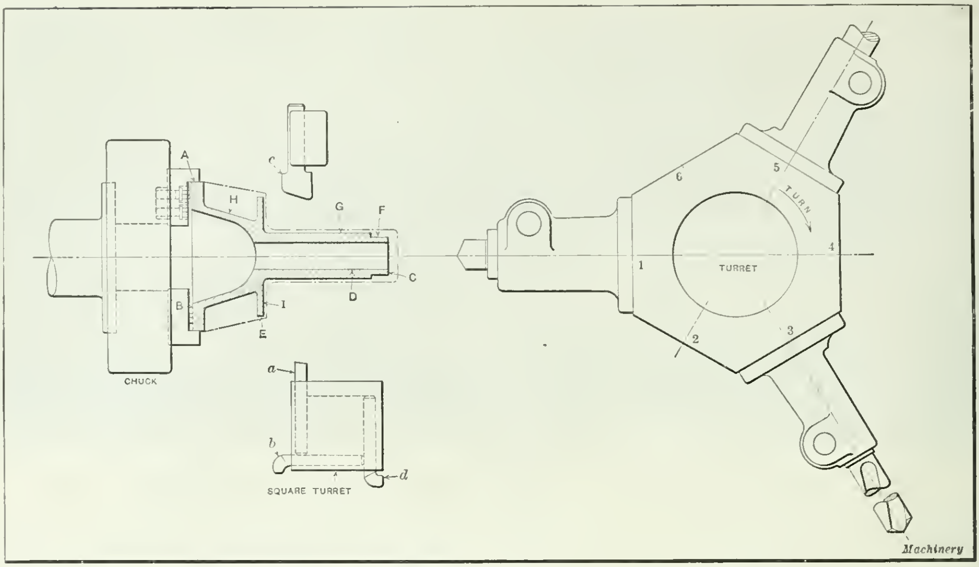


Fig. 2. Tooling Equipment employed in First Operation on Airplane Engine Nose-piece

The work is mounted on the machine in the manner just described. (2) Surface *B* is rough-faced; surface *K* is rough-turned; surface *L* is rough-faced; and surface *A* is rough-turned; all of these cuts being taken by tool *e* which is mounted in the square turret. (3) Hole *M* is rough-bored by the cutter held in the boring-bar mounted in the holder in Face 1 of the turret. This boring-bar is provided with a pilot which extends into a bushing in the machine spindle during the taking of this cut. (4) The internal taper surface *N* is gashed out by the stepped double-edged forming tool mounted in the holder in Face 2 of the turret. By referring to the end view of this tool shown at *f*, it will be seen that the device consists of two tools secured on opposite sides of a bar. Means are provided for adjusting these tools. The outer end of the tool-holder is provided with a hardened steel bushing *g* which extends into hole *M* when the tool on this tool-holder is being used. (5) Surface *N* is rough-formed by the forming tool mounted in the holder in Face 4 of the turret. This tool is similar to the one mounted in Face 2 of the turret except that the taper surfaces are not stepped. It is also provided with a pilot bushing. (6) Surface *B* is rough-faced; surface *K* is rough-turned; surface *L* is rough-faced; and surface *A* is rough-turned; all of these cuts being taken by tool *h* which is mounted in the square turret. This

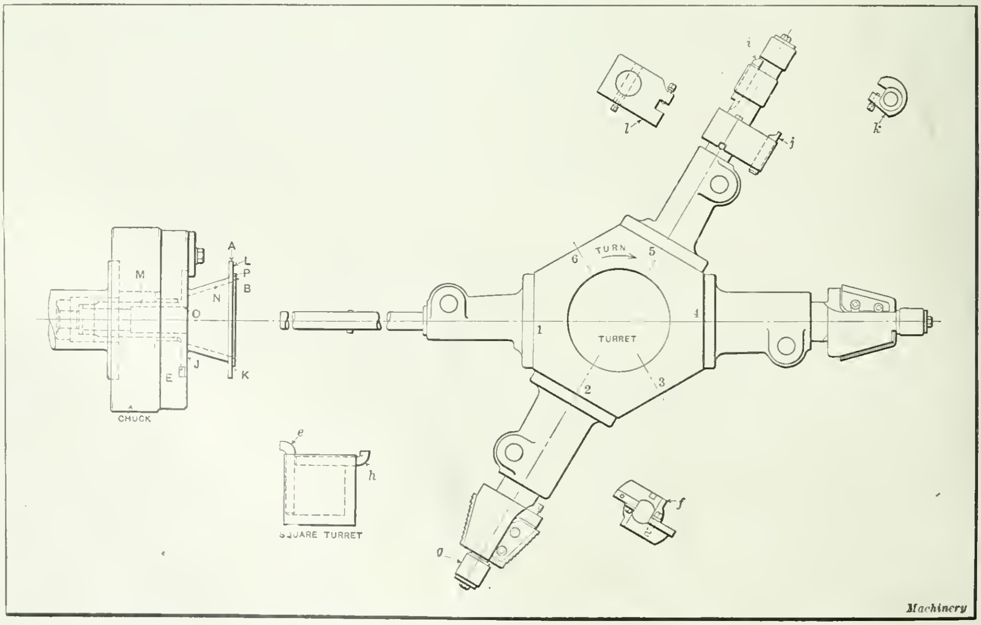


Fig. 3. Tool Lay-out used in taking Roughing Cuts on the Flange End of the Airplane Engine Part

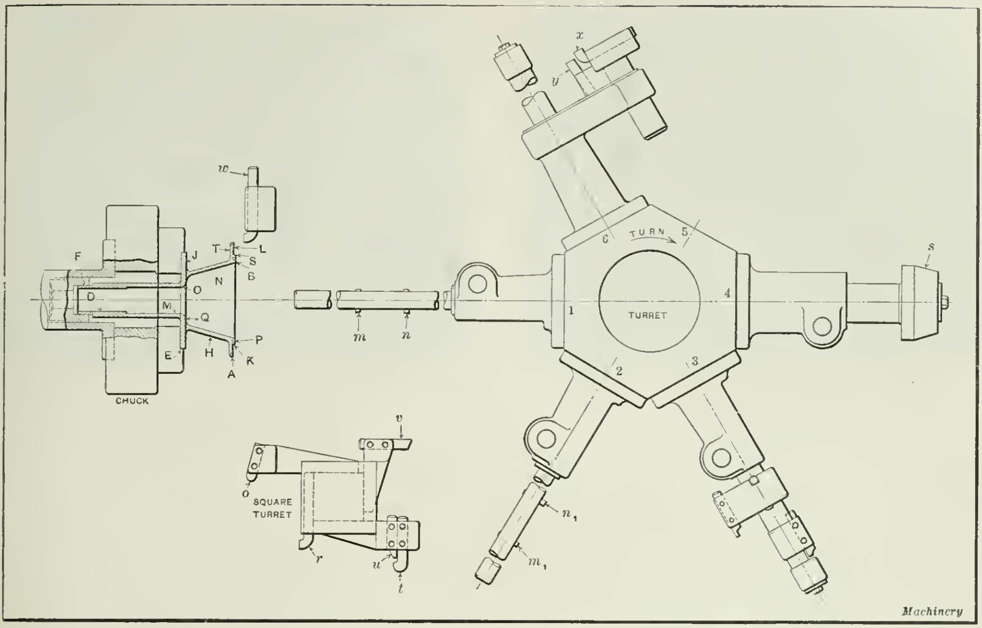


Fig 4. Lay-out and Tooling Equipment used in Finishing Operation on the Flange End of the Nose-piece

tool is similar in shape to tool *e*. (7) Corner *O* is rounded by tool *i*, and recess *P* is rough-formed by tool *j*, these tools being held in the piloted tool-holder mounted in Face 5 of the turret. End views of the attachments provided for mounting these tools are shown at *k* and *l*.

Tool Lay-outs Used in Third and Fourth Operations on Nose-piece Forging

A lay-out of the tooling equipment used in the third operation on the forging is shown in Fig. 4. The successive steps performed in this chucking are as follows: (1) The work is mounted in a 15-inch Coventry chuck provided with suitable recessed soft jaws that grip the work around surface *E*. The small end of the forging is supported by means of surface *F* being inserted into a specially provided bushing in the end of the spindle. (2) Holes *D* and *M* are rough-bored by tools *m* and *n*, respectively, which are held in the boring-bar mounted in the holder in Face 1 of the turret. (3) Holes *D* and *M* are finish-bored by tools m_1 and n_1 which are mounted in the boring-bar held in Face 2 of the turret. (4) Surface *N* is finish-taper-bored by tool *o* which is mounted in the square turret and used in conjunction with a taper attachment, and surface *Q* is finish-faced by the same tool which is fed across surface *Q* by means of the cross-slide. (5) Surfaces *A* and *K* are rough-turned and surfaces *B*, *L* and *S* are rough-faced by tool *r* which is mounted in the square turret. (6) Corner *O* is finish-rounded and recess *P* is finish-formed by two separate tools mounted in the holder in Face 3 of the turret. These tools and the holder are similar in construction to those mounted in Face 5 of the turret, Fig. 3. (7) The revolving part *s*. mounted on the end of the attachment held in the holder in Face 4 of the turret, is inserted into the tapered surface *N* to provide means for supporting this fragile end of the work during the remaining steps performed in this chucking. (8) Surface *T* is finish-faced and chamfered at the outer end by tools *t* and *u* respectively, which are held in the square turret. (9) Surface *H* is finish-taper-turned by tool *v* which is mounted in the square turret and used in conjunction with the taper attachment, and surface *J* is finish-faced by the same tool. (10) Surfaces *B*, *L* and *S* are finish-faced and surface *K* is turned by tool *w* which is mounted in a tool-post on the rear of the cross-slide. (11) Surface *A* is finish-turned by tool *x*, and surface *K* is finish-turned by tool *y*, these two tools being mounted in the piloted tool-holder which is held in Face 6 of the turret, as shown.

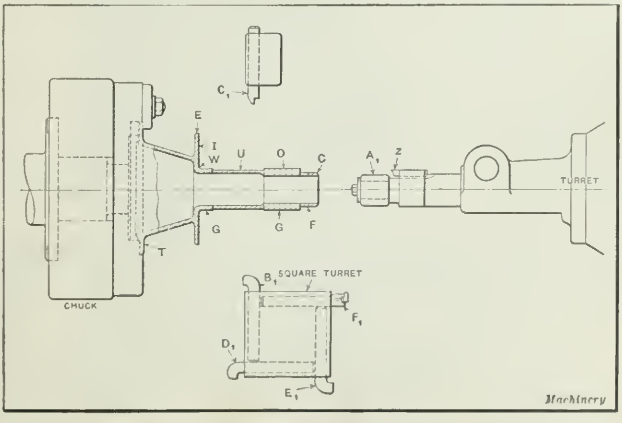


Fig. 5. Equipment provided for performing the Final Operation on the Engine Nose-piece

The final operation on the forging is performed with the tooling equipment that is illustrated in Fig. 5. The various steps in this operation are taken in the following order: (1) The work is held in a fixture in which it is seated by means of surface *K*, Fig. 1, and is held in place by clamps which bear against surface *T*. (2) Surface *C* is faced and chamfered by tool *z* which is mounted on a holder in the hexagonal turret. This tool-

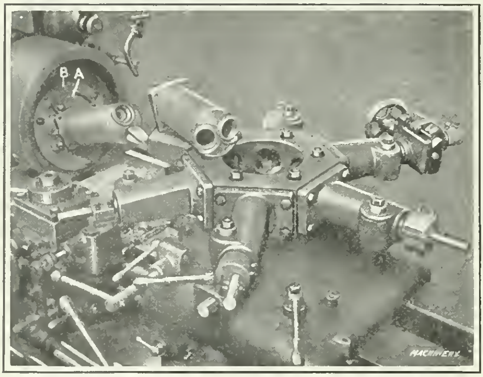


Fig. 6. Machine provided with Tools and Special Indexing Fixture required in machining the Cylinder Head of a Water-cooled Airplane Engine Cylinder

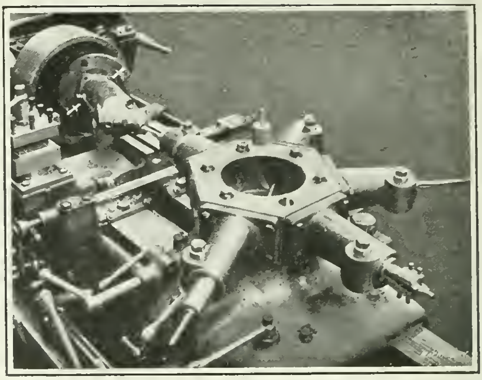
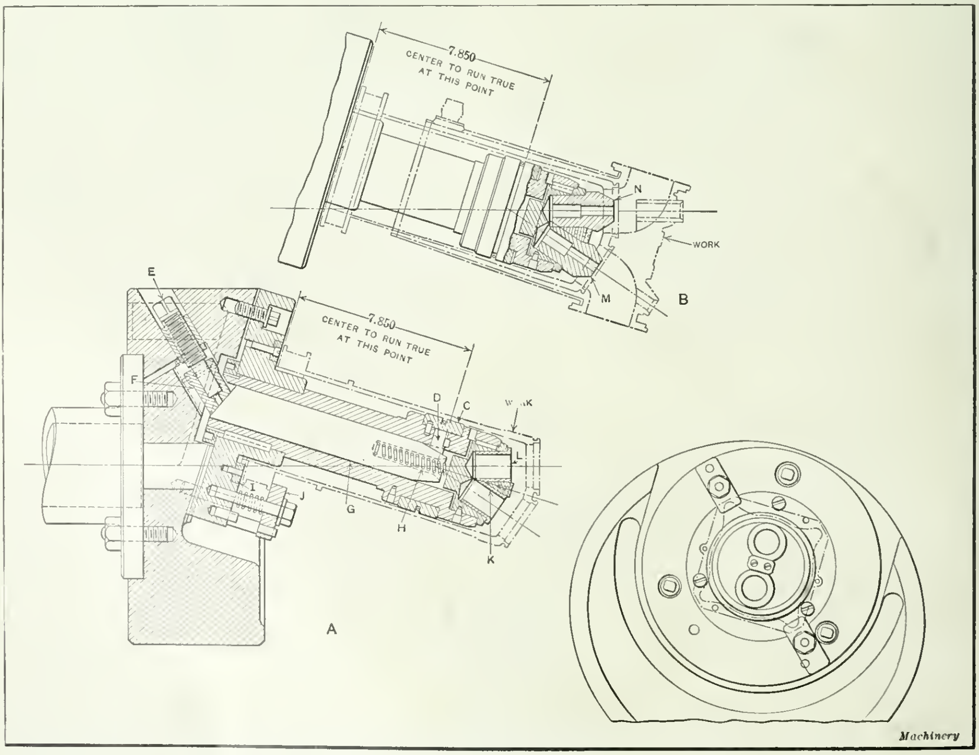


Fig. 7. Set-up of Tooling Equipment and Work on Machine employed in machining the Valve Guide Holes in the Airplane Engine Cylinder

holder is provided with bushing A_1 which is inserted into hole *D* during this and succeeding operations in order to support the work at the small end. (3) Surfaces *F*, *G*, and *E* are rough-turned and surface *I* is rough-faced by tool B_1 which is mounted in the square turret. (4) Surface *E* is finish-turned and rounded and surface *U* is finish-turned by tool C_1 which is mounted on a toolpost at the rear of the cross-slide. (5) Surfaces *G* are finish-turned; surface *I* is finish-faced; and corner *W* is finish-formed; all of these cuts being taken by tool D_1 which is mounted in the square turret. (6) Surface *F* is finish-turned by tool E_1 which is held in the square turret. (7) The threads on surface *F* are cut by the chasers held in tool-holder F_1 which is mounted in the square turret. (8) The completed part is finally removed from the lathe.

Indexing Fixture for Machining Bosses and Holes at an Angle in Cylinder Head

The machine shown in Fig. 6 is provided with the tooling equipment required in machining the holes and bosses in the head of a water-cooled airplane engine cylinder. These bosses and holes are at an angle with the center line of the cylinder, their axes intersecting on the cylinder center line on the inside of the cylinder. For this reason it was necessary to develop a special indexing fixture in order to bring the center lines of these bosses into alignment with the


7.850
CENTER TO RUN TRUE AT THIS POINT
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7.850
CENTER TO RUN TRUE AT THIS POINT
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Fig. 8. Special Indexing Fixture provided for machining the Holes in the Cylinder Head at an Angle with the Center Line of the Cylinder

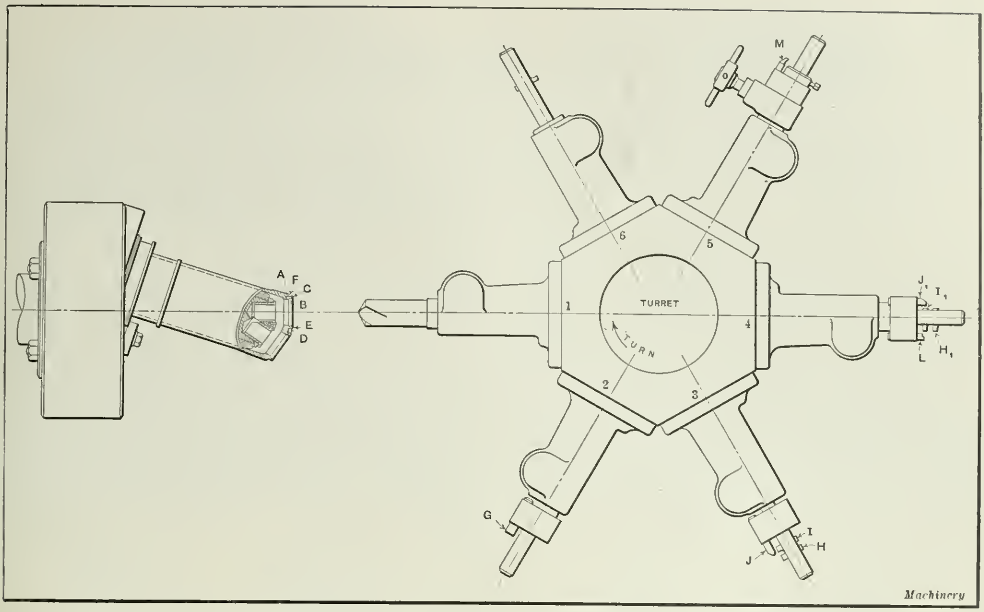

Fig. 9. Lay-out of Tools provided on Turret Lathe for machining the Holes and Bosses on the Head of the Cylinder preparatory to welding the Valve Boxes in Place

tools in the turret during the operations performed on them. The fixture is inclined at the same angle with the spindle of the machine as the axes of the bosses are in relation to the center line of the cylinder, so that after one boss has been placed in position for the operation, it is only necessary to revolve the fixture through 180 degrees in order to bring the other boss into the correct machining position.

A sectional view of a fixture which differs slightly from the one shown on the machine in Fig. 6, is shown in Fig. 8; however, the general principles are the same. The work is placed on the fixture in the manner indicated by the dot-and-dash lines at *A*, being held in the fixture by means of the pressure exerted on the cylinder bore by the split bushing *C* as it is forced radially outward from the center of the mandrel by several pins *D*. This occurs when screw *E* is tightened, which causes the wedge-shaped piece *F* to act upon the end of plunger *G*, thus forcing it forward. Plunger *G*, in turn, forces pins *D* outward by means of the taper surface on the end of the plunger which is in contact with inclined surfaces on the ends of the pins. When screw *E* is loosened the plunger is forced back by the expansion coil spring *H*, which is held in a hole drilled in the front end of the plunger.

In locating the work on the fixture for the machining operation, use is made of two accurately spaced dowel holes which have previously been machined 180 degrees apart through the flange of the cylinder in order to provide means for locating the cylinder on the crankcase. These holes are of two different sizes, and the small one is utilized in locating the cylinder for machining the first hole and boss. Plate *I* is provided with a pin which is inserted into this dowel hole, after which clamps *J* are tightened, thus holding the work in place. After the first hole and boss have been machined, clamps *J* and screw *E* are loosened and the cylinder is revolved approximately 180 degrees. The actual location of the second boss is accomplished by inserting a hardened plug through the machined hole in the first boss into the bushing which happens to be in the same position as bushing *K* in the illustration. When the cylinder is in this position the pin in plate *I* will be in the largest dowel hole in the cylinder flange, which on account of its size, does not influence the position of the cylinder. On the machine shown in Fig. 6, the work is indexed by revolving plate *A* on which the cylinder is mounted, through 180 degrees. This plate is placed eccentrically with the machine spindle, and the correct position is determined by means of a spring plunger. The fixture is then clamped in the desired position by means of the circular gib *B*.

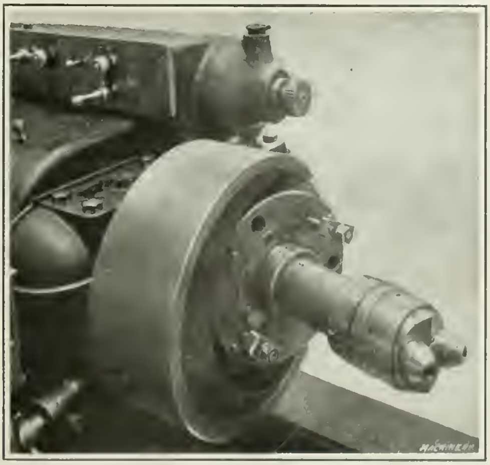

Fig. 10. Close-up View of Machine provided with Inclined Fixture used in machining the Valve Guide Holes

Tool Lay-out Employed in Machining Cylinder Head Bosses and Holes

The tooling equipment with which the machine shown in Fig. 6 is provided, is illustrated in Fig. 9. The various steps in this operation are taken in the following procedure: (1) The work is placed on the fixture in the manner previously described. (2) A hole is drilled through one of the bosses by the drill mounted in Face 1 of the turret. (3) Surface *C* is rough-faced by tool *G* which is held in the tool-holder mounted in Face 2 of the turret. This tool-holder is provided with a pilot which extends into the bushing which happens to be in the position indicated by bushing *L* in Fig. 8, while taking this cut. (4) Hole *A* and counterbore *B* are bored by tools *H* and *I* respectively; and surface *D* is turned by tool *J*, these tools being held in the tool-holder mounted in Face 3 of the turret. (5) Hole *A* and counterbore *B* are finish-bored by tools H_1 and I_1 respectively; surface *D* is finish-turned by tool J_1; and chamfer *E* and surface *C* are finish-faced by tool *L*, these tools being held in the tool-holder in Face 4 of the turret. (6) Recess *F* is formed by tool *M* held in the special slide tool mounted in Face 5 of the turret. (7) Hole *A* is finish-bored by the tool held in the piloted boring-bar mounted in Face 6 of the turret. After these steps have been performed, the cylinder is indexed in the manner previously described and similar cuts are taken on the second boss and hole in the cylinder head.

Machining Valve Guide Holes in the Cylinder Head

After the foregoing operation is performed on the cylinder head, the water jacket is fitted to the cylinder and the valve-boxes are welded in counterbores *B*, Fig. 9, as indicated by the dot-and-dash lines at *B* in Fig. 8. The cylinder is then mounted on the fixture as shown at *B* in order to machine the valve guide holes. The only difference between the fixture as shown at *B* from the way it is shown at *A* is that bushings *K* and *L* at *A* have been replaced by bushings *M* and *N* in order to accommodate the smaller boring-bar pilots used in machining the valve guide holes. The first position of the cylinder is determined by the pin in plate *I* and the dowel hole in the cylinder flange as previously described. The second position is determined by inserting a hardened plug through the hole finished in the first part of the operation, and into the bushing which is in the position indicated by bushing *M*. This is identical with the method used in locating the cylinder for the second portion of the operation shown at *A*. Fig. 10 shows a close-up view of a machine provided with the inclined indexing fixture that is used in this operation.

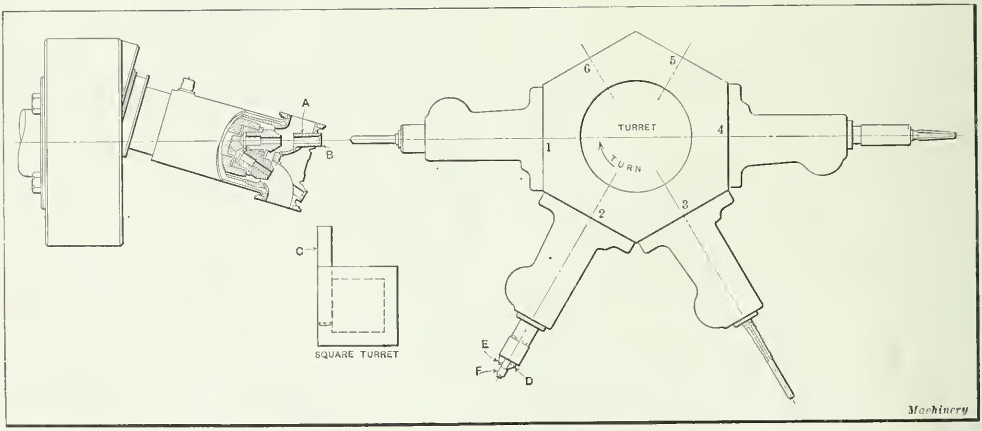

Fig. 11. Tooling Equipment provided for machining the Valve Guide Holes in the Airplane Engine Cylinder Head

The tooling equipment used in finishing the valve guide holes is illustrated in Fig. 11. The successive steps in this operation are taken as follows: (1) The work is located on the fixture in the manner just described. (2) Hole *A* is rough-drilled by the straight-fluted drill mounted in Face 1 of the turret. This drill is supported during this step by the steady bar *C* which is mounted in the square turret. (3) Hole *A* is chamfered at its outer end by tool *D*, and surface *B* is finish-faced and chamfered by tool *E*, these tools being mounted in the holder in Face 2 of the turret. This holder is also provided with a pilot *F* which extends into the bushing that happens to be in the position indicated by bushing *N*, Fig. 8, while the cuts are being taken. (4) Hole *A* is rough-taper-reamed by the stepped reamer held in the holder mounted in Face 3 of the turret. (5) Hole *A* is finish-taper-reamed by the finishing reamer held in the holder mounted in Face 4 of the turret. After these cuts have been taken, the cylinder is indexed in the manner previously mentioned and the second hole is machined similarly to the first hole. A machine engaged in one of the reaming steps is shown in Fig. 7, this machine being provided with the indexing fixture shown in Fig. 8 and the tooling equipment illustrated in Fig. 11.

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MEASURING WORM AND ACME THREADS

By THOMAS A. REILLY

In connection with the article on page 1131 of the August number of MACHINERY, "Three-wire System for Measuring Standard Worm Threads," the writer would refer those interested in a complete study of the subject to the several pamphlets on thread measurements that have been published by the Bureau of Standards. A word of caution should also be given in regard to the use of the method proposed in the article in the August number, because the method explained is approximate only, and while nearly enough correct for practical purposes when the helix angle is not too steep, there are cases when, on account of the steepness of the helix angle the accuracy required in the work may not permit of the use of the method explained. It would be difficult, if not impossible, to give a general rule to determine when corrections should be made for the helix angle, as this depends largely on the nature of the work, and while the writer would like to see a simple correct method of calculating these measurements, it seems that no reasonably simple method can be proposed that would take in all the factors. Nevertheless, a word of caution in regard to the fact that the method proposed has limitations is not out of place.

* * *

The importance of forwarding shipping documents promptly when shipping goods to Australia is emphasized in a recent commerce report. The Australian Department of Trade and Customs has stated that failure of shipping documents to arrive in Australia by the time the goods reach that country has resulted in a decision that after January 1, 1921, goods will not be delivered until the documents are received. Only in exceptional cases will any deviation from this rule be made, and even then an extra duty of at least 50 per cent of the ordinary duty will be required, pending the submitting of the complete documents.

Stresses in Brackets and their Bolts

By VICTOR M. SUMMA, Engineering Examiner, American Brake Co., St. Louis, Mo.

THE design of malleable-iron or cast-steel brackets and their fastening bolts is often the result of individual opinion and "rule-of-thumb" methods rather than the outcome of a scientific investigation of the forces acting upon them. There is, however, very little justification for employing guesswork methods, especially as the scientific method is simple and in the majority of cases results in the production of brackets having greater strength for their weight than would otherwise be the case.*

In Fig. 1 is shown an ordinary bracket designed to support a load W suspended from a pin of diameter D at a distance l from the back and lower edge of the casting. As the tendency of the bracket is to turn about point O the bolts will be subjected to tensile stress as well as shearing stress. It is clear that while the upper bolts will resist a total shearing force Q equal to that of the lower bolts, the total pulling force on each set of bolts is necessarily unequal, so that the value of P is different from that of R. The strain of the top bolts is greater than that of the lower bolts in proportion to their distances m and n from O. Therefore, if P stands for the total stress of the upper bolts, the stress R of the lower ones will be $\frac{n}{m}P$ or $R = \frac{n}{m}P$. It is evident that to maintain equilibrium the following relation between the moments of W, P, and R about O must exist:

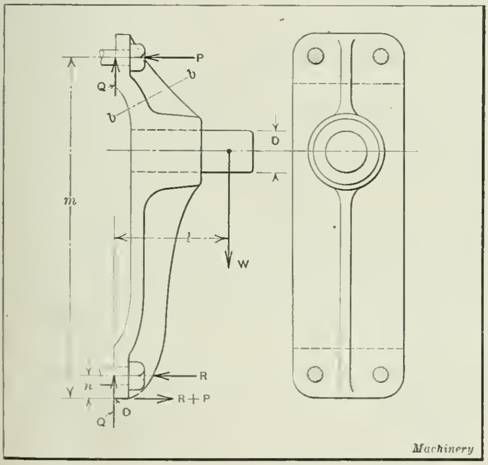


Fig. 1. Bracket designed to support a Weight W at a Distance l from the Wall

$$Wl = Pm + \frac{Pn}{m}n = P\left(m + \frac{n^2}{m}\right) = P\left(\frac{m^2+n^2}{m}\right).$$

from which it follows that:

$$P = \frac{Wl}{m^2+n^2}m, \text{ and } R = \frac{n}{m}P = \frac{Wl}{m^2+n^2}n$$

As these formulas give the tension forces acting on the bolts, the unit stress can now be determined if the diameter of the bolts is given. Since these stresses are normal to the shearing unit stresses of the forces Q, their combined effect can be determined by means of formulas:

$$P_1 = \frac{S}{2} + \sqrt{\left(\frac{S}{2}\right)^2 + S_s^2}, \text{ and } P_2 = \sqrt{\left(\frac{S}{2}\right)^2 + S_s^2}$$

in which

S = unit tensile stress;

S_s = unit stress in shear;

P_1 = maximum resultant in tension;

P_2 = maximum resultant in shear.

In order to analyze the stresses in the material of the bracket, it is necessary to draw the bending moment diagram shown in Fig. 2. It will be noted that the moment Wl in this diagram has been replaced by couple FF. This substitution is necessary in order to ascertain where the bending effect of Wl on the casting is the greatest, which of course depends on the location of the pin with respect to the bolts. As to the points of application of force FF it is reasonable to assume them to be applied at the top h and bottom k, respectively, of the pin having a diameter D, since it is at these places that the pin must react in order to resist the turning moment of load W. The intensity of force F is given by the equation $FD = Wl$, and is therefore equal to Wl divided by D.

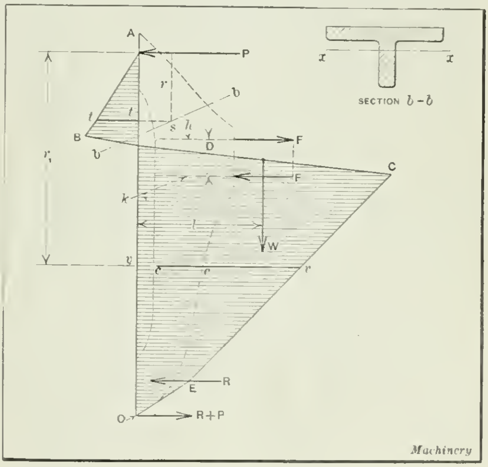


Fig. 2. Bending Moment Diagram for the Bracket illustrated in Fig. 1

The external forces can now be calculated from the foregoing equations, and as they are perpendicular to the straight line AO the bending moment diagram can be readily drawn by the usual method. In Fig. 2 the shaded area represents such a diagram in which lines such as vv and tt, for instance, represent to a given scale the bending moments at sections c-c and b-b, respectively of the casting, the straight line AO being the origin of the lines, and the broken line $ABCEO$, the line drawn through the end of each moment line.

Assume now that the view in the upper right-hand corner of Fig. 2 shows the section of the casting at b-b and that it is required to find the maximum stress of this section. It is first necessary to calculate the modulus of section Z with respect to the neutral axis x-x, about which the resisting fibers of the material tend to revolve. If r is the perpendicular distance of the center of gravity s from the line of action of the force P, then the bending moment to which the section is subjected is $P \times r$, the value of which is represented on the diagram by line tt. The maximum stress S

(when Z is the minimum value) is $S = \frac{Pr}{Z}$. From the diagram it is evident that this stress is tensile and that it occurs at the rib of the bracket.

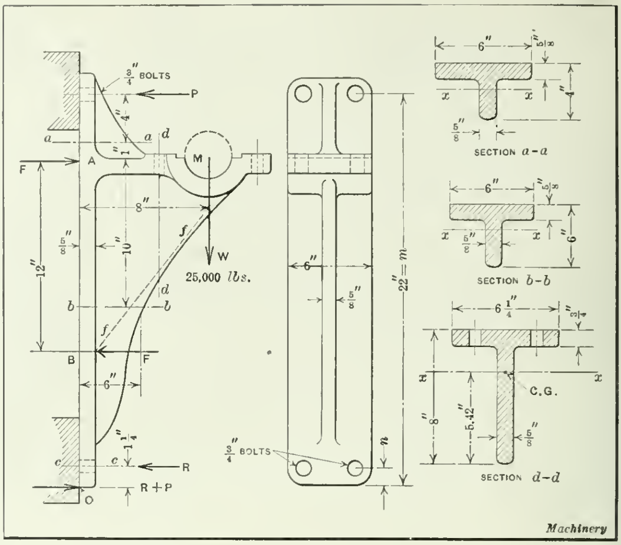


Fig. 3. Bracket designed to support a Weight of 25,000 Pounds at a Distance of 8 Inches from the Wall

Calculating Stresses in Bracket Bolts

The following example illustrates the method of determining the stresses in bolts which are employed in fastening brackets such as the one shown in Fig. 3 by substitution in the preceding formulas for the values of P and R:

$$P = \frac{25,000 \times 8}{22^2 + 1.25^2} \times 22 = 9100 \text{ pounds}$$

approximately

$$R = \frac{25,000 \times 8}{22^2 + 1.25^2} \times 1.25 = 516 \text{ pounds}$$

which shows that each of the top bolts carries a load of one-half of 9100 pounds or 4550 pounds in tension, besides one-fourth of 25,000 pounds or 6250 pounds in shear, and that they are the bolts liable to be overstressed. The maximum stresses due to the combined effect of the forces of 4550 pounds and 6250 pounds are

$$\text{Tension } P_1 = \frac{4550}{2} + \sqrt{2275^2 + 6250^2} = 8920 \text{ pounds.}$$

$$\text{Shear } P_2 = \sqrt{2275^2 + 6250^2} = 6650 \text{ pounds}$$

or dividing the results thus obtained by 0.4418 (which is the sectional area of a ¾-inch bolt) the corresponding unit stresses are found to be 20,100 pounds and 15,100 pounds per square inch respectively. From these results, it is evident that the size of the top bolts should be increased from ¾ to ⅞ inch in order to give the required strength.

Calculating Stresses in Brackets

In regard to the analysis of the stresses in the casting forming the body of the bracket shown in Fig. 3 it is first necessary to consider what action the hypothetical couple FF is likely to have. From the illustration it is evident that the force W has a tendency to put the fibers from A to M in tension, or to exert a pull at A while the fibers along ff will be in compression or cause a thrust at B. The arm of the couple may be assumed to be 12 inches in length and the following equation obtained:

$$F \times 12 = 25,000 \times 8$$

and

$$F = \frac{25,000 \times 8}{12} = 16,660 \text{ pounds}$$

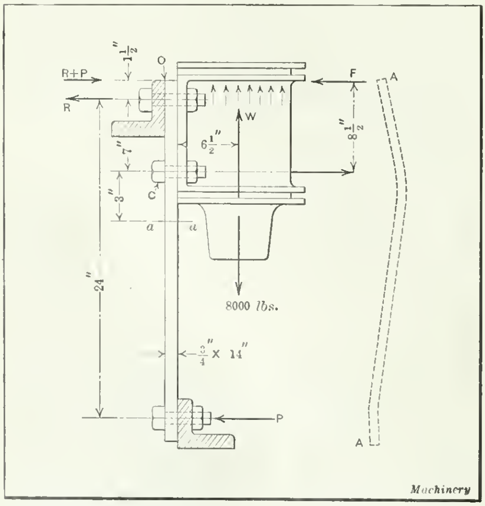


Fig. 4. Diagram showing how Force exerted on Piston of Air Cylinder acts on Plate to which Cylinder is attached

As the bending moment at a given cross-section is the algebraic sum of the moments of the forces on one side of the section, the stresses at section a-a (the section modulus of which is 2.5) are:

$$S = \frac{9100 \times 4}{2.5} = 14,500 \text{ pounds per square inch in tension}$$

or compression.

The stresses at section b-b (the section modulus of which is 5.7) are:

$$S = \frac{9100 \times 15 - 16,660 \times 10}{5.7} = 5400 \text{ pounds per square}$$

inch in compression.

The stresses at section c-c can now be calculated (taking into consideration the fact that $R + P = 516 + 9100 = 9616$)

$$S = \frac{9616 \times 1.25 \times 6}{(6 - 1.5) \times (0.625)^2} = 40,600 \text{ pounds}$$

in tension or compression which shows that the bracket is liable to break at this point and that the rib should reach down to the edge, or that the thickness should be increased at this point.

In calculating the stresses at section d-d (the center of gravity of which is 3½ inches from the line of action of the load) it is necessary first to calculate the least section modulus and the maximum section modulus. By calculation, these are found to be 9.7 and 20.5, respectively. Hence, the stresses due to the bending moment are:

$$S = \frac{25,000 \times 3.5}{20.5} = 4260 \text{ pounds per square inch}$$

which is evidently a tensile stress that occurs at the back of the casting; and

$$S = \frac{25,000 \times 3.5}{9.7} = 9000 \text{ pounds per square inch}$$

which is a compressive stress, and occurs at the front portion of the rib. The shearing stress is, of course, equal to the load divided by the area of the section and equals

$$\frac{25,000}{8.27} = 3020 \text{ pounds per square inch}$$

This analysis shows that the bracket is amply strong at this section.

Stresses in Simple Plate

In Fig. 4 is shown a cylinder which is attached to a 14-inch by ¾-inch plate by means of four bolts. Assuming that plate and cylinder are integral parts of each other, let it be required to find the stress in the supporting plate at a section *a-a*, 10 inches from the top bolts.

In this case the effect of the air pressure is an upward force whose turning moment about edge *O* is equal to 8000 × 7.25 inch-pounds. Therefore the resisting forces at the bolts through the angles are:

$$P = \frac{8000 \times 7.25}{(25.5)^2 + (1.5)^2} \times 25.5 = 2270 \text{ pounds}$$

$$R = \frac{8000 \times 7.25}{(25.5)^2 + (1.5)^2} \times 1.5 = 133 \text{ pounds}$$

Since the turning effect of the cylinder produces a couple *FF* acting at *O* and at the bolts *C* with an arm equal to 8½ inches

$$F \times 8.5 = 8000 \times 7.25$$

or

$$F = \frac{8000 \times 7.25}{8.5} = 6820 \text{ pounds}$$

Hence the bending moment *M* at the section *a-a* is the algebraic sum of the moments of all the forces on one side of it, or

$$M = P\ (24 - 10) = 2270 \times 14 = +\ 31,700 \text{ inch-pounds}$$

The accuracy of this value may be checked by taking the algebraic sum of the moments on the other side which equals:

$$-\ [F - (P + R)] \times 11.5 - R \times 10 + F \times 3$$
$$= -\ [6820 - 2403] \times 11.5 - 133 \times 10 + 6820 \times 3 =$$
$$-\ 31,700$$

Dividing this by the modulus of section of the plate with regard to the neutral axis in the direction of its width, the stress at *a-a* in tension or compression, is:

$$S = \frac{31,700 \times 6}{14 \times (0.75)^2} = 24,000 \text{ pounds per square inch}$$

The view *A-A* at the right gives an idea of the shape the plate is liable to take under excessive load. In conclusion it may be noted that the section *a-a* in this example, as well as *a-a*, *b-b*, and *c-c* in the preceding example, is subjected to flexure stresses only; and that the seemingly direct stress due to the pulling effect of *W* is counteracted in its effect by the opposite resistances of the bolts. In other words, these brackets which at first glance might be looked upon as struts—and analyzed as such—have very little or nothing in common with them.

* * *

REPAIRING LARGE STEAM HAMMER COLUMN

An unusual repair job on a large steam hammer column is described by John W. Weida, night superintendent of the Canton Drop Forging & Mfg. Co., Canton, Ohio, in a recent issue of *Reactions*. The weld was performed on the column of a 3000-pound steam hammer, the column being made from a hollow steel casting, with walls varying from 1½ to 2½ inches in thickness. The column was broken clear across and was repaired by thermit welding. To perform the work, the hammer was dismantled and an opening of 2½ inches between the two fragments of the column was cut out with an oxy-acetylene torch. Then the required mold was made around the weld, and 450 pounds of railroad thermit poured into it. The weld proved very successful.

ALUMINUM ALLOYS FOR CASTINGS AND FORGINGS

Experiments and researches in regard to the alloying of various chemical constituents and metals with aluminum, to produce better castings and forgings, have been conducted by the Lynite Laboratories, Cleveland, Ohio. The results obtained were recently discussed in a paper presented before the Indiana Section of the Society of Automotive Engineers by R. E. Carpenter, manager of the laboratories. Prior to the experiments, the effect of slight changes in the chemical constituents upon the standard alloys generally used had not been considered to any extent. The standard 92-8 aluminum-copper or No. 12 alloy was used almost exclusively. The first experiments included a careful study of the effect of slight changes in the percentages of the constituents as well as the results secured by adding other metals.

Production of New Alloys

The first important result was the production of the Lynite No. 112 alloy which is the original No. 12 alloy with slight additions of other metals. The desirable casting characteristics are not materially different from those of the earlier one, but a decided improvement in the physical properties is effected; in fact, there is an improvement of approximately 15 per cent. Alloy No. 112 was used extensively in producing Liberty engines. The minimum standards used by the inspection department of the Government for these parts allowed castings to pass inspection having a tensile strength of only 16,000 pounds per square inch, and an elongation of 1 per cent. Even at this low mark, many castings did not meet the specifications. However, the No. 112 alloy proved very satisfactory, as only three of the test bars taken from all the castings produced failed to attain this minimum tensile strength, and these failed by only a few hundred pounds. A great many of the castings had a tensile strength of 24,000 pounds per square inch.

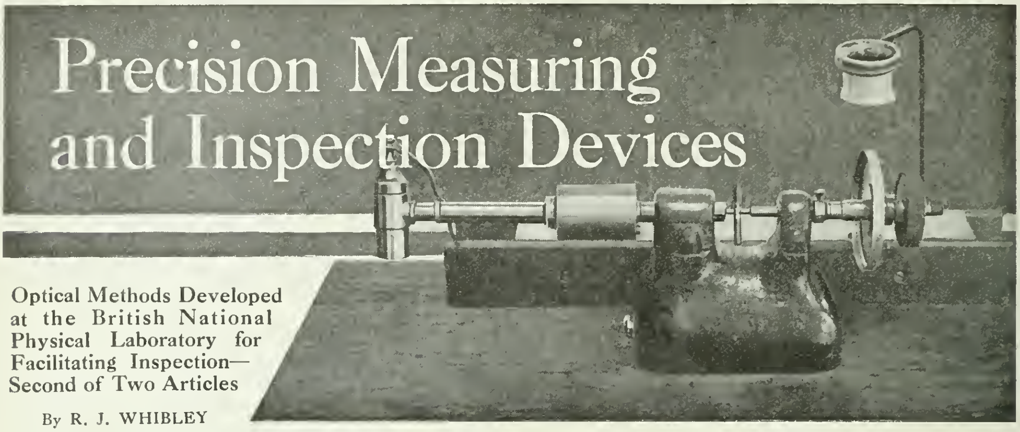
The next improvement was the No. 112-B alloy. Castings made from this alloy have an average tensile strength of between 19,000 and 21,000 pounds per square inch, with an elongation of from 1½ to 2 per cent, in standard test bars. Even with these physical properties, aluminum is only comparable with an ordinary grade of cast iron, except with respect to elongation. In an endeavor to develop a better material, 1000 or more alloys covering compositions of aluminum-copper, aluminum-zinc, and aluminum-zinc-copper, with other added constituents were made and tested. As a result of this research, the high-tensile-strength alloy No. 145 was evolved. This alloy has an average tensile strength of 27,500 pounds per square inch and an average elongation of 4.5 per cent. The combination of these two desirable qualities provides an excellent casting alloy which makes possible the use of aluminum alloys in parts previously made of malleable iron. It also permits the reduction of the sections of some castings to the point where the only limit is the ability to pour them satisfactorily in the molds. The specific gravity of this alloy is only 2.92; alloys having a specific gravity exceeding 3 are usually high in zinc and have not been found reliable.

Perhaps the most sensational result in the experiments was the development of a forging alloy having a tensile strength of from 55,000 to 65,000 pounds per square inch, an elongation of from 18 to 22 per cent and a reduction in area of from 38 to 40 per cent. The process followed in making such forgings involves working the material under accurately controlled temperatures and giving careful heat-treatments after forging.

* * *

The total working population of the United States is forty million people, according to statistics printed by the Department of Labor. The labor turnover is estimated to be about 25 per cent, and the cost of hiring and discharging employes is approximately two billion dollars per year.

Precision Measuring and Inspection Devices



Optical Methods Developed at the British National Physical Laboratory for Facilitating Inspection—Second of Two Articles

By R. J. WHIBLEY

THE first article on this subject described attachments used in connection with the Newall measuring machine and also dealt with various other optical devices used in connection with measuring and testing. The present article will deal with the minimeter and with the gage comparator used by the National Physical Laboratory for inspecting precision gage-blocks, by means of which it is claimed that readings to an accuracy of one millionth of an inch can be made.

The Minimeter

It has become necessary when inspecting precision gage-blocks to use measuring machines which are more highly sensitive than the standard machines of this type. Obviously it is useless to attempt to verify the accuracy of a statement that a gage-block is correct to 0.00001 inch if the measuring machine used is not capable of detecting differences greater than this magnitude.

The most important requirement of any comparator or measuring machine is that it must be independent of the operator as regards variations in reading for the same piece. The machines that are now in use at the National Physical Laboratory for inspecting precision gage-blocks give successive readings to an accuracy of one-millionth of an inch. In these a new principle has been adopted in that the moving anvil does not slide in a fitted hole but is attached to a fixed part of the machine by flexible steel strips, thus avoiding many errors that arise when sliding fits are used. The first machine made is illustrated in Fig. 13, while Fig. 11 shows the mechanical arrangement of the instrument proper. On the bed *A* a fixed block *B* is secured, on an extension of which the adjustable anvil *D* is mounted. The face of the anvil is novel, the usual flat being replaced by three small steel balls soldered in position, so that a three-point contact is established on the surface of the gage. The moving anvil is provided with one larger ball *E*, which is secured to block

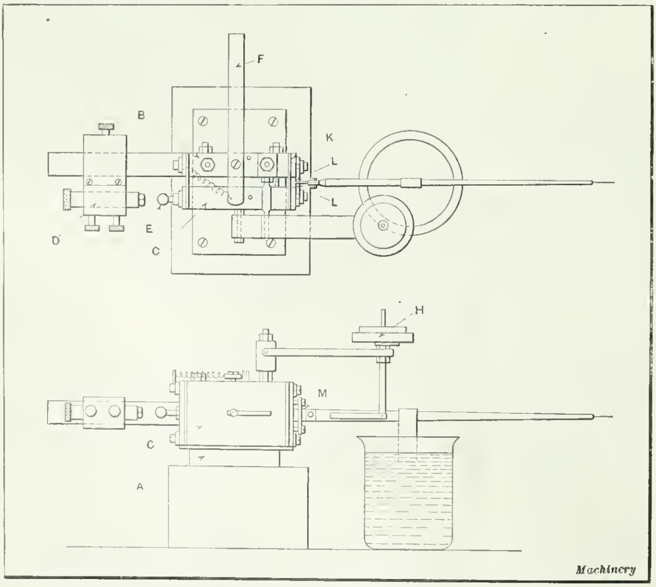


Fig. 11. Arrangement of the Magnifying Mechanism employed on a Minimeter used for inspecting Precision Gage-blocks

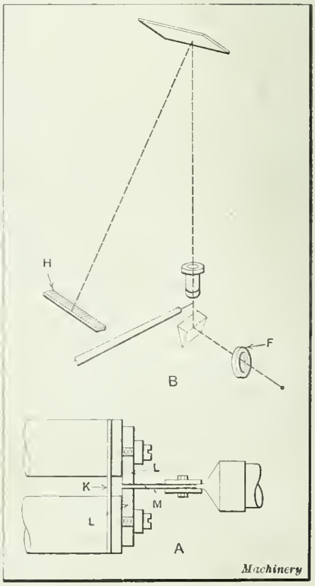


Fig. 12. (A) Needle Support on Minimeter. (B) Optical Magnifying Arrangement

C, which with *B* forms a pair of blocks slightly separated. The ends of the blocks are connected by two vertical strips of steel. The lower part of Fig. 12 shows an enlargement of the needle end of these blocks and their connections, one of the steel strips being seen at *K*. By means of these flexible strips movable block *C* can move in relation to the fixed block, a distance of about 0.0003 inch, the travel being limited by adjustable stops. Each block carries at the end, two small plates *L* to the inner edge of each of which a very thin strip *M* is attached. A small clamp holds the outer ends of these strips with a distance piece 0.02 inch thick between them, the clamp being formed with a socket into which a pointer 10 inches long is fitted, the heel of this pointer only being visible in the enlarged view. The pointer is made from a twisted quill of tin foil with an ordinary needle inserted at the pointing end. A small piece of foil attached to the needle extends down and just dips into a basin of water for the purpose of retarding the pointer movement.

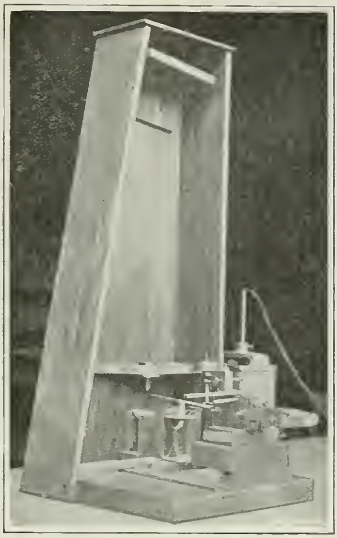


Fig. 13. Original Design of Minimeter constructed and used in the National Physical Laboratory, England

It will be obvious that any relative movement between the blocks *B* and *C*, Fig. 11, will cause the thin strips *K* to move relatively also, causing the pointer to swing. A movement of 0.00001 inch between the blocks causes the end of the pointer to move through 0.0035 inch, that is, a mechanical magnification of 350. For inserting the gage, the movable block is slightly retracted by the lever *F*, the travel of the block being limited in each direction by suitable stops. The steel strips by which the blocks are connected are not stiff enough to maintain a sufficient pressure on the gage-blocks under examination, and therefore the pressure is augmented by a weight *H* which operates through a parallel motion, the upper horizontal link of which is pivoted to a fixed portion of the instrument and the lower link to the movable block. The system multiplies the pressure by 2 so that an 8-ounce weight produces a pressure of 1 pound.

The travel of the end of the pointer is not read directly but is optically magnified. The diagram of the arrangement is shown at *B*, Fig. 12, and it will be seen that light from a "Point-o-lite" lamp is rendered parallel by a condenser lens *F*, after which it passes through a right-angled reflecting prism and illuminates the field traversed by the pointer. An image of the pointer is formed by the lens which appears on the scale *H* after reflection from an overhead mirror. When the image of the needle moves through 0.18 inch, the blocks have moved 0.00001 inch relatively to one another, the combined optical and mechanical magnification being 18,000. The scale is calibrated so that successive lines read differences of 0.00001 inch, each division being sufficiently large so that it may be subdivided by estimation to 0.000001 inch.

It is interesting to note that so far as the mechanical parts of the apparatus are concerned, the device does not call for any specially accurate workmanship; in fact, the sample in use was made in the workshop of the laboratory in a few hours. The three-point ball contact on one side of the gage and the single-point ball contact on the other, surmounts the difficulty usually experienced in making a pair of flat surfaces parallel with and perpendicular to the movement. Any small amount of dirt or grease does not affect the readings so readily, as four contact points quickly settle down and the creeping reading associated with flat surfaces which are not perfectly clean does not exist.

With this simple machine it is possible to compare two complete sets of blocks (excluding 2-inch, 3-inch and 4-inch sizes) to an accuracy of 0.000001 inch in nine hours. Three readings are taken on each gage and all the combinations are repeated as a check. With the ordinary measuring machine such an undertaking required seventeen hours, and the measurements were accurate only to 0.00001 inch.

Machine for Testing Precision Gage-blocks

The latest machine in use at the laboratory for testing precision gage-blocks is shown in Fig. 14. This machine was designed by J. E. Sears, the present head of the metrology department, and contains many ingenious features. The bed carries two heads, the right-hand one having an accurate bore, 1¼ inches diameter, accommodating a sliding spindle lapped to fit, which can be clamped in any convenient position. The left head is secured to the bed, and carries the moving anvil, the magnification of the movement being, as before, partly mechanical and partly optical. A gage-block is seen in position between the measuring faces.

The mechanism of the instrument is shown in Fig. 15. It will be seen that the measuring face of the moving anvil, which is ¼ inch in diameter, is on the end of a spindle which extends to the rear of the head, the spindle having at its forward end a collar with a spherical under surface which is held in a beveled hole in the headstock barrel by a compression spring. The rear end of the spindle is held by four screws radially arranged, the housing carrying the screws being slotted in four places. It will be seen in Fig. 16 at *A*, that one of these slots is deeper than the other three. The slots enable the adjustable measuring face to be brought into a position square with the axes of the heads and parallel with the fixed measuring face, since the fixed face was lapped in a special jig carrying the lapped adjustable spindle. The reason for making one of the slots deeper than the others is to supply a varied springy resistance to the adjusting screws in the housing, so that by tightening one of the screws the opposite screw is pushed away an amount

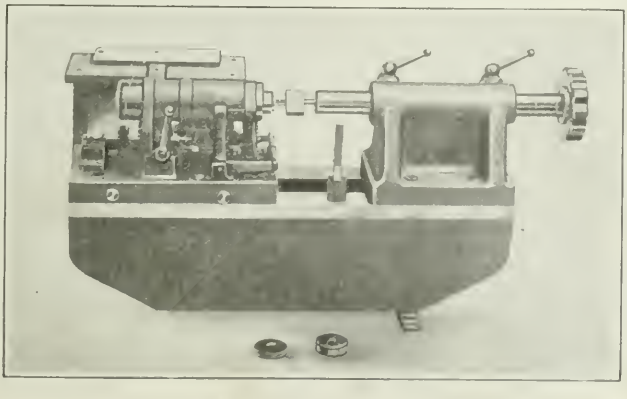


Fig. 14. Latest Type of Machine used for comparing Precision Gage-blocks up to Four Inches in Size

depending upon the stiffness of its support, the differential effect resulting in a very accurate adjustment of the measuring face.

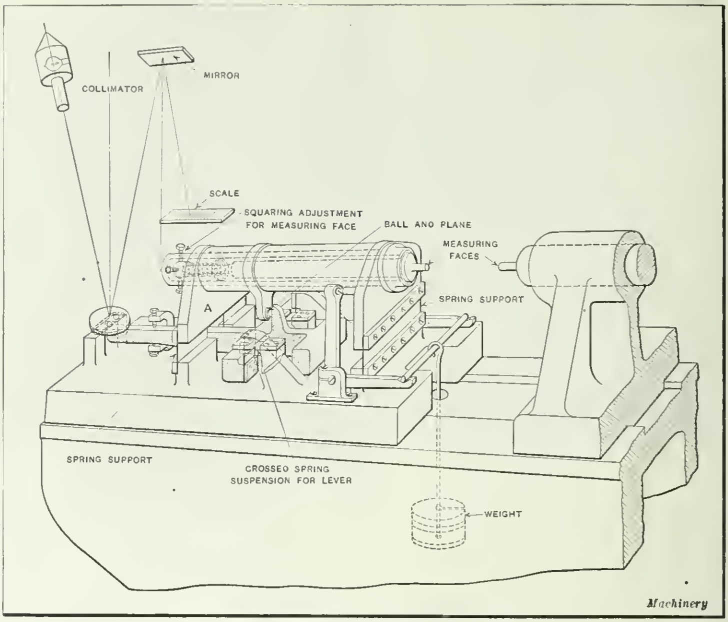


Fig. 15. Mountings of the Adjustable Measuring Anvil of Four-inch Comparator, and Optical Arrangement employed

General Arrangement

The movable barrel is secured to the fixed headstock by three flexible steel spring supports, one at the front and two at the rear. A lever seen in front of the left end of the barrel in Fig. 14 rotates a small cam which then bears on the rear leg of the barrel, as at *A*, Fig. 15, and retracts the measuring faces slightly for the insertion of the gages. The cam is then reversed to release the barrel, and the weight shown in Fig. 15, acting through the bellcrank and push-pins, maintains a constant pressure on the gage. The small movements of the barrel are transferred to the short vertical arm of another bellcrank. This bellcrank is not pivoted but is suspended in a very striking manner, upon which the success of the instrument largely depends. A cross-piece at the elbow of the bellcrank is supported at each side of the machine by two steel strips at right angles to each other. One end of each strip is secured to the bellcrank, the other ends being secured to brackets cast on the base. The lever moves, therefore, without friction or backlash about the intersection of planes passing through the neutral axes of the strips. The arrangement is shown diagrammatically at *B*, Fig. 16. The short arm of the bellcrank carries a steel ball which contacts with the plane face of a small hardened disk let into a projection under the barrel, the point of contact being vertically over the intersection of the neutral planes of the strips supporting the bellcrank. In this way sliding friction is practically eliminated.

It must be remembered that a movement of 0.000001 inch at the moving anvil is still of that magnitude at the ball contact. The long horizontal arm of the bellcrank multiplies the movement ten times. The movement here is transferred to a small circular disk carrying on its upper surface a plano-convex lens silvered on the under plane surface. The method of suspending the disk is clearly shown at *C*, Fig. 16. Three 1/16-inch balls are soldered on the under side of the disk, the middle ball being offset 0.1 inch from the center line of the two outer balls. The outer balls rest between two small cylinders 1/16 inch in diameter, which are laid in grooves cut in the two supports secured to the base. The other ball rests on a similar pair of cylinders located at right angles to the others and let into the upper face of the end of the bellcrank lever. Any movement of the bellcrank will, therefore, tilt the mirror lens with a minimum amount of friction. All the contacting surfaces are polished and the weight of the lens mirror and backing disk is reduced as much as possible.

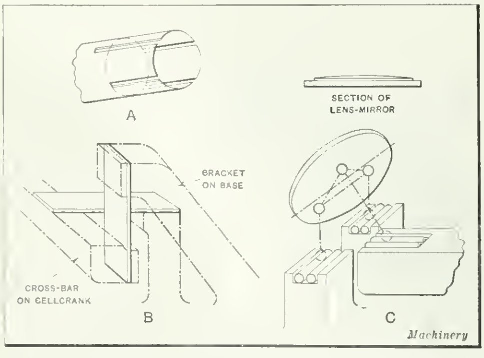


Fig. 16. (A) End of Slotted Spindle Housing; (B) Device through which the Barrel Movement is multiplied and transferred to the Lens; (C) Method of mounting Lens Disk

In an almost vertical position above the lens, the focal length of which is about 80 inches, a 100-candlepower "Point-o-lite" lamp passes light through an attached condenser or collimator. A fine wire is stretched across the condenser field so that an image of the cross-wire, illuminated by the lamp, may be brought to a focus after reflection from an overhead mirror to a scale situated immediately behind the moving barrel. As the height from the lens mirror to the fixed overhead mirror is 5½ feet, and as the light traverses this distance twice, the long arm of the optical lever is 5½ feet multiplied by 2, or 132 inches. The short arm of the optical lever is the distance of offset of the three balls supporting the lens mirror; that is, 0.1 inch. As the beam reflected from the tilting lens mirror turns through twice the angular tilt of the mirror, we have to multiply the result by 2, and since the bellcrank mechanical advantage is 10, the total magnification is:

$$10 \times (132 \div 0.1) \times 2 = 26{,}400$$

A travel of 0.00001 inch of the moving anvil gives a deflection on the scale therefore of about ¼ inch. The scale is calibrated by means of standard gage-blocks varying in size by 0.0001 inch, the divisions obtained being subdivided into 0.00001 inch. Readings to one-tenth of these latter divisions, that is, to millionths of an inch, can be readily taken. Owing to the use of flat measuring faces, cleanliness of the gages and faces is even more important than with the machine previously described, but it is possible with this machine to measure pieces that have no plane faces.

In dealing with such minute differences, the question of the temperature at which estimations are made is extremely important, since a rise of 1 degree F. will increase a 1-inch precision gage-block to approximately 1.0000064 inches, that is, an amount more than six times the sensitiveness of the machines used. It is, therefore, imperative that all comparative measurements should be carried out as rapidly as possible so that the gages shall not acquire an increased temperature through prolonged proximity to the body of the operator. The measuring faces will never come fully in contact with the gage faces unless both are thoroughly cleansed with alcohol or gasoline immediately before use. Ordinarily the faces are separated by the thin film which apparently adheres to all exposed surfaces, and in the case of polished steel amounts to between 0.000001 and 0.000002 inch in thickness. It is this film that supports the measuring pressure and also accounts for the phenomenon of "wringing."

* * *

PRECISION STUD-DRIVER

In assembling automobile engines for high-grade cars, it is required to drive studs so that there will not be a deviation of over 0.010 inch in the amount which different studs project above the finished surface. Such a degree of accuracy is not required because of mechanical considerations, but because of the superior appearance of the job when the studs are all set within this close limit of tolerance. For use in driving studs so that the projection above the surface will come within the required limits, a special stud-driver has been developed in one of the automobile plants. This tool is shown in Fig. 1. It is of quite simple design, consisting of an opening into which the stud projects so that it may abut against a stop *A* placed inside the stud-driver. The distance from the end of this stop to the finished lower face *B* is exactly equal to the amount by which it is desired to have the stud project from the work.

In using a tool of this type, it is only necessary to screw the stud down until the lower surface of the driver engages the finished surface of the work in which the stud is driven, thus stopping further turning of the stud and assuring the attainment of the required accuracy. Inside the body of the tool there is a three-lobed cam *C*, each surface of which engages a roller *D*. These three rollers grip the work, and as the tool is turned by hand, the cams inside the body force the rollers inward, the grip being proportional to the resistance offered by the stud against turning with the rollers. Three holes are drilled in the body of the tool to receive compression springs *E*, which serve the purpose of forcing the rollers up the inclined tracks *C* of the cam, so that when the tool is dropped over a stud, rollers *D* will engage the stud before the turning of the tool causes the cam *C* to force the rollers inward to secure a driving grip. With a tool of this kind, studs may be rapidly driven into place and held within the close limits previously mentioned. Time is saved that would otherwise be devoted to making repeated measurements to see that the studs are driven to exactly the required depth.

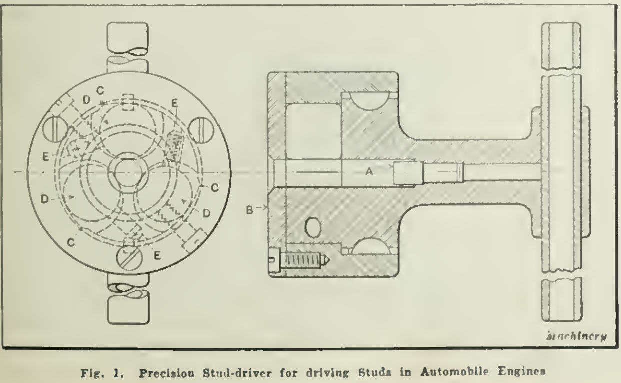


Fig. 1. Precision Stud-driver for driving Studs in Automobile Engines

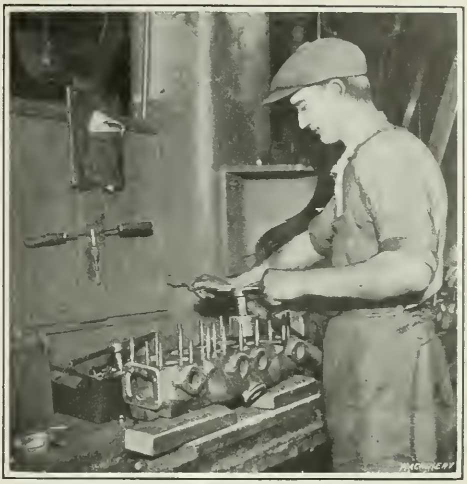


Fig. 2. Use of a Stud-driver of the Type shown in Fig. 1

* * *

EDUCATION IN MANAGEMENT

A course in "management education" to provide a sufficient number of properly trained executives for the industries of the United States is to be established in many American colleges, according to an announcement made by Dr. Hollis Godfrey, president of the Drexel Institute, Philadelphia, Pa., formerly commissioner of the advisory commission of the Council of National Defense. The plan, an outgrowth of a convention attended by representatives of industry and colleges in Philadelphia last March, is backed by corporations representing a capitalization of $26,000,000,000.

The council of management education has been formed to become "a clearing house for all industrial and educational matters in the country, to promote the mutual understanding of the mutual problems of industry and the college, and to keep a perpetual inventory of the educational needs of industry and of the ability of the colleges to meet these needs." Temporary offices have been opened in the Drexel Building, Philadelphia, until headquarters are furnished in Washington.

An annual appropriation of $100,000, borne entirely by American industry, has been made to carry on this work, which has been divided into two classes: First, to determine the field of service which each college can cover, and second, to provide the college with all industrial data which may be utilized in forming courses for men contemplating entering industry, and in reaching the men already in industry through extension courses. Within one year, it is estimated, one hundred colleges will have included the extension industrial courses and all will be provided with the industrial material upon which to base undergraduate work.

On the executive committee which has this work in hand are members representing the railroads, public utilities, and the oil, textiles, mining, rubber, leather, paper, and machinery industries. The machinery industries are represented by Frederick H. Payne, president of the Greenfield Tap & Die Corporation, Greenfield, Mass.

Small-quantity Production Methods

Application of Interchangeable Manufacturing Principles to the Methods Employed when Producing Machines in Limited Quantities

By EARLE BUCKINGHAM, Engineer, Pratt & Whitney Co., Hartford, Conn.

When comparatively few machines of one type are manufactured, few parts are duplicated in great numbers, and so, similar surfaces, rather than similar parts, should receive attention. This requires a thorough analysis of the four following factors: (1) The possibilities of standardizing the nominal sizes so as to have the smallest possible number; (2) the possibilities of standardizing the minimum clearances between companion parts for each standard size to meet the various functional conditions; (3) the possibilities of standardizing the tolerances for the various standard sizes and conditions; and (4) the determination of the best surface to be maintained as a standard size; that is, whether it should be the maximum male surface or the minimum female surface. Until these factors are determined, it will be difficult to lay out a simple and consistent procedure that will result in economical production.

Interchangeable manufacturing methods, as considered in previous numbers of MACHINERY, relate to a comparatively high rate of continuous production for which the expense of a complete equipment of special tools, fixtures, and gages is justified, and for which the time and constant study required to keep the component drawings in proper shape is essential to prevent any break in the continuous flow of production. But, when any commodity is manufactured intermittently in small lots, the cost of such procedure is often greater than the results justify. Nevertheless, many of the principles involved in interchangeable manufacturing can be applied with economical results to the production of small quantities.

One caution must be given before further discussion is made of the subject of standardization. In order to obtain the best results, all known conditions involved must be given due weight; but the consideration given to any factor should depend on the frequency of its occurrence. One usual condition will far outweigh several exceptional conditions. An unusual condition will always require special consideration regardless of attempts at standardization. If an established standard will not meet the required condition, it should not be used. Regardless of the extent of standardization, exceptions will always occur and must be dealt with. Thus, a standard is theoretically the best construction that will satisfy the majority of the known conditions. In practice, however, all existing conditions must be met. Therefore, if an established standard is unsatisfactory for any particular service, unusual conditions are present and must be met.

Standardization of Nominal Sizes

It is evident that if the number of nominal sizes employed is reduced, the number of standard tools and gages required in the production department will be correspondingly reduced. As an example, the matter of reducing the number of nominal sizes of shafting was recently taken up by a committee of the American Society of Mechanical Engineers, and their recommendations are well worth following. Two distinct but closely related problems were considered. First, the standardization of the diameters of shafting used for the transmission of power, such as lineshafts and countershafts, etc. This usually consists of cold-rolled shafting which is used without machining. The following fourteen sizes have been adopted as standard for this type of shafting: 15/16, 1 3/16, 1 7/16, 1 11/16, 1 15/16, 2 3/16, 2 7/16, 2 15/16, 3 7/16, 3 15/16, 4 7/16, 4 15/16, 5 7/16 and 5 15/16 inches.

The second problem confronted by the committee was the standardization of the diameters of machined shafting used by machine-tool builders in making their product. For this purpose, the following have been adopted as standard: Sizes up to 2½ inches, increasing by intervals of sixteenth inches; from 2½ inches to 4 inches inclusive, by eighth inches; and from 4 to 6 inches by quarter inches. The foregoing sizes are sufficient to meet the majority of conditions. If proper attention is given to this point in the design of a mechanism, the use of unnecessary intermediate sizes will be eliminated.

Standardization of Minimum Clearances

The amount of the minimum clearance between companion parts depends on many factors. Among them are the size of parts, the length of the bearing, the class of fit required, and the conditions, such as temperature, etc., under which they must operate. The classes of fits which apply to cylindrical parts, for example, may be approximately summarized as follows: (1) Running fits, where one part must revolve freely; (2) sliding fits, where one part must slide freely; (3) push, or dowel fits, where neither part is required to revolve but where both parts must assemble readily, and be held in alignment; (4) force, driving, or shrinkage fits, which are made with pressure or by shrinkage, and used in assembling parts which must be held in fixed positions.

The amount of the minimum clearance for a running fit is dependent, to some degree, on the length of the bearing. A long bearing, for example, may have a somewhat greater clearance than a short one. The proper length of the bearing depends on the load and the material used in the bearing. The load controls, to a large extent, the diameter of the bearing. Thus, the first step toward standardizing the minimum clearances is to determine the most common material employed in making the bearings, and to establish standard lengths of bearings for the various diameters of shafts. The exceptions which will inevitably develop must, of course, be treated on their own merits. Take, for example, a long feed-screw or a long bending roll which is supported on the ends. Regardless of the diameter or length of the bearing, greater minimum clearances than the established standard would be required. If the number of similar exceptions is appreciable, supplementary standards can be developed to meet them.

Another factor which must be considered before the standards can be safely established, relates to the conditions under which the parts must operate. Thus, if the parts must operate when subjected to higher or lower temperatures than normal shop temperatures, due allowance must be made. On the other hand, if such temperatures are the exceptions, the corresponding clearances must be exceptions. A good example of this occurred with a concern that manufactures power presses, several of which were ordered by a plant in Alaska. The shed in which the presses were set up was unheated; for this reason the lubricating oil became very heavy, and the presses would not work properly until the clearances in the bearings had been increased sufficiently to permit the heavier oil film.

In a similar manner, standards for all other classes of fits desired should be developed, not only for cylindrical but also for all other common surfaces. Every attempt should be made to standardize the more common surfaces and conditions first, and the others as it proves advisable.

Standardization of Tolerances

When manufacturing interchangeable parts in large quantities, the tolerances should be as great as the functioning of the mechanism permits, in order to secure the greatest economy of manufacture. As the functional conditions will vary so much, this practice seldom permits any great standardization of tolerances. On the other hand, when manufacturing in small quantities, using standard tools and equipment wherever possible, the tolerances should represent as far as possible, results which may be consistently obtained with the use of standard tools and which will insure that the parts will function properly. The first step, therefore, toward standardizing the tolerances is to determine the accuracy of parts produced by the various manufacturing methods. In this way, standard tolerances for each method will be developed, such as tolerances for grinding, reaming, drilling, boring, finish-turning, rough-turning, milling, planing, etc. The next step is to establish a practice for machining the various functional surfaces according to the requirements which they must meet. For example, on shafts, all running fits should be ground, all bearings should be reamed, etc. In general, the extent of the tolerances will increase as the sizes of the parts increase. Thus, for each method of manufacturing, a standard tolerance should be determined for each standard size.

Maximum Male or Minimum Female Size as Standard

In considering whether the maximum male or minimum female basic size should be the standard, shafts and their corresponding holes will be dealt with. In general, the tools for making the holes, such as drills, reamers, etc., are non-adjustable, while the tools for machining the shafts are adjustable, either in themselves or are carried on adjustable members of the manufacturing machines. This makes a strong argument in favor of maintaining the basic size of the holes as standard. This practice is now becoming quite universal. Of course, an exception to this will always occur when cold-rolled shafting is to be used without machining.

A little study will show that this practice can be applied to advantage on other surfaces. The basic dimension of the width of a slot or groove can be kept standard, and the necessary clearance can be provided by reducing the size of the mating member.

Effecting Economy by Using Standard Parts

The development and use of standard parts offers one of the greatest opportunities for economy in the manufacture of small lots of commodities. The greatest difficulty in the way of accomplishing this is the necessity of training the designers to use them. There seems to be a fear among these men that the extensive use of such standard parts will limit their initiative and curtail their originality. The fact is the extensive use of standard parts will eliminate a large amount of the designer's drudgery, thus freeing much of his time and thought for creative work.

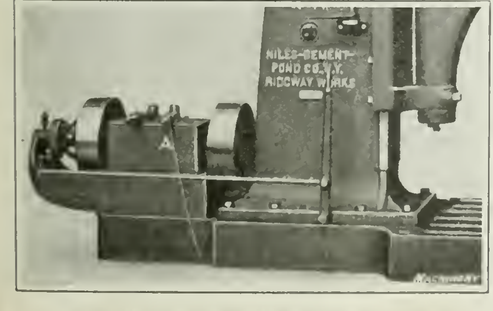


Fig. 1. Four-speed 10-horsepower Speed-box attached to the Rear of a Radial Drilling Machine

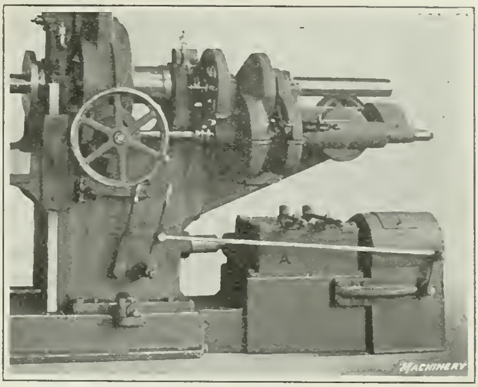


Fig. 2. Speed-box applied to a Horizontal Boring Machine

In order to promote the use of standard parts, records relating to them should be made in a simple and convenient manner. Certain types of parts, such as levers, gears, bushings, studs, pulleys, etc., should always be considered as potential standard parts, even if certain of them are used merely in a single place, and should be tabulated or indexed for ready reference. In this way a series of standard parts is readily begun. After the start, a study should be made and a balanced series laid out to cover possible future needs. Otherwise the series will be unbalanced, that is, the differences between some of them will be very small, while between others they will be very great. Such a series would eventually contain an excessive number in order to cover a given range. The essence of standardization is to reduce the number of standards to a minimum.

Standardizing Unit Assemblies to Suit Several Machines

The design of the commodity which is to be manufactured in small lots should be carefully studied and every opportunity taken to incorporate smaller unit assemblies. As with many of the component parts, each unit assembly should be considered as a potential standard. If this is done, many of them, such as oil-pumps, speed- and feed-boxes, reversing mechanisms, etc., will be found applicable to several machines.

An interesting example of what is possible along these lines is shown in the accompanying illustrations. Here a standard four-speed, 10-horsepower speed-box is illustrated on various types of machine tools. In Fig. 1, this speed-box is shown at *A* attached to the rear of a radial drilling machine. In Figs. 2 and 3, it is attached to different types of horizontal boring machines, its position again being indicated by *A*. This speed-box is also illustrated in Fig. 4, at *A*, as part of a large slotter. The various machines themselves are made in small lots as required, but these speed-boxes, and other common standard parts, are made in relatively large lots and carried in stock. This example indicates to a small degree the many possibilities along these lines.

It is of interest to note in this connection, that one large corporation which controls several plants building many different kinds of machine tools, has been carrying out a standardization program for several years. Certain types of parts and some unit assemblies which have been developed at the different plants have been compared and discussed.

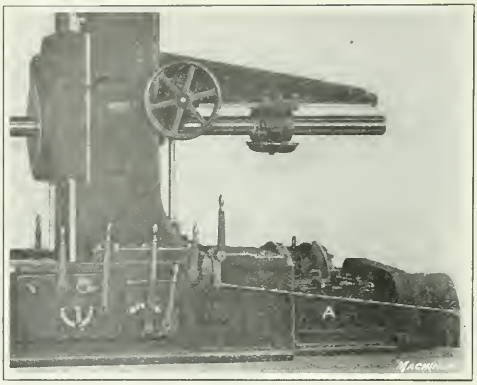


Fig. 3. Application of Speed-box to Another Horizontal Boring Machine

In most cases, this discussion has led to the adoption of a certain series of them as standards for all plants. In addition, the plant best fitted for that particular work has been selected to manufacture all of such parts or unit assemblies for all the plants. In this way, the economies resulting from producing in large quantities are secured, where no one of the plants involved has a very large production of any one size and type of machine tool. As with standard parts, if any extensive use is to be made of standard unit assemblies, they must be recorded and tabulated in a simple and convenient form for ready reference.

Component Drawings for Small-quantity Production

The component drawings of a mechanism which is to be manufactured in small lots will vary considerably from those used when the production is large. As a rule relatively few of the operating clearances and also few of the manufacturing tolerances will be specified. Notes, such as "force fit," "running fit," etc., will be the usual method of noting this information.

To determine properly the correct clearances and tolerances for any surface, much time is required for studying the design, checking results obtained on the various surfaces in production, etc. When parts are made in small quantities, there is little or no opportunity to do this work, although to specify these requirements without such study is generally useless. At best they are only a guess, and are often established by some one who knows little of the actual working conditions.

When a part becomes standard, or when elementary surfaces as in holes and on shafts are standardized, the production of these parts and surfaces is large enough to permit the necessary study and tests to be made. Here the component drawings should specify the maximum and minimum sizes exactly as in the case of component drawings for large-quantity production. A full discussion of the requirements of such drawings is given in the articles published in the November and December, 1919, and in the January and February 1920, numbers of MACHINERY.

Manufacturing Equipment

Relatively little special manufacturing equipment is provided for manufacturing in small lots. Generally nothing more than boring jigs and planer templets is necessary. The machine operators are usually skilled machinists and perform most of the machining cuts on standard machine tools with the use of standard cutting tools. Each piece of work is set up and clamped to the bed of the machine with only the aid of standard measuring tools to test its position. With such a type of operator, the component drawings do not actually require the same amount of detailed information as is necessary when the work is performed by less highly skilled labor.

In many cases, not even boring jigs or planer templets are provided; the work is first laid out, and then the machining cuts are taken to match the lines drawn. As the production increases, however, more and more special manufacturing equipment can be used to advantage. As the quantities become large enough to pay for the cost of this equipment, its provision and use will greatly promote economical production. The essential requirements of this equipment, whether much or little is provided, are identical with the requirements of equipment for manufacturing large quantities.

Gages and Methods of Inspection

The gages used in this type of manufacturing consist principally of standard measuring instruments and plug, ring, and snap gages of standard sizes. Thread gages for standard threads are also used to an appreciable extent, as well as adjustable snap and plug gages which may be set with the aid of standard measuring instruments or standard size-blocks. Where adjustable gages are used, it is very desirable to have means for sealing them so that they may be adjusted in the tool-room but not promiscuously in the shop.

When boring jigs are provided, these form in themselves effective gages for testing the location of holes by using suitable plug gages and bushings in place of the boring tools. When planer templets are employed, these also make effective gages, an indicator being substituted for the planer tool. As with other manufacturing equipment, gages should not be provided until the volume of production is great enough to make their use economical.

The inspection of parts made in small quantities, where stock is left on many pieces for fitting at assembly, and where the component drawings give incomplete information, is quite different from the inspection of parts made in large quantities. The extent of the inspection required depends to a large extent on the methods of paying the workmen. For example, when the wage is paid on a time basis alone, this inspection is relatively slight. On the other hand, if piece-work prices or bonuses are paid, a more complete inspection is required, as a bonus should not be given for spoiled work.

Most of this inspection requires a skilled workman, as little special gaging equipment is available, and this necessitates the use of standard measuring instruments in many cases and also many special set-ups. In addition, with the incomplete component drawings, the inspector must be sufficiently experienced to tell whether or not the parts as completed will function properly when no fitting is to be done at assembly. When fitting is required, he must also be able

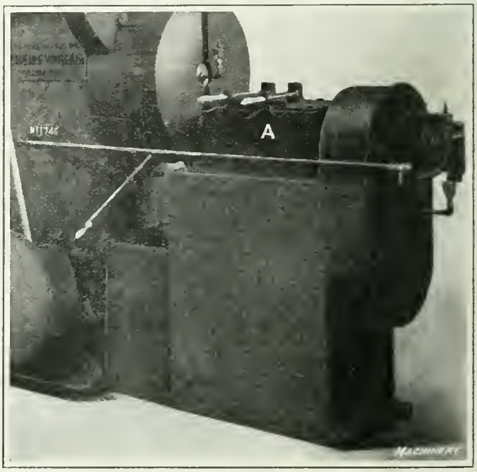


Fig. 4. Slotter equipped with Same Speed-box as shown on Other Machines

to determine whether or not the amount of stock left for this purpose is suitable.

On large pieces, the inspection should be made while the part is set up on the machine used in finishing it, so that if corrections are necessary, they can be made without an additional set-up. When no special locating fixtures are employed and a part is removed from the machine, it is almost impossible to relocate it in order to correct one surface and yet keep the proper alignment with the other finished surfaces. The inspector should be capable, not only of detecting errors, but also of convincing the workman of them without antagonizing him. The inspection of standard parts should be carried on in the same general manner as the inspection of parts produced on a large-quantity basis.

The assembling of small lots of machines usually involves a considerable amount of fitting. For example, all the small holes are not drilled in the larger pieces until assembly. Small brackets and similar parts are then clamped in position and the holes for their holding screws, dowels, etc., are located from them. Sliding members are scraped to fit each other, and to correct their alignment. This requires a certain amount of machinery on the assembling or erecting floor and also the services of skilled mechanics. However, as much of the machining as possible should be completed before the parts reach the assembling department. In most cases, this requires the provision of special manufacturing equipment and gages. Thus as the quantity of the production increases and more and more special equipment is furnished, less fitting at assembly is necessary. After the machines are assembled, they should be carefully tested for alignment, backlash, etc., and when possible, they should be actually tried out on work of the character they are made to perform. This last is the crucial test because upon its results the success or failure of the mechanism is judged.

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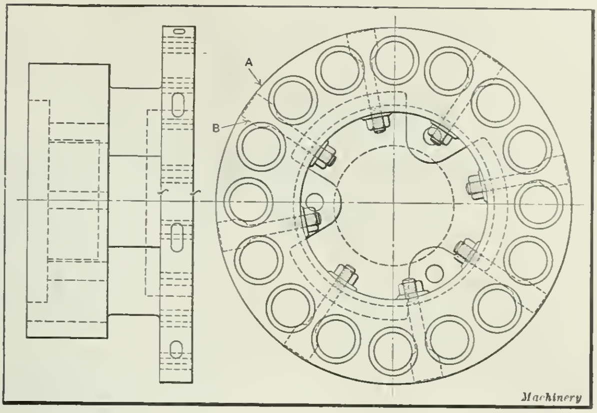


Fig. 2. Detail View of the Rotary Fixture used to carry Sixteen Bushings when machining them to Length

ROTARY FIXTURE FOR MILLING BUSHINGS

In the plant of the De Laval Separator Co., Poughkeepsie, N. Y., an old-style Brown & Sharpe rim milling machine is used for straddle-milling cast-iron bushings to length, and the excellent results obtained by equipping this machine with the fixture shown in Fig. 2, clearly indicate that a machine of this kind is especially adaptable for single-purpose operations on work of this general character. This is one of the various production jobs on which it can be safely said that no material advantage would be gained by employing modern machine tools of more or less complicated design.

The fixture with which the machine is fitted is shown in detail in Fig. 2, and mounted on the work-spindle in Fig. 1. The body of the fixture *A* is made of cast iron and carries sixteen hardened tool-steel bushings. It will be seen that each pair of these steel bushings is held in place by means of machine-steel lock-bolts *B* so that they may be readily replaced when so desired. The bushings which are machined in this fixture are made of soft gray iron, the rough castings being 2¾ inches long. These castings are first turned and cut in two on a Cleveland automatic, thus producing two bushings, each 1 5/16 inches in length. These are then ground to a diameter of 1 inch before being machined on the end by the machine shown in Fig. 1. The bushings are a push fit in the steel bushings of the fixture, from which they project on each side enough to permit an average of 7/64 inch to be removed by each cutter; that is, the finished length of the bushings is 1 3/32 inches. The diameter of the fixture on the center line of the bushings is 10 inches, and the fixture revolves at the rate of one revolution in 10.35 minutes so that the work is fed to the cutters at the rate of about 3 inches per minute. With due allowances for the time that is consumed in setting up and replacing the cutters, a production rate of approximately 85 bushings per hour is attained.

It will be realized that this is a continuous milling operation. The fixture is loaded and unloaded while in motion, and there is no necessity for stopping the machine; consequently, no time is lost by the operator after the machine is once in operating condition. Two side milling cutters, ¾ by 5 inches in diameter, are used, the speed of the cutter-arbor being 85 revolutions per minute. A tray of bushings is shown resting on a table near the machine, in which the bushings are placed in lots of 100. It may be well to state that the cast-iron blanks from which these bushings are made are also used to produce a bushing of the same diameter but of 2 15/32 inches finished length. The same type of equipment is employed in straddle-milling these long bushings as has just been described, but in this case the depth of cut is 9/64 inch instead of 7/64 inch. The same production rate of 85 pieces per hour is maintained and the same speeds for both cutter-spindle and work-arbor are employed.

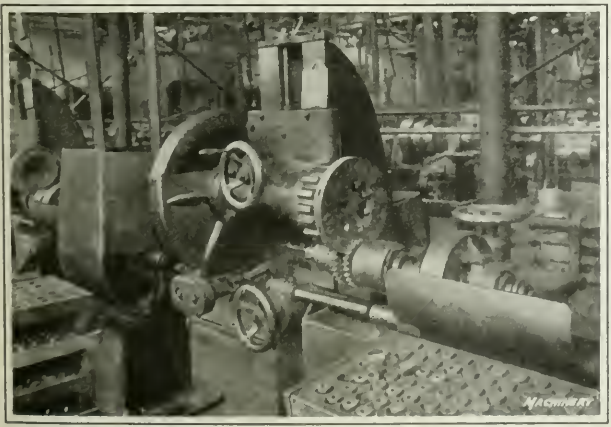
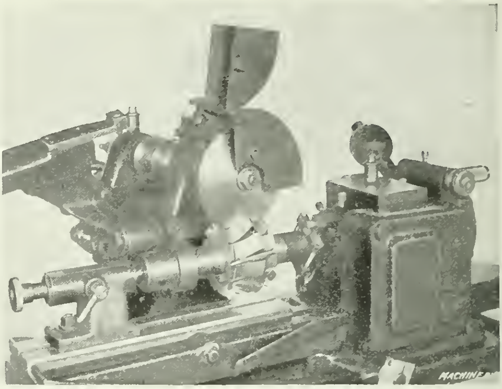


Fig. 1. Milling Machine equipped with Rotary Fixture for straddle-milling the Ends of Cast-iron Bushings

Making "Curvex" Milling Cutters

Methods and Equipment Employed by the Pratt & Whitney Co., Hartford, Conn., in the Manufacture of Formed Milling Cutters with Helical Flutes



THERE are parts of many metal products which can be efficiently machined through the use of formed milling cutters, but two reasons have influenced shop men against the use of tools of this type. Of these, the first was that difficulty was experienced in making tools of this type, and the second, that practical limitations made it impossible to produce formed cutters with helical flutes. Realizing the important advantages which are secured through making all types of milling cutters with flutes of helical form, the Pratt & Whitney Co. of Hartford, Conn., conducted an exhaustive study of the conditions which must be fulfilled in order to manufacture formed milling cutters with helical flutes, with the result that methods and special machinery have recently been perfected for the production of what are known as "curvex" milling cutters.

How Straight-fluted Formed Cutters are Made

Before entering upon a discussion of the methods used by the Pratt & Whitney Co. for making these spiral-fluted formed milling cutters, it will be well to consider briefly the methods used in the production of straight-fluted formed cutters. Regardless of whether the flutes are straight or helical, the turning and boring of the blank and the milling of the flutes are quite simple machine shop operations. The outstanding difference in practice occurs in relieving the teeth. With a straight-fluted cutter, the method of procedure in backing off or relieving the teeth is to take a formed tool or "knife" as it is called by toolmakers, the contour of which conforms with the tooth outline of the milling cutter.

This backing-off tool is used to take a cut over the entire width of each tooth, and it will be evident that working under such conditions—especially with wide-faced cutters—the operation must be handled with extreme care and deliberation, in order to prevent setting up excessive strains in either the machine, the work, or the relieving tool. With helical-fluted cutters, this method of relieving cannot be employed; and it is the difficulty experienced in relieving the teeth of such formed milling cutters that has constituted the stumbling block which has prevented tools of this kind from coming into general use, after the advantageous features of other helical-fluted cutters had come to be thoroughly understood.

How Helical Flutes Improve the Cutting Efficiency

It is a matter of quite general mechanical knowledge, that by having the flutes of a milling cutter of helical form, the cutter is able to work with less vibration, and a better finish may be produced on the work because of the shearing action that is secured. The ability of the helical flutes to reduce vibration will be readily appreciated when a comparison of their action is made with that of a straight-fluted cutter which has the entire cutting edge of each successive tooth engage the work at the same instant. On the other hand, the action of the helical flute is progressive, the cutting edge coming into contact with the work at one side of the cutter, and this point of contact then moving across the cutter as the tool rotates, until finally the point of contact is lost at the opposite edge of the tool.

One good way of explaining this difference of action is to regard the helical-fluted cutter as a composite tool built up from a large number of straight-fluted milling cutters of infinitely narrow face width. Such a set of cutters could be mounted on an arbor, the cutting edge of each tool slightly behind the edge of the adjacent tool. If such a built-up tool were rotated in contact with the piece of work, it will be apparent that the edges of each of these narrow cutters would come into contact successively, thus accomplishing their

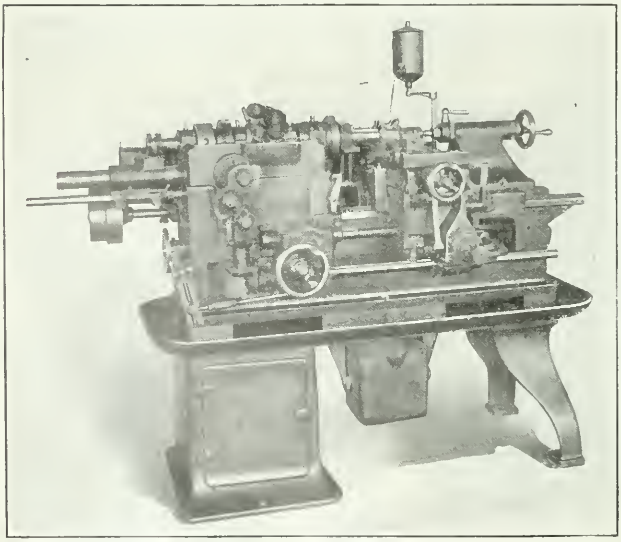


Fig. 1. Automatic Machine for Use in backing off Teeth of "Curvex" Milling Cutters

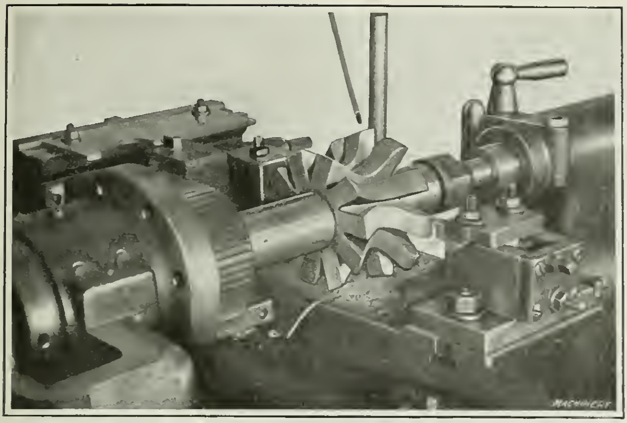


Fig. 2. Close-up View of Cutter, Relieving Tool, Templet, and Tracer Point

cut without producing the vibratory effect that would be induced through bringing all of the cutters simultaneously into contact with the metal to be milled.

Relieving Pratt & Whitney "Curvex" Milling Cutters

Mention has already been made of the fact that so far as turning the cutter blank and milling the flutes are concerned, there is nothing unusual in the procedure followed in making "curvex" milling cutters. In the past it has been impossible to make cutters of this type because of the difficulty encountered in relieving the teeth, and of developing machines and methods of doing this work. The solution was found by Frederick Müller, acting in a consulting engineering capacity for the Pratt & Whitney Co. Mr. Müller for many years has been known in the machinery trade as "Automatic" Müller as a result of his work in designing automatic machinery of many different types. Mr. Müller developed automatic machines for handling this work, so that one operator is able to give the necessary amount of attention to a large number of machines. As shown in the close-up view, Fig. 2, it will be seen that there is a relieving tool which operates on the milling cutter teeth, and a tracer point that engages the edge of a templet which is employed to control the form of the cutter. Naturally, the templet is made of exactly the same form as the work that it is required to mill; and in order to obtain accurate results, it is important to have the tracer point and the relieving tool the same shape and size.

Fundamentally, the backing off of helical-fluted formed milling cutter teeth is accomplished in exactly the same way as the relieving of the teeth of any other rotary tool, it being merely required to produce the necessary clearance behind the cutting edge of each tooth. But very little thought will be sufficient to convince the reader that the backing off of the teeth of formed cutters with helical flutes is by no means a simple problem. Evidently it is necessary to provide for so guiding the backing-off tool over the work that the required contour of the cutter will be maintained, and also to so adjust the angular position of the cutter as the backing-off tool is fed longitudinally across its face, that the required compensation will be made for the lead of the helix. In addition, the usual oscillating cross-slide for manipulating the backing-off tool, and means of feeding the tool longitudinally across the face of the cutter must be provided.

Machines used for this purpose are equipped with two independent sets of mechanism that operate alternately to produce the following results: One set of mechanism provides for rotating the spindle by which the cutter blank is driven and for imparting the necessary oscillatory movement to the cutter-slide. The other is depended upon to traverse the carriage along the bed of the machine to impart the necessary feed movement to the relieving tool, and while this feed movement takes place to rotate the cutter blank through a sufficient part of a revolution to compensate for the helical flute form and maintain a constant relationship between the relieving tool and the flutes of the milling cutter blank. The two sections of the machine work intermittently, so that while the spindle is revolving the cutter and the relieving tool-slide is oscillating, there is neither a feed movement nor a rotary compensating movement of the cutter; and conversely, while the feeding of the relieving tool and the adjusting of the cutter are taking place, the machine spindle and relieving slide are at rest.

Arrangement of the Mechanism in the Machine

It will be apparent from Figs. 4, 5, 6, 8, and 9 that driving of the machine is accomplished by means of a pulley *A* from which motion is transmitted through a positive clutch *B* to either of the two sections of the machine which were just mentioned. Clutch *B* is of the so-called "load and fire" type, and energy is stored up in the operating spring by means of a lever *C*, Fig. 8, the movement of which is accomplished by means of a cam carried by the main camshaft located inside the bed of the machine. For transmitting power to the spindle and for oscillating the cross-slide on which the relieving tool is mounted, the drive is carried from clutch *B*, Figs. 4 and 5, through a speed-change box *D* in which there is a cone of gears arranged to provide five speed changes. From this speed-box, power is transmitted through bevel gears *E* to a worm and worm-wheel *F*, Fig. 8, that is connected to the spindle and rotates with it. The cross-shaft that carries the spindle-driving worm is carried through to the front of the machine to transmit motion through a set of change-gears *G*, Fig. 6, that provides for timing the rota-

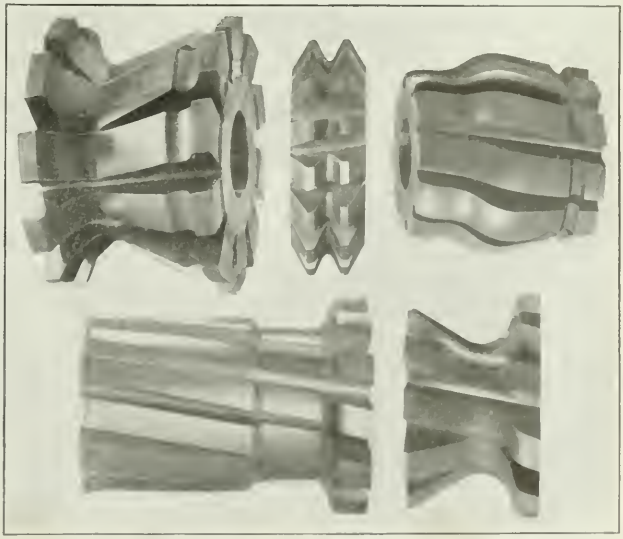


Fig. 3. Examples of "Curvex" Milling Cutters, showing Diversity of Shape and Size

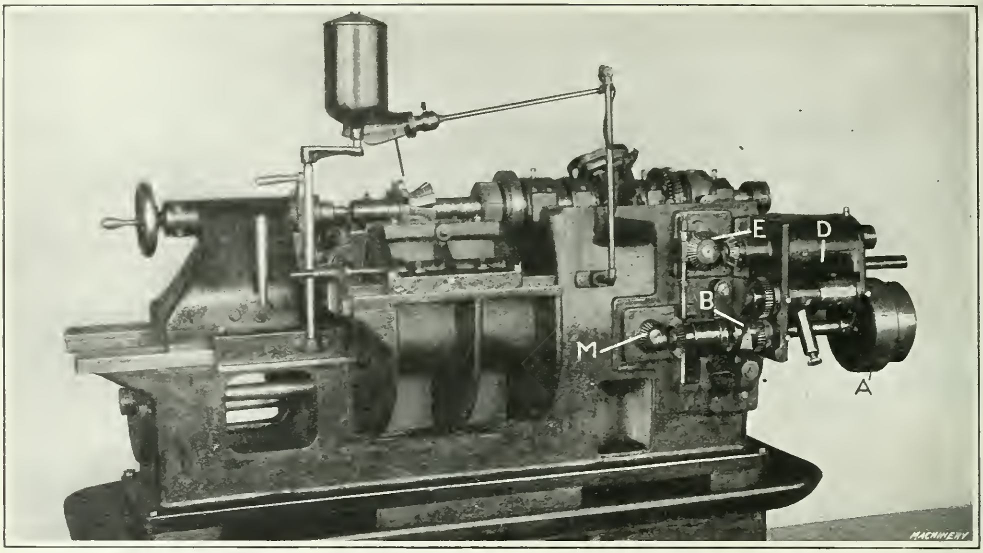


Fig. 4. Rear View of Automatic Machine for relieving "Curvex" Cutters, showing Arrangement of Drive

tion of the machine spindle with the oscillation of the relieving slide, so that the reciprocating movement of the tool will be properly synchronized for the number of flutes in the milling cutter that is being relieved.

From the change-gears *G*, motion is transmitted through bevel gears *H* and a horizontal shaft to a worm and wheel *I*, and a second pair of bevel gears to a shaft on which cam *J* is carried. This cam runs in contact with a roller mounted at the lower end of lever *K*, the upper end of this lever being connected with the cross-slide on which the relieving tool is carried. In this manner a reciprocating movement is imparted to the slide. While the main driving clutch *B* is engaged to transmit motion to this part of the mechanism, the spindle makes one revolution and the relieving slide is moved in a number of times equal to the number of flutes in the cutter, thus taking a relieving cut over each tooth.

Mechanism for Feeding Carriage Longitudinally

Before the work of relieving the cutter teeth can proceed further, it is necessary to move the tool along the face of the cutter, and this feed movement also makes it necessary to rotate the cutter slightly in order to compensate for the helical form of the flutes. With the main driving clutch *B* in the opposite position to that which it previously occupied, power is transmitted through bevel gears *M*, Figs. 4 and 5, to a shaft that transmits motion through a worm and wheel

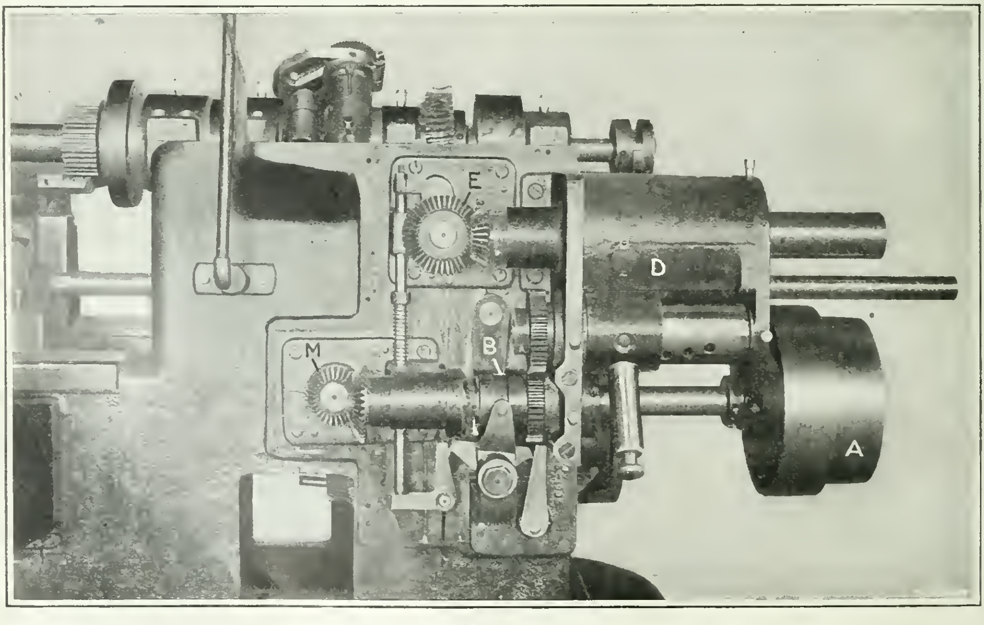


Fig. 5. Close-up View of Driving Mechanism on Automatic Relieving Machine

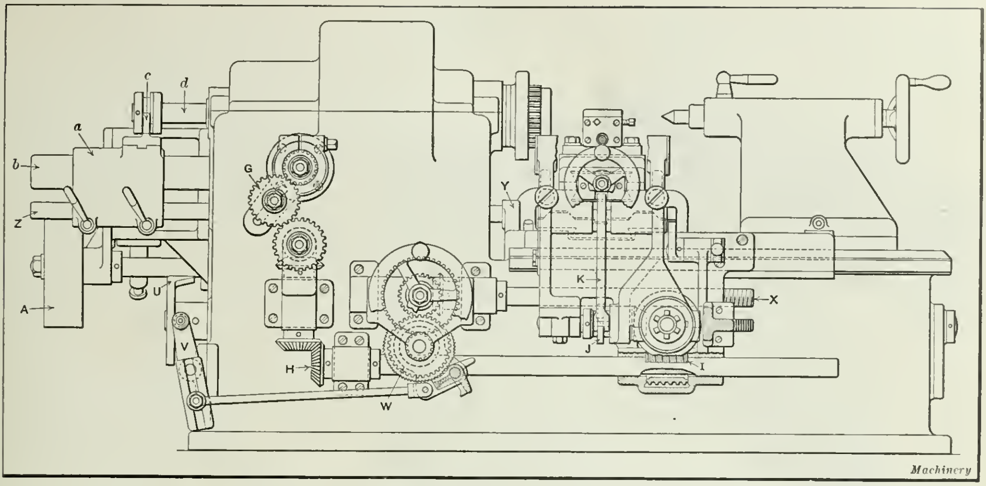


Fig. 6. Mechanism for transmitting Power to Oscillating Relieving Slide, feeding Relieving Tool, and adjusting Position of Milling Cutter

to a camshaft *N*, Fig. 8, mounted inside the bed of the machine. In order to explain the functioning of this part of the mechanism, let us assume that the relieving tool has just completed its work of taking a cut over each of the milling cutter teeth, and that it is required to adjust the machine ready for its next cycle of operations. At this point, attention must be called to the fact that the oscillating slide that carries the relieving tool is of a composite construction, as shown in Figs. 12 and 13, being composed of three slides mounted one on top of the other. The two lower slides may be clamped together to form a single member, or these slides may be released and moved independently of each other. The upper slide, while not clamped to the second slide, is carried by it, and is moved therewith by means of the relieving mechanism.

When the relieving tool has completed a cycle of operations, the rotation of the milling cutter stops with the tool opposite a groove between two teeth. Then

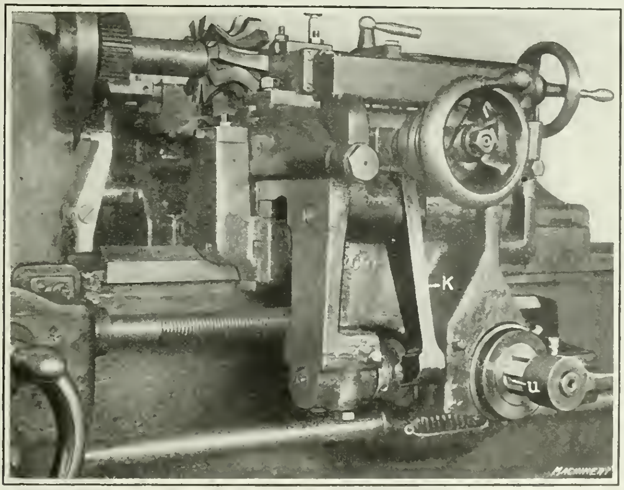


Fig. 7. Close-up View of the Cross-slide Mechanism

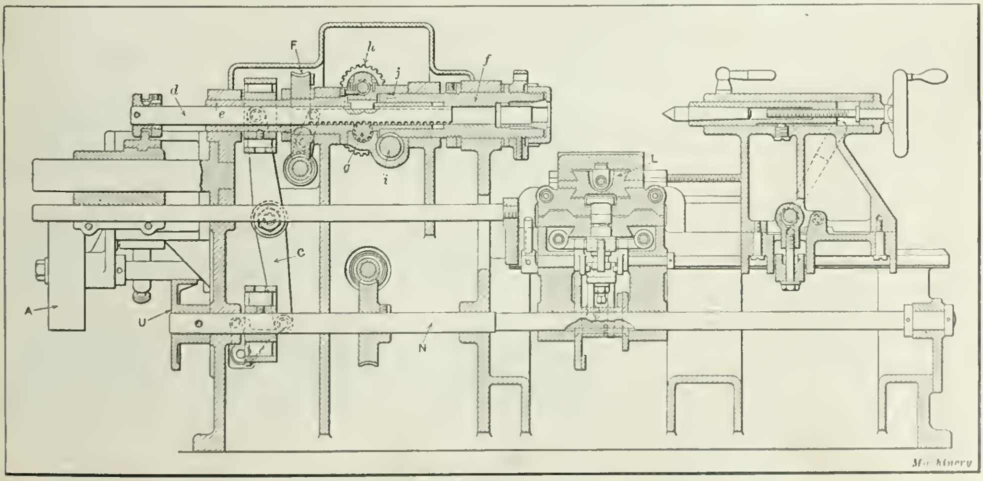


Fig. 8. Longitudinal Sectional View of Machine

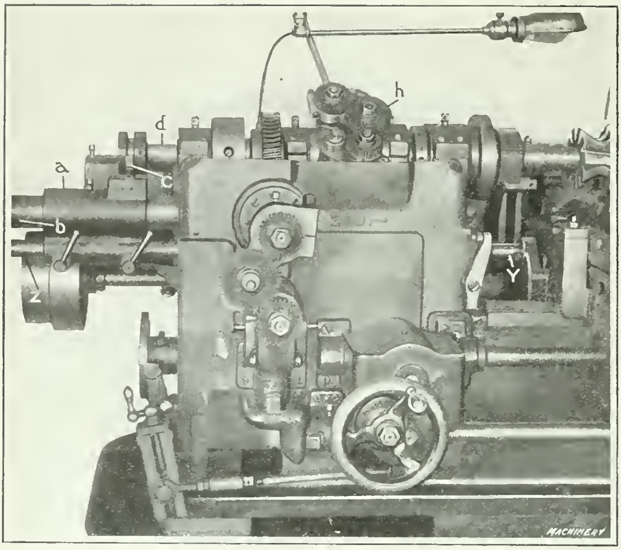


Fig. 9. Close-up View of Mechanism for transmitting Drive to Relieving Slide and for obtaining Angular Adjustment of the Milling Cutter

the cam O carried on shaft N oscillates lever P about its pivotal support, with the result that all three slides Q_1, Q_2, and Q_3, are moved backward together against the tension of springs R, about 1/16 inch. The purpose of withdrawing the slides in this manner is to enable the carriage to be fed longitudinally along the bed of the machine without interference between the former pin S and the templet T that governs the form of the milling cutter that is being relieved. Feed movement of the carriage is accomplished by a cam U, Figs. 6 and 8, mounted at the extreme left-hand end of camshaft N. This cam imparts an oscillatory movement to lever V which, through a connecting link, operates a ratchet and pawl that impart a specified movement to change-gears W. The position of the pin in crank V may be adjusted to regulate the amount of feed movement, crank V being graduated so that the position of the pin may be set opposite the mark indicating the required feed movement of the tool along the work in thousandths of an inch. From change-gears W motion is transmitted to a feed-screw X that controls the movement of the carriage.

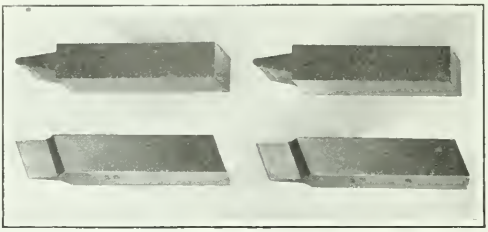


Fig. 10. Close-up View of Two Relieving Tools for relieving "Curvex" Cutters

Automatic Compensation for Helical Form of Flutes

At the same time that the relieving tool is being fed along the milling cutter, it is required to rotate the cutter to make the required compensation for the helical form of the flutes. This result is accomplished by a bracket Y, Figs. 6 and 9, on the carriage that imparts a longitudinal movement to rod Z, which is slidably held in bushings. Carried by this rod, there is a bracket a that slides on a guiding pilot b and has a yoke c attached to its upper side to provide for imparting a longitudinal movement to rod d. At its right-hand end, rod d has rack teeth cut in it. Before proceeding further with the description of this mechanism, mention must be made of the fact that the spindle that carries the milling cutter blank is arranged in two sections, namely, an inner spindle e, Fig. 8, on which the driving worm-wheel F is carried and an outer spindle or sleeve f surrounding the inner spindle and arranged with a socket at its forward end to receive the work-holding arbor. It will be apparent that a longitudinal movement of rod d results in imparting a rotary motion to pinion g and an arrangement of change-gears h carried on the spindle e and bodily rotatable therewith. By means of the gears h motion is imparted to a worm i and worm-wheel teeth cut in the outer spindle f at j. In this way, the cutter is rotated through a distance corresponding to the required angular adjustment for the longitudinal feeding of the relieving tool along the face of the cutter. The gears h can be changed to conform to various leads of helical flutes on the cutter.

At this step in the cycle, it is necessary to unlock the mechanism that clamps slides Q_1, and Q_2, Fig 12, together so that slide Q_2 may be moved independently of slide Q_1, in order to bring the former pin S back into contact with the templet T. Obviously the purpose of this setting is to bring the relieving tool into the required position to take a cut over each tooth while the milling cutter makes its next complete revolution. Movement of slide Q_2 is accomplished by means of spring k, Fig. 13, which is contained in a cylinder filled with oil. The construction of this part of the mechanism has been worked out on the dashpot principle, so that while spring k is able to return slide Q_2 to the required position, the oil will retard the movement so that there is no danger of causing vibration or of indenting either the former pin S or the master templet T. In fact, so delicate is the adjustment that it has been found possible to make a templet out of an ordinary playing card and use it

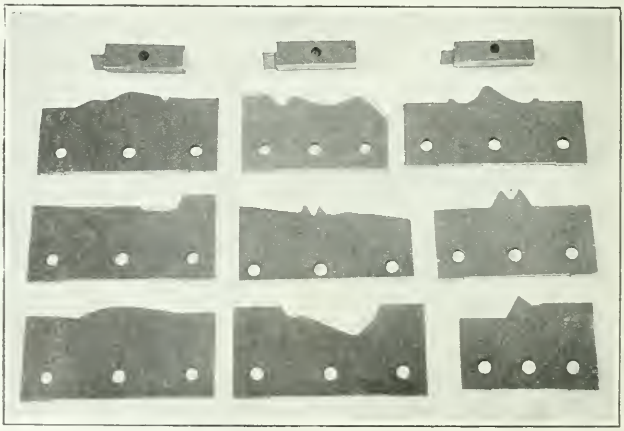


Fig. 11. Templets for governing the Form of "Curvex" Cutters, and Tracer Points used in Connection with these Templets

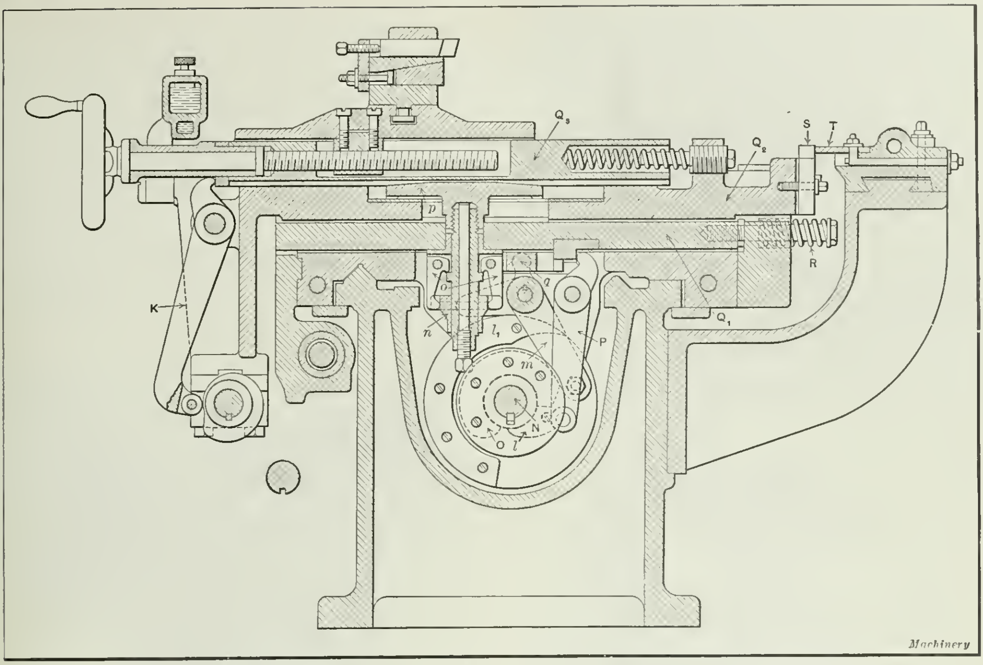


Fig. 12. Cross-sectional View, showing the Means of adjusting and clamping the Three Cross-slide Members

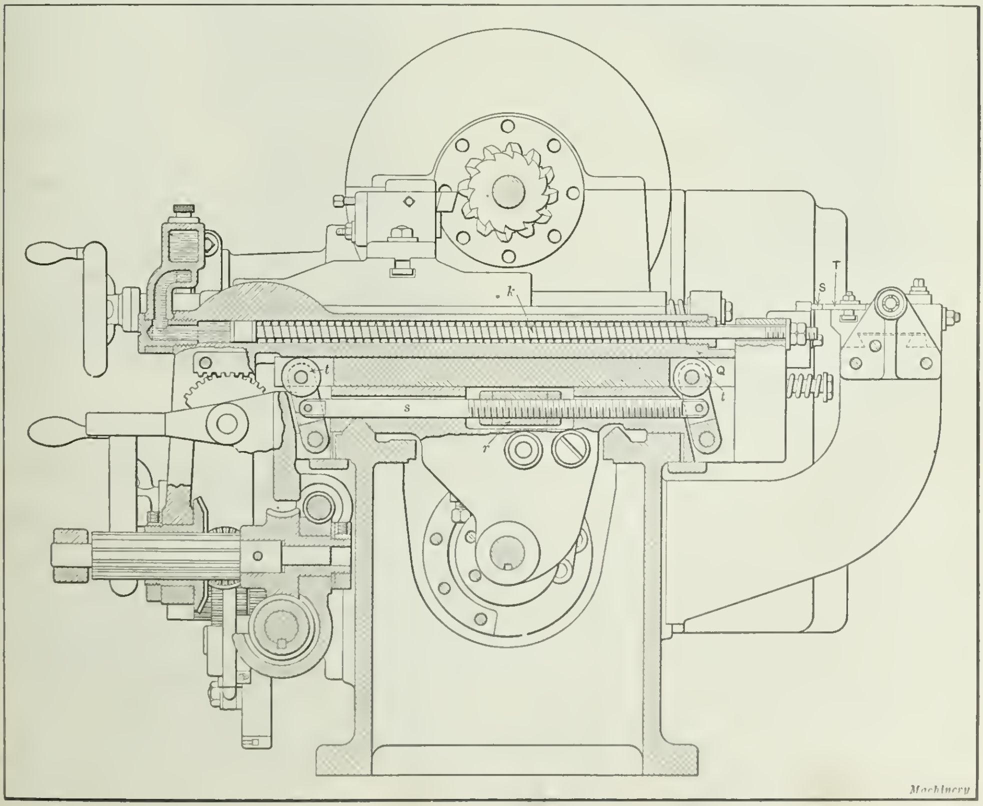


Fig. 13. Cross-sectional View, showing Means of returning Tracer Point to Templet without Vibration

on the machine for relieving a milling cutter. Of course, this is only a "stunt" to demonstrate the sensitiveness of the operation, as the ordinary templets are made of steel. During the return movement of slide Q_2 by spring k, slide Q_1 is independently returned by spring R.

Features of the Cross-slide Operating Mechanism

Having stated the conditions that are required in adjusting the cross-slide mechanism, we are ready to explain the means by which the required result is accomplished. Carried on shaft N, Fig. 12, there is a second cam l that operates a lever m which is in the form of a bellcrank. At the opposite end from the cam roller, this bellcrank carries a yoke that engages a tapered block n and provides for pulling this block down between two clutch fingers o, or for raising the block, as required. This clamp pulls a strap p down on top of slide Q_2, locking it in position on slide Q_1; and as slide Q_3 is carried by slide Q_2 it will be apparent that all three slides are connected by this action. The reverse movement of bellcrank lever m by the cam l_1 releases the slides. At the time that it is required to release the clamp in order that slide Q_2 may move over slide Q_1 through the action of spring k, cam l_1 moves the roller on lever m in the opposite direction, thus raising taper block n from between fingers o and lifting strap p out of contact with slide Q_2. At the same time, a projection q on the lever m throws over a strap r, Fig. 13, and through two rods s and auxiliary links, slide Q_3 is raised on rollers t so that it may be moved freely through the action of spring k. At or about the time that the former pin S comes into contact with templet T, thus checking further movement of slide Q_2, the roller on lever P, Fig. 12, runs down a decline on cam O and allows spring R to move slide Q_1 back to its starting position. Then the roller on lever m runs up the rise on cam l and pulls down block n so that the clamping jaws o and strap p may lock the two members of the cross-slide together to form a single unit.

A description of this adjustment of the position of the cross-slides would be incomplete without making reference to the way in which provision has been made for adjusting the mechanism that oscillates the relieving slide Q_3 for different relative positions of the two cross-slides Q_1 and Q_2. It will be apparent from Figs. 7 and 12 that the camshaft bracket, the cam-lever K, and all auxiliary mechanism for obtaining the required oscillatory movement is carried at the front of slide Q_2, and that power must be transmitted to this mechanism from a horizontal shaft running in bearings secured to the front of the machine. To allow the drive to be effected, regardless of the transverse position of the cross-slide Q_2, it will be seen that there is a splined shaft u that slides through one of two bevel gears transmitting movement to the camshaft that rocks lever K, from which motion is transmitted to the relieving slide. With such a transmission, a transverse movement of the cross-slide does not cause any trouble. The operation of relocating and clamping the slides requires but a few seconds, and then the main driving clutch at the back of the machine is again reversed to start the spindle rotating for the performance of the next cycle of operations.

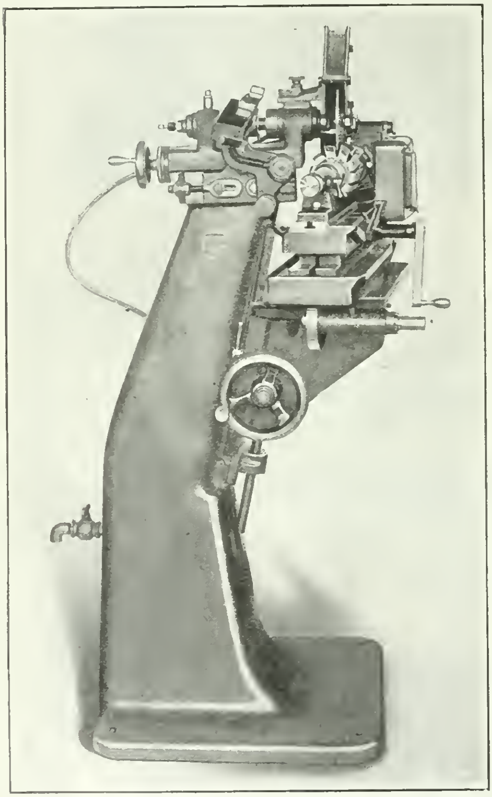


Fig. 14. Side View of Cutter Grinding Machine, showing how the Table is moved Parallel to the Face of the Conical Wheel

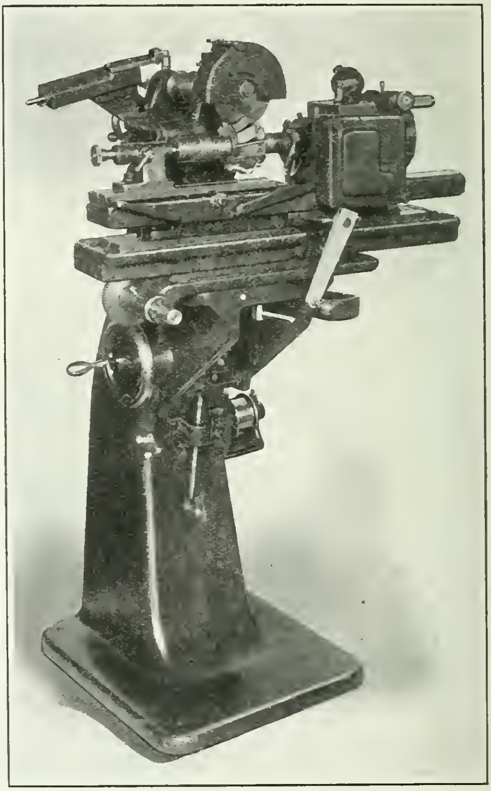


Fig. 15. Front View of Cutter Grinding Machine, showing Hand-operated Lever and the Grinding Wheel in Operation on a Cutter

Special Cutter Grinding Machine

In addition to the development by Mr. Müller of the special machines for relieving "curvex" milling cutters, it was also found necessary to provide a tool-grinder adapted for sharpening them. The machine used for this purpose is illustrated in Figs. 14 to 16. It is equipped with a grinding wheel having a conical grinding surface which presents only a single element of the cone to the face of the cutter flute that is being ground, so that there is but a single line of contact between the wheel and work at any one time, and the wheel is able to follow the helical path of the flute to grind the cutting edge to the required form. There is nothing particularly unusual about the actual tool grinding operation, but the design of the machine has been carefully worked out to provide for truing the grinding wheel to the required form and for adjusting the position of the wheel to compensate for the reduction in size of the wheel that occurs during the truing operation. The theoretical grinding line is always in the same relation to the position of the work, notwithstanding the reduction in the wheel.

The design of the machine also permits the table to be raised or lowered to compensate for different diameters of cutters to be ground, the arrangement being such that this adjustment does not interfere with the relative position of the theoretical grinding line. Referring first to the side view of the tool-grinder shown in Fig. 14, it will be seen that the knee on which the table saddle is carried is supported from an inclined bearing on the column, the angularity of which brings its face parallel to the face of the conical grinding wheel when it is held on a horizontal arbor. Of course, the grinding wheel is so located relative to the line of centers on which the cutter arbor is supported, that the previously mentioned line of contact between the grinding wheel and the cutter coincides with a radius of the cutter. The theoretical grinding line is therefore always in the same relation to the axis of the cutter to be ground regardless of the elevation of the table.

At the right-hand end of the machine, Figs. 15 and 16, it will be seen that there is an ordinary index-plate which is arranged with circles having different numbers of holes to provide for indexing cutters with various numbers of flutes. In order to grind each flute to conform to the required helical path, it is necessary to impart a combined traverse and rotary movement to the cutter. This result is accomplished by reciprocating the grinding machine table in the usual way, and at the same time, imparting the reciprocal rotary movement to the cutter that is being ground. The table movement is operated by a hand-lever which traverses the table by means of a rack and pinion. Secured to the machine there is also a stationary rack which meshes with a pinion carried by the mechanism at the right-hand end of the table. This pinion transmits power through a set of change-gears *v*, Fig. 16 to a worm meshing with a worm-wheel on the live center that supports the cutter arbor. In this way, provision is made for imparting the necessary reciprocal rotary movement to the work for grinding the helical flutes; and by changing gears it is possible to adjust the machine for grinding cutters with flutes of various helix angles.

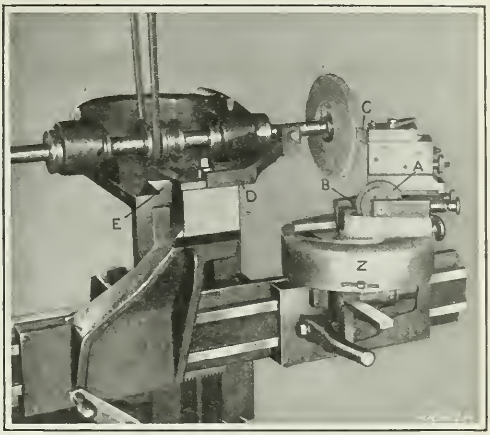


Fig. 17. Close-up View of Top of Special Grinding Machine for grinding Relieving Tools and Tracer Points to the Required Form

Provision for Truing the Grinding Wheel

It has already been mentioned that the line of contact between the wall of the cutter flute and the grinding wheel intersects the line of centers on which the cutter is supported, and it is important to maintain this relationship. Hence, the diamond wheel-truing tool on the machine must be carefully adjusted for this purpose. Fig. 16 illustrates the method of procedure. A steel disk *w* of the same size and form as the grinding wheel, is set up in place of the wheel, and a test arbor with a knife-edge gage *x*, arranged to intersect the line of centers, is set up between centers on the machine. Gage *x* is then brought into contact with steel disk *w* and the transverse slide carrying the disk is adjusted until gage *x* contacts uniformly with the disk for its full length. It will be seen that the wheel-truing device *y* is carried on a pivotal support, so that it may be swung back away from the wheel except at such times as it is required to dress the wheel. Then the bracket is swung down so that the diamond point may be traversed back and forth across the inclined wheel face. The reciprocal slide on which the diamond is mounted, is inclined at such an angle that the diamond point follows the inclined face of the wheel. When first setting the diamond, it is brought into engagement with the steel disk *w*, located as before described. After once being set, no adjustment of the diamond is necessary except to compensate for wear of the diamond itself. After the diamond has been thus set, the disk *w* is removed and the regular grinding wheel put in place and trued. It will be clear that as a result of the foregoing arrangement the grinding line of the wheel intersects the axis of the cutter to be ground. In subsequent truing operations, the wheel is moved up to the diamond so that the previously mentioned grinding line remains unchanged.

Forming Tracer Points and Cutting Tools for the Relieving Machines

In an earlier section of this article mention was made of the fact that it is necessary to have the relieving tool used on this backing-off machine of exactly the same form and size as the tracer point following the master cam that governs the form of the milling cutter. For producing these two tools, use is made of a special grinding ma-

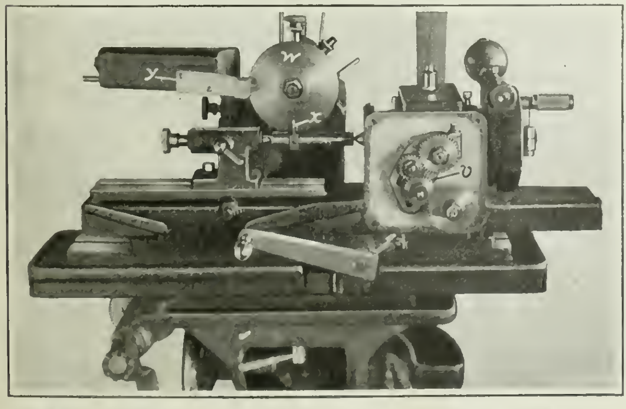
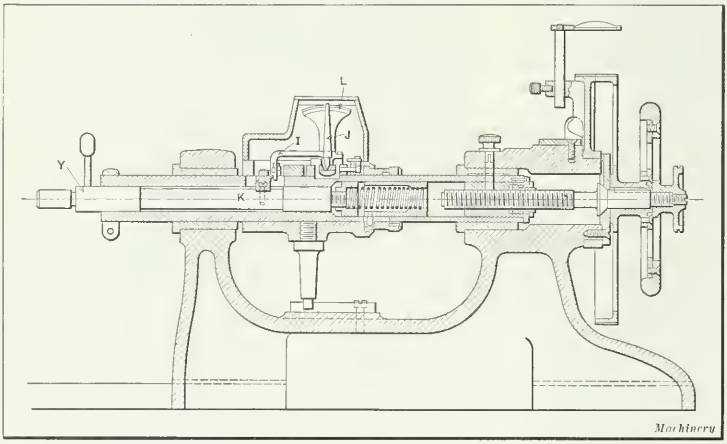


Fig. 16. Close-up View of Top Portion of Cutter Grinding Machine, illustrating Method of setting up the Wheel and Change-gears

chine shown in Fig. 17. The tool to be ground is carried by floating tool-block *Z*, and the problem consists of providing means for oscillating this tool-block so that the point of the tool will be ground to the required radius of curvature. This result is accomplished by means of a cam *A* which is made with a large number of cam elements of different radii of curvature distributed around the circumference of a disk. The cam may be set with any of these elements in contact with a hardened anvil *B* so that the floating tool-block may be oscillated with the cam constantly in contact with the anvil, thus providing for grinding the tool *C* that is in contact with the abrasive wheel to duplicate the form of the cam. The wheel is carried by a head *D*, which slides on a guideway *E*. Were it not for the necessity of providing clearance for the cutting tool, this would be a very easy grinding operation to perform as it would merely be necessary to provide the cam with the form desired for the tool. But when the tool is set at an angle, as shown in Fig. 17, in order to produce the desired clearance, it will at once be apparent that the form of the ground piece is slightly distorted. A correction is made for this condition by carefully shaping the cam so as to compensate for the distortion.

Features of "Curvex" Milling Cutters

In relieving the teeth of a milling cutter with helical flutes, the backed off surface of the tool is distorted in a way that prevents the work milled by the tool from fitting the tool, although it is an exact duplicate of the templet which guided the backing-off tool while the milling cutter was being relieved. At first, it may appear strange that a milling cutter is able to reproduce a required form, although that form does not correspond to the contour of the cutter for any cross-section through the axis of the tool. As a matter of fact, such a result is to be expected, when it is borne in mind that only one point on the cutting edge is in operation at a time and that the test made by laying the work against the tool has no significance, because it is not generated by points along the cutting edge of the tool working simultaneously, but through the progressive action of these points coming into contact with the work one after another. From Fig. 3 an idea will be obtained of the variety of "curvex" milling cutters which has been produced, although these examples by no means fix the limits of the forms of cutters that can be produced by this method.



Sectional View of the Measuring Machine made by the Societe Genevoise d'Instruments de Physique

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Plans are under way to celebrate the fortieth anniversary of the American Society of Mechanical Engineers on November 5 by providing for the holding simultaneously of forty sectional meetings of the society membership.

THE S. I. P. PRECISION MEASURING MACHINE

By ASHER GOLDEN

The writer has read with interest the description on page 135 of the October number of MACHINERY of an improvement on the indicator of the Newall measuring machine. The object of this improvement was to overcome the viscosity of the liquid in the level tube, which caused the movement of the bubble to lag. It is stated by the author that if wires were placed in the machine and rotated, the bubble in the level was slow to show variations in diameter of 0.00005 inch. It is claimed that the improvement shows variations of roundness of 0.00001 inch.

The indications of a measuring device are valueless for high-precision work unless the human element can be either completely eliminated or else corrected. It is for this reason that measuring machines are designed with some form of indicator that will make the readings independent of the touch of the operator. It is the writer's belief that the only measuring machine so far designed that completely eliminates this factor is the S. I. P. machine made by Société Genevoise d'Instruments de Physique, of Geneva, Switzerland.

As shown by the accompanying sectional view this machine has two multiplying levers *I* and *J*. The lever *I* is actuated directly by the hardened block *K* attached to the rod *Y*, the end of which forms one of the measuring points. The multiplying ratio of the two levers is 1 to 1000. The scale *L* is graduated in twentieths of an inch. The scale has its 0 at the middle with ten divisions to the left and ten to the right. When the measuring face is not in contact with any object being measured, the indicating needle *J* appears at the extreme left or minus end of the scale.

If the two measuring points of the machine are brought close together or against a gage or other object being measured and the right-hand measuring face (not shown in the illustration), is slowly brought up so as to make contact, the indicating needle moves over the scale to the right. When the needle points to 0, the pressure is about one-half pound. It is in this position that all readings are taken. If the right-hand measuring point is still further advanced, the needle continues its movement to the right and indicates that the pressure exceeds that necessary for taking the readings. If the measuring points, when set, are accidentally brought up so that the pressure exceeds one-half pound, the right-hand measuring point is simply backed off until the indicator shifts to the left and points to 0. A movement of one division of the scale corresponds to a movement of the rod *Y* of 0.00005 inch. By the application of a magnifying lens it is a simple matter to split the divisions into five parts, thus enabling the operator to read to 0.00001 inch.

* * *

The falling off in working efficiency on the part of industrial workers is noted all over the world. The British statistics on coal mining show that in 1913 the output of the British coal mines was 287,000,000 tons as compared with only 230,000,000 tons in 1919. Yet there were 63,000 more people employed in the industry in 1919 than in 1913. In terms of productivity per man, the output in 1913 was 332 tons per man as against only 253 tons in 1919.

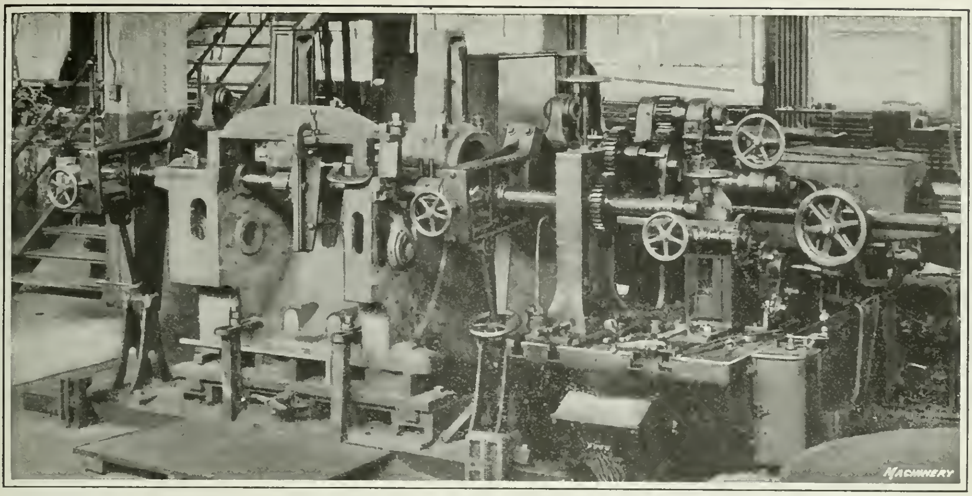

Fig. 1. Horizontal Boring Machine designed for Boring, Reaming and Facing Operations on Lathe Headstock and Tailstock Castings

Heavy-duty Boring Machine

Machining Headstock and Tailstock Castings for Ninety-inch Driving Wheel Lathes

THE special horizontal boring machine illustrated in Fig. 1 is used in the Putnam Machine Works, of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., for machining headstock and tailstock castings for 90-inch driving wheel lathes. The machine is driven by a 7½-horsepower constant-speed motor direct connected to the main spindle boring-bar, from which by means of suitable gear trains, an auxiliary boring-bar is driven. This bar is supported by two adjustable bearings carried in suitable swing arms at each side of the casting. Handwheel adjustment is provided for locating these arms at the proper angle and also for adjusting the bearings radially. In the illustration Fig. 1, this boring-bar is set up for machining holes *D* and *C*, Fig. 3.

It will also be seen by referring to this illustration of the headstock casting, that provision for machining holes *E* and *F* requires that the bearing arms be not only swung downward but also that the adjustable bearings must be set at a greater radial distance than would be possible if this adjustable feature were not provided. It should be stated that this illustration is not a fully dimensioned drawing and that only those dimensions are shown which will enable an idea of the size and proportions of the castings to be had and the relative position of the holes being machined. When making the adjustment before machining holes *E* and *F*, the journal box carried in an upright bracket (at the gear end of the machine) attached to the base, may be lowered by means of another handwheel adjustment, and the bracket adjusted transversely to accommodate the setting necessary for the operations on the second pair of holes. This change of center distance requires changes in the gear train, which the transmission mechanism suitably provides for. An inspection of the illustration Fig. 1 will enable the construction to be quite plainly seen as well as the method of clamping the casting to the machine table. Transverse adjustment is provided for convenience in locating the work-table when setting up the work. The handle which operates the cross-screw, by means of which this transverse movement is accomplished, is shown near the floor, on the front of the machine. It will be noticed that there are two fixed bearings, located at the rear of and above the spindle boring-bar; these are used on headstocks of a slightly different model than that illustrated. This machine, when set up for machining tailstock castings, does not require the use of the swing arms, and in such cases the boring-bar is removed and the arms are lowered.

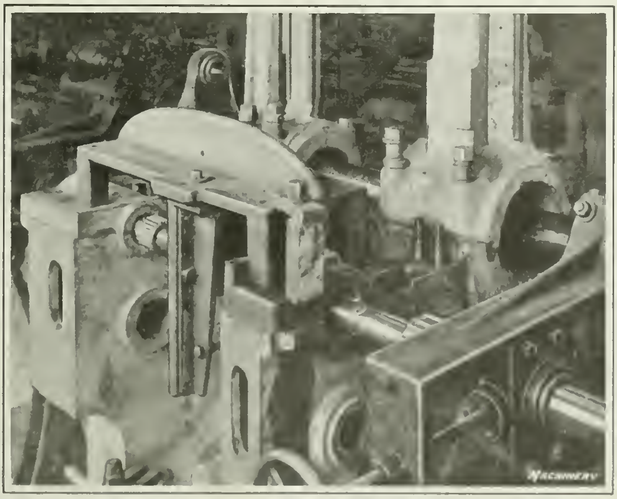

Fig. 2. Close-up View of the Work showing Boring-bars with Reamers and One Tool

In setting up the machine for these operations, the bearing caps are assembled and an arch bracket is clamped to the caps for holes

C and *D*, Fig. 3, from which a center bearing is attached to stiffen and maintain perfect alignment for the boring-bar. This arch bracket is prominently shown in Fig. 2. The work performed on the headstock casting, Fig. 3, consists of boring and reaming the three holes *A*, *C*, and *E*, in the front wall and holes *B*, *D*, and *F* in the back wall of the castings, and facing both sides of the bosses through which these holes pass. The spindle holes *A* and *B* are finished to 14 and 10½ inches in diameter, respectively. The finished diameter of hole *C* is 6 inches; of holes *D* and *E*, 4½ inches; and of hole *F*, 6⅝ inches. The length of each of these holes is indicated in Fig. 3.

Fig. 2 is a close-up view of the tooling set-up, showing the boring-bars and the tool used in boring hole *C*, as well as the two shell reamers carried on the boring-bar, with which both this hole and the other back-gear shaft hole *D* are simultaneously reamed. It will be evident that this smaller bar is fed through the work, whereas the boring-bar for the main spindle holes is provided with a feed-screw by means of which the tools for boring both bearing holes are fed along the bar during the operation.

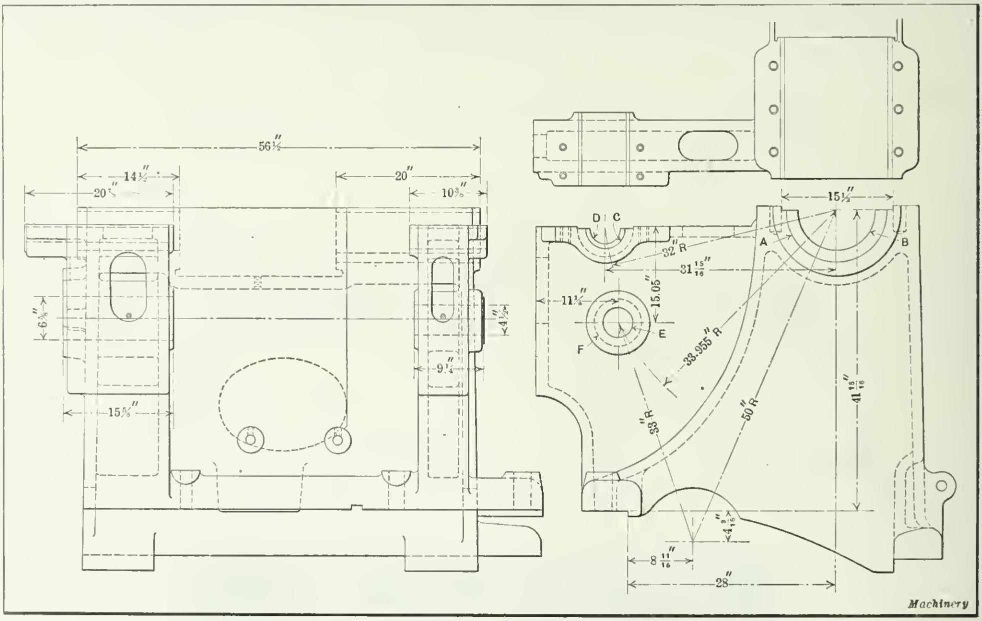

Fig. 3. Partially Dimensioned Drawing of Headstock Casting, on which are indicated the Holes machined on the Boring Machine

In the facing operations on the bosses for all these holes the boring-bars are utilized for attaching the familiar type of star-wheel cross-feed mechanisms. Thus, after the castings have been once set up on the machine, assurance is given that all holes will be machined parallel and in the proper relation to each other, and that the bosses will be faced so as to register square both with the holes and with the base of the casting. The time required to finish headstock castings of the design shown is approximately thirty-two hours, including setting up the work. This time element cannot be stated exactly, since irregularities in the casting and the earlier operations on the base and caps are likely to add somewhat to this in the setting up of the work. For this reason, a maximum time consumption of thirty-six hours is allowed.

* * *

It has been estimated that the total value of machine tools built in Great Britain during 1919 was about $40,000,000 at present exchange rates.

WHAT IS REQUIRED TO CONSTRUCT A MODERN AIRPLANE

The number and variety of parts entering into the construction of a modern airplane is far greater than the engineer or mechanic engaged in other lines of production would think. The following is a list of the parts required to build a De Haviland four-cylinder plane: 2608 wood parts, only 608 of which are alike in shape; 1665 sheet-metal parts, of which 1500 differ in shape; 20 different forgings; 139 different tubes; 78 different castings; 5335 bolts and machine screws, of which 1500 differ from each other; 1589 nuts of 50 different styles; 1213 washers of 100 different styles; 10,675 wood-screws of 150 different shapes and sizes; 8609 nails, tacks, etc., of 150 different shapes and sizes; 659 wires of 20 different kinds; 87 terminal standards of 40 different shapes; 750 small metal parts of 300 different shapes; 366 pieces of linen, of which 50 are different; 12 bearings; 474 items of equipment, including military equipment, of which all but 4 are different; 343 miscellaneous parts, of which 300 are different.

In addition, there are many such articles as bakelite, cellulose fiber, fabrikoid, felt, glass, leather, rubber, rawhide, and transparent sheets. There are also required 128 yards of linen, 827 yards of silk thread, 215 yards of special cotton tape, 440 yards of cotton twine, and 168 yards of linen twine. Allowances for waste or spoiled material have not been included in these figures. Moreover, each plane requires 110 gallons of shellac, varnish, and dope. The 2608 pieces of wood include 664 pieces of veneer, 1586 pieces of spruce, 152 pieces of ash, 36 pieces of walnut, 6 pieces of maple, 24 pieces of hickory, and 140 optional pieces of different hard woods.

* * *

The Italian Government has made a ruling forbidding the Italian automobile factories to sell more than 10 per cent of their total product in Italy. The remainder of the production must be exported. It is expected that through the export trade thus created, an improvement in the exchange situation may be effected.

Service Department in a Machine Tool Plant

An Outline of the Purpose, Organization, Equipment, and Methods of the Service Department of the Heald Machine Co., Worcester, Mass.

THE successful manager of a machine shop today, in purchasing new equipment, does not look merely for a certain type of machine tool; what he wants is productive capacity. He feels that he must go into the problem deeper than merely to find out that a machine will perform a certain operation. Service departments have been developed rapidly in recent years in the organizations of various industries, but probably nowhere do they serve a more helpful purpose than in the machine tool industry. This fact is due to the long life of machine tool equipment and to the continuous loss to the owner when unsuitable equipment is installed.

The machine to be selected for a given purpose is the one which will furnish the largest output in proportion to the factors of first cost, operation cost, overhead, maintenance, and depreciation. In so selecting a machine, it has become common practice for the prospective purchaser to obtain definite estimates or guarantees with regard to the production he will secure on his particular work. Production managers frequently find wide differences between the production estimates given by representatives of different machines of the same type; this is due usually to the different way in which these estimates are made. The careful manager will naturally have greater confidence in estimates given out by a service department organized for such work, than he would in those derived by less systematic means.

How Dependable Service may be Rendered the Prospective Machine Tool Purchaser

In order that the machine tool manufacturer may make accurate estimates and guarantees, it is necessary for him to maintain a service department; and to assure the meeting of these guarantees by the machine when installed in the customer's factory, experienced operators must be employed to assist the customer in starting these machines and to instruct the man who is to run the machine with regard to its handling and adjustments. These skilled operators or demonstrators, being present when the machine is put in operation in the customers's shop, are in a position to see that the expected results are obtained.

A highly developed service department operating along these lines is maintained by the Heald Machine Co., Worcester, Mass. The department is composed of two main divisions: An engineering section with its engineers, designers, and service shop, and a division consisting of a field demonstrating force of experienced service representatives. The engineering section employs a number of draftsmen whose time is given over entirely to the designing of work-holding fixtures and to the study of the best grinding and holding methods for each individual case. It also operates a small shop equipped with one of each type of machine built by the Heald Machine Co. In this shop, a partial view of which is shown in Fig. 1, there are installed two cylinder grinding machines, three internal grinding machines, and two rotary surface grinding machines, with a variety of magnetic chucks. In addition to the machines, there is a stock of several thousand grinding wheels, having a wide range of combinations of grit, grade, abrasives, size, and shape. This complete line of wheels forms a working stock from which it is possible to select the most efficient wheel for any kind of work without the necessity of making allowances or waiting for the delivery from the wheel manufacturer of a wheel such as required before the operation can be tried out.

With this equipment available, it is an easy matter for the service department to run off 5, 50, or 500 pieces of any particular kind that may be sent in by a prospective customer in order to determine accurately what speed should be used in handling the work, what accuracy the operator can regularly secure, and the degree of finish that wheels of various grades and grits will produce. It should be evident, therefore, that the recommendations of a service department so organized can be made conservative and correct, because this method of procedure enables the department to eliminate all guesswork when determining the productive rate.

The Engineering Department and its Work

In addition to test work done in the service shop, a complete record is kept in the engineering department covering the experience of other customers in their shops on similar work. These records include information received from the demonstrators concerning production secured in the different factories, as well as reports regarding the working out of the various types of jigs and fixtures used. The demonstrator's reports are carefully indexed and cover fully the nature of the piece, its size and shape, the method of holding, the amount of stock left for grinding, and the grade and grit of wheels used. With such information on hand, founded on experience, accurate estimates can be given to prospective customers. The department keeps on file complete sets of drawings covering fixtures that have been already made or designed for holding different kinds of work, so that by referring to these, a design which is suitable for a new piece can often be found which will require only slight changes to meet the requirements of the work on which it is proposed to be used.

All correspondence which requires the attention of the engineering service department is delivered directly to the engineer in charge. In this way actual engineering thought and not merely clerical attention is given to these inquiries. If the question is a simple one which can be readily answered from the information available, a reply is sent immediately. Often the department already has on file definite information with regard to the output of such work and even blueprints showing a good method of holding. If such is the case, this information can be furnished promptly. In other cases, where the work is a new application or has additional difficulties, considerable time and study must be spent in handling the proposition and special jigs may have to be drawn up, and recommendations for the equipment decided on. Frequently the service department sends for samples of the work to be handled, and these are experimented with by an operator in the service shop. When this is done, accurate and complete information can, of course, be furnished.

The Demonstrator—his Duties and Difficulties

The foreman of the service shop is one of the company's most experienced demonstrators, and his knowledge of outside manufacturing conditions is of great value, not only in the test grinding, but also in assisting the operators of the service shop, who are being trained to become demonstrators. Demonstrators, thus trained, are fully competent and skilled operators. In addition to being a skilled operator, the demonstrator must also be a man of tact and judgment, and it is not always the most successful operator who makes the best demonstrator. It is the business of the demonstrators to see that the machines shipped are installed in the proper manner, so that the customer will secure the best results both as regards quality and quantity of production, and also to see that the methods developed by the engineering section are properly carried out in the customer's shop.

Usually the demonstrator goes into a shop where he is a total stranger and must proceed to start a machine, see that the speed of the countershaft is correct, determine whether the machine has been set up in the proper manner, and ascertain that the holding fixture, wheel-heads, and grinding wheels are correct. The demonstrator commonly finds that the speed of the countershaft is incorrect, in which case, it is his duty to see that different pulleys are secured for the main lineshaft to furnish the correct speed for the countershaft. The tactful demonstrator usually secures these changes without much difficulty. In a certain shop where six machines were in operation, the demonstrator found that the countershaft was running backward and that the entire machine, work-spindle, wheel-spindle, and even the pump were running in a direction opposite to that intended by the designer of the machine. This was actually an unsafe condition. Under such circumstances, no grinding machine could be expected to perform efficiently, and in order to realize the estimated production rate and quality of work, the demonstrator was required to correct this condition.

A common cause of failure to meet the production estimates has been found to be the allowance of an excessive amount of material for grinding. This is especially noticeable in cylinder grinding, in which it often becomes a serious matter. The cause may be due to poor boring, where a hole is produced that is not square with the face of the cylinder so that the wheel removes more metal at one end and less at the other end than it should. In order to rectify such troubles, the demonstrator usually has to investigate the boring operation, and as a result, the boring machine must be trued up in order to produce work which can be ground efficiently. It will be appreciated that the demonstrator is liable to encounter numerous difficulties and be considered a meddler in attempting to rectify such conditions. A good demonstrator is, in a certain sense, an efficiency engineer in the customer's factory, and the customer therefore secures not only a machine tool, but engineering experience and assistance of the most valuable kind when he purchases a machine which is installed under a service system.

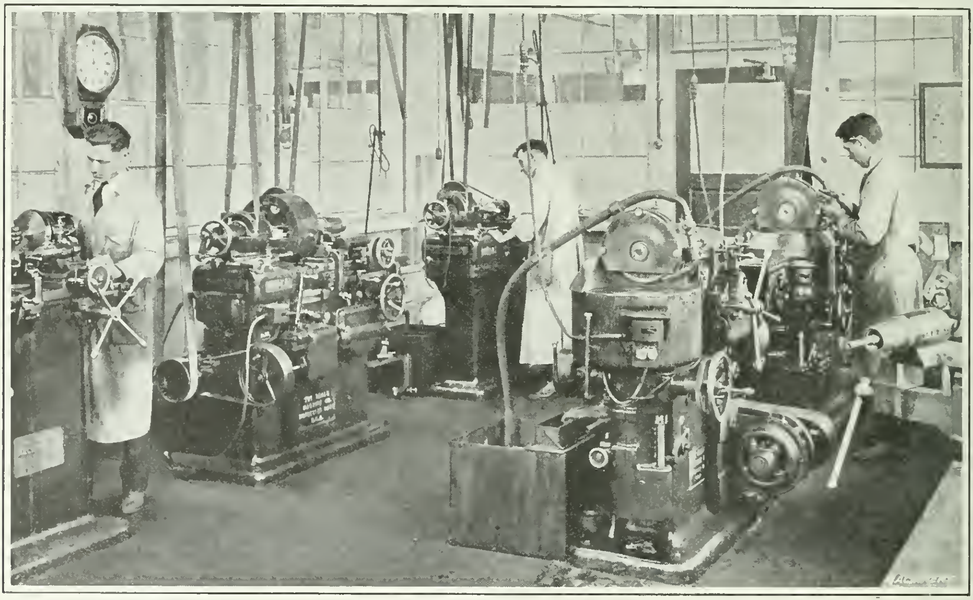

Fig. 1. Service Department in the Heald Plant where Work-holding Fixtures are tried out, Wheels determined upon, and Time Estimates made

Breaking in New Operators

Another factor which tends to reduce production, and for which the manufacturer of the grinding machine is sometimes wrongly held accountable, is the changing of operators. While it is unreasonable to expect the manufacturer's assistance for troubles of this kind, it is frequently demanded, and a demonstrator is sent for, although all he is called upon to do, upon arrival at the shop, is to break in a new operator. In many shops it has been found that the machines are not treated as they should be; oil of the recommended viscosity is not used; proper speeds are not employed; the required adjustments are not made; and in many cases the machines are not given the proper care and attention. When such conditions are permitted to exist, an unfair advantage is taken of the manufacturer who is endeavoring to give a reasonable amount of attention and service to all his customers.

Following up Installations of Machines

The service department plans to have a demonstrator follow up every machine that is sold, to make sure that the machine is properly installed, that the workman is instructed as to the operation and care of the machine, and that any special fixture and tool work has been properly attended to. This is an important item, because it is a good deal easier to start an operator in the right way than to get him to change to some other method of doing the work after he has been running the machine according to his own ideas for a month or more. Frequently, too, different work is ground on the machine from what had been originally planned when it was bought. In that case, a wrong size of wheel-head may have been furnished, and the customer may, for example, be trying to grind a hole 3 inches in diameter, when the wheel-head is only suitable for holes 3/4 inch in diameter. In that way production is kept down and there is dissatisfaction as to the output, whereas the trouble is due to the fact that the proper equipment for that particular job is not being used. The demonstrator can straighten this out quickly and agreeably if he arrives promptly after the machine is installed.

The demonstrators are distributed over a wide territory and are usually subject to the direction of the branch managers located in the territory where they are working. Several of the demonstrators are located permanently away from the factory, while others come under the direction of the main office in Worcester. In some of the branch offices, a stock of repair parts as well as complete machines is carried so that the demonstrator can secure from the nearest supply source the parts that he may need in caring for machines that have seen hard service.

Conclusion

Unfortunately all customers do not appreciate what this service means to them, or what the efforts and care involved in assuring them conscientious service after the machine is installed mean to the builder of the machine. The service department is, to a large extent, non-productive, because there is often no direct return for the amount of labor put into any particular job handled by the department. The prospective customer is under no obligation to purchase machines or equipment because of the experimental work performed in his behalf, but in the majority of cases the information and recommendations are found to be so worthy of favorable consideration by the customer that orders for the equipment recommended follow. The customer cannot help but have a certain amount of confidence in following these recommendations, knowing the amount of work and study that has been put into them.

While it may be generally true that the primary purpose of service departments is sales promotion, the department conducted by the Heald Machine Co. works with the underlying idea of finding out and suggesting the best way to do things to secure maximum efficiency and to have the recommendations take the form of actual efficiency engineering suggestions. Naturally, service of this type is conducive to increased sales for the company that makes the effort and the expenditure involved, and that gives the users of its product the full advantages of a complete engineering service department.

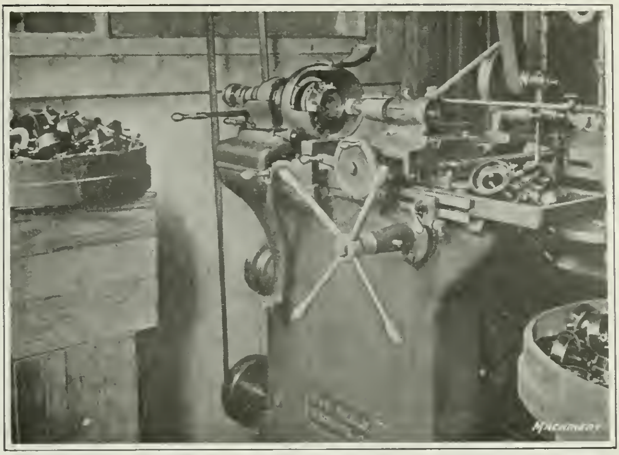

Fig. 3. Method of grinding Condensite Timers determined upon in the Service Department as shown in Fig. 2, in Use in the Customer's Shop

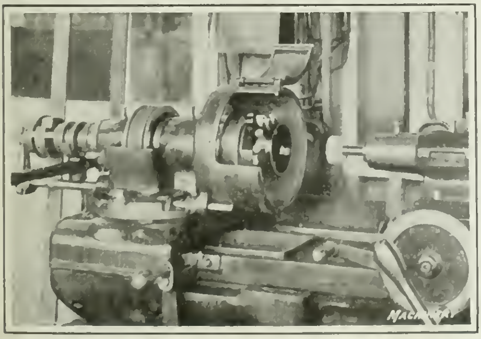

Fig. 2. Testing out Method of grinding Condensite Timers in Heald Service Department

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GASOLINE AND LUBRICATING OIL PRODUCTION

Approximately 13 per cent more gasoline was produced during the first six months of the present year than in the corresponding period of 1919. The domestic consumption in the first half of 1920 was 28 per cent greater than in the same part of the preceding year, while the total consumption was 32 per cent more.

According to the Bureau of Mines, the production of lubricating oils increased 22 per cent during the first half of this year, but the stocks on hand were lowered due to an increased consumption of 35 per cent. The export of lubricating oils was very great as compared with other petroleum products, representing 41 per cent of their total consumption during the first half of 1920. The increasing use of oil as fuel in ocean vessels is shown by the consumption of 100 per cent more bunker oil in the first six months of 1920 than in the same period of 1919.

* * *

The Interstate Commerce Commission has suspended until December 17, 1920, the new tariffs placing $10 demurrage charges on open cars held more than forty-eight hours.

Press Work in an Electric Motor Plant

First of Two Articles Describing Methods Used in the Power Press Department of the General Electric Co., Lynn, Mass.

By FRED R. DANIELS

THERE is probably no industry in which power presses play a greater part than in the manufacture of electrical equipment. The armature and field of the motor,—or the rotor and stator—are composed of laminated stampings of various shapes and sizes. These, together with the numerous switch boxes, gear covers, and similar drawn parts, constitute an interesting collection from which a few examples have been selected for the purpose of describing the dies and other special mechanism employed in the production of these parts.

To a considerable measure, the punching out of the numerous slots and holes in motor stampings is, as of old, performed on notching presses, but with the advent of the sub-press, the single punch and the indexing device of the notching press are being gradually supplanted by the perfectly aligned multiple punch and die unit. Although accurate results are obtainable on the notching press and quite rapid production may be realized, the best results are obtained by the sub-press. The first cost of the sub-press and the difficulty of obtaining perfect alignment of the upper and lower members in manufacturing probably accounts for the retention, in part, of the notching press on work of this kind. The equipment described was chosen with an idea of presenting representative examples illustrating the manufacture of motor-accessory sheet-steel parts, the work being performed in the press department of the General Electric Co.'s plant at Lynn, Mass.

Dies for Producing Stampings for Sewing Machine Motors

In manufacturing the stampings for a small sewing machine motor, known as the SA type, a series of four-pillar sub-presses is employed. Fig. 2 shows a view of the upper and lower members of the sub-press employed in the first operation. This is a full compound blanking die which produces the stator stamping shown at the right below the dies, and the rotor stamping in its first stage, as shown at the left. The dies used in the following operations are those employed in finishing the rotor stamping, the stator stamping being completed in one operation in the die shown. These stampings are made from sheet steel, 0.025 inch thick.

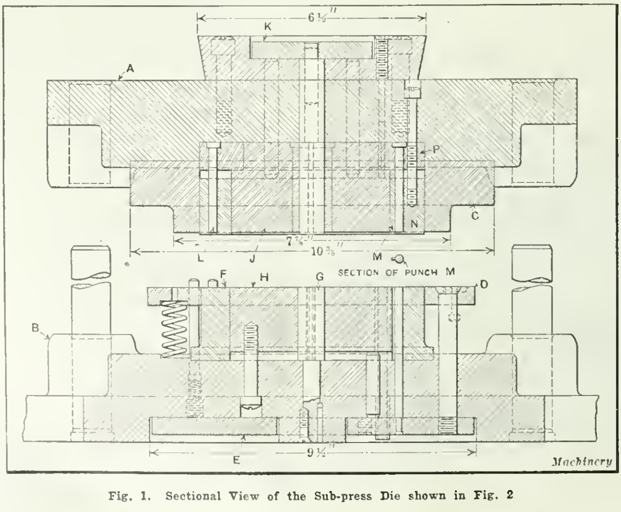


Fig. 1. Sectional View of the Sub-press Die shown in Fig. 2

A sectional view taken through the center of the sub-press is shown in Fig. 1, from which the method of operation will be clearly understood.

The upper and lower holders *A* and *B*, respectively, carry all the operative parts and hold them in perfect alignment. This is the feature of sub-presses which makes them particularly suitable for the manufacture of laminations for electric motors. Barring very slight variations in the laminations due to wear on the cutting edges of the die,

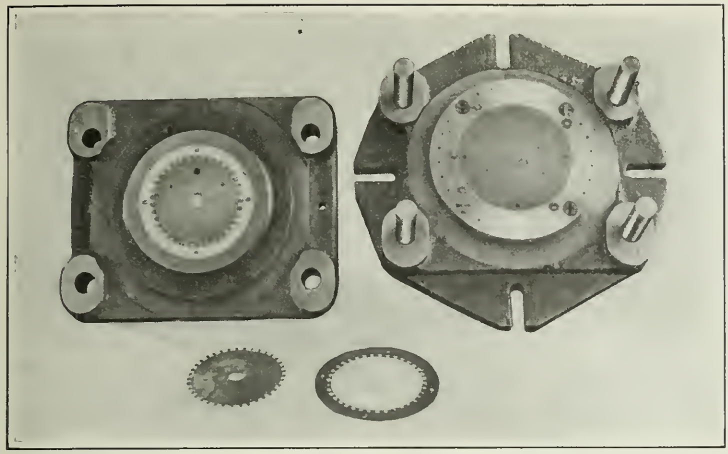


Fig. 2. Full Compound Blanking Die for producing Motor Stator Punchings

absolute duplicates can be produced, so that when assembled the laminations show no variation in contour or alignment of holes. In all the equipment here described, the upper and lower holders are made of cast iron; the punches, dies, and bushings of tool steel, hardened and ground; and the punch-plates, knock-out parts, and strippers, of machine steel. The upper holder carries die *C* and punch *J*, and between these parts the knock-out *N* operates. The feathered punches *M*, of which there are thirty-seven, and the four plain punches *L*, are attached to the punch-plate *P*, between which and the knock-out a space is provided to enable the knock-out to operate. The knock-out is operated by suitable pins extending through the upper member to the knock-out plate *K*.

Referring to the lower member, punch *G* is held fixed, so that as the ram of the press descends it will pierce the center hole in the blank and enter a steel bushing in the upper member, while the die *C* in passing down over the blanking punch *F* blanks out the stamping. Simultaneously, punches *M* and *L* of the upper member pierce the smaller holes in the work. An arrangement similar to that employed in the upper member is used to support the lower knock-out, and a corresponding opening between this part and the lower holder is also provided as the illustration clearly shows. As the knock-out *H* is permitted to descend when the spring-supported stripper *D* and knock-out plate *E* (on which the knock-out pins rest) are lowered by die *C*, space is provided for the feathers on punches *M* to protrude into the space that was formerly occupied by the knock-out.

Dies for Repunching and Trimming Rotor Stampings

The sub-press dies employed to perform the second operation on the rotor stampings are shown in Fig. 3, which also shows the appearance of the work before and after the operation is completed, while Fig. 4 is a detailed view of this sub-press. This operation is that of punching six holes. The dies employed are of simple construction; in the upper holder *A*, the punch-plate *C* is carried for holding six punches *D*. Between the punch-plate and the stripper *E*, the customary spring construction is employed. The three knock-out pins *H*, extending from the stripper to the knock-out plate *J* in the head-block of the upper holder, are a part of this familiar type of stripping mechanism. The three screws *K*, which maintain the desired alignment between the operative parts of the upper section of the sub-press, are provided with a locking arrangement for the nut so that as they operate through holes in the holder *A*, there will be no danger of turning and causing trouble. This construction is common to all the sub-presses described in which the strippers are attached by this method. The die-block or bushing holder *F* of the lower member carries suitable steel bushings in which the punches operate, and a locating pin *G* by means of which the blank from the previous operation is located by its center hole.

The third operation is performed with the dies shown in Fig. 6, and consists of trimming the blank and of punching three small holes near the center as shown in Fig. 5, which shows the sub-press employed in this operation and the appearance of the stampings before and after the operation is performed. Referring to Fig. 6, the upper holder *A* carries the trimming die *E* and the punch-plate *J* in which punches *D* are secured. The knock-out *F*, through holes in which the punches operate, functions through the familiar pin and knock-out plate arrangement incorporated in the equipment previously described. As the upper member descends, die *E* trims the blank with the aid of trimming punch *C*, on which the work is located by means of two pins, one for the center hole of the stamping and the other for one of the six holes previously punched. As the blanks are being trimmed, the narrow rings of scrap are forced down around punch *C* until they are severed by cutter *G* located in the lower holder. Since this sub-press was designed a series of vent holes has been added in punch *C* which do not show in the illustration. Fig. 5 shows the cutter and the locating pins previously mentioned.

Construction of Multiple Slotting Dies

The slotting operation performed on the blanks, in which a series of radial slots is punched, may be successfully performed with two different sets of dies of the sub-press type. The first of these is shown in section in Fig. 7 and also in Fig. 8, the latter illustration showing in addition, a view of the stamping before and after the work is performed.

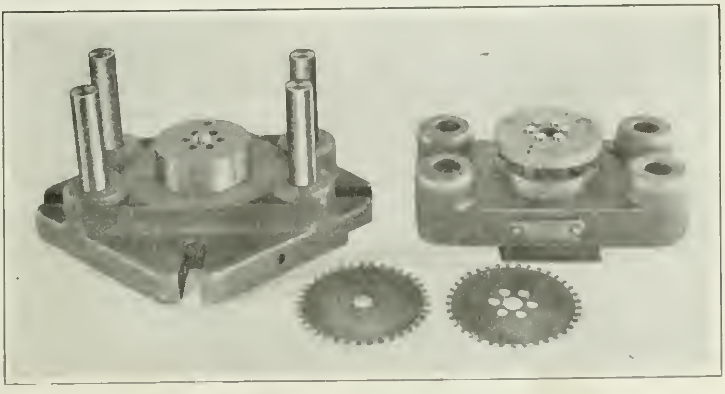


Fig. 3. Sub-press Die used for punching Holes in Sewing Machine Motor Rotor Stampings

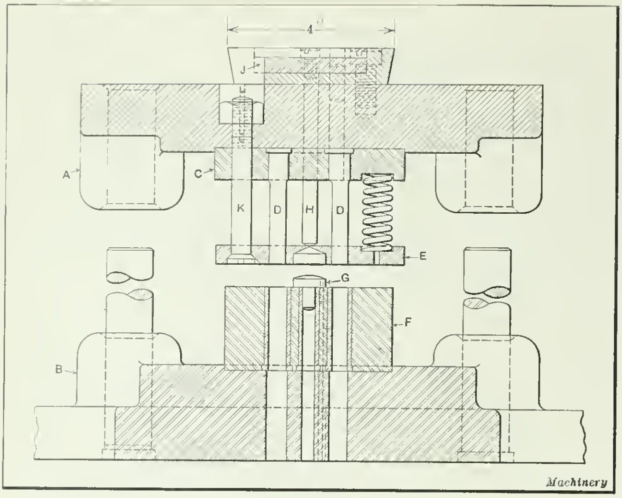


Fig. 4. Sectional View of the Sub-press Die shown in Fig. 3

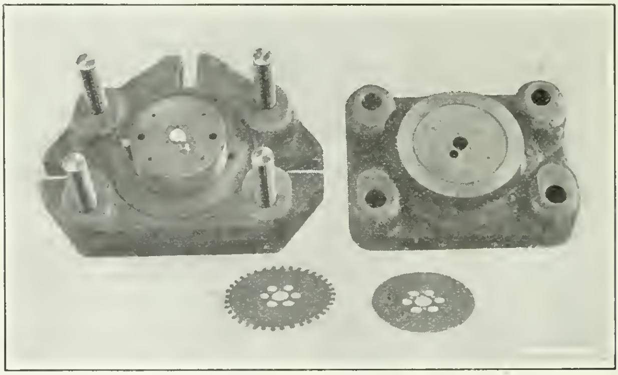


Fig. 5. Trimming and Repunching Die for Rotor Punchings

This die is known as a two-stroke multiple slotting die; it differs from those used for similar operations in that an indexing feature is incorporated, so that only one-half as many die openings are required as would be the case with a single-stroke die of this type. This provides greater strength for the die sections, which otherwise would be rather frail unless this or some other means of reinforcing these die sections were employed.

The stripper *J* is attached to the upper holder *A* in the regular way, and through it the twenty-four punches *H* held in the punch-plate operate. Attention is called to the use of two series of stripper springs rather than one, and also to the locking pin for the stripper screw nut. Die-block *C* in the lower holder *B* carries twenty-four die segments *K* which are set into the die-block and secured by four pin-keys *L*. For the purpose of indexing the die one-half space preparatory to punching the intermediate slots during the second stroke of the press ram, the handle *E* is attached to the center stud *D* beneath the lower holder, and is offset so as to operate in a recess cut in the holder, as shown. This handle carries a detent block *F* in which the spring-actuated detent *G* is carried, which engages notches in a steel plate attached to the lower casting. Attention is called to the shape of the handle at section *X–X*; it is made this shape in order to prevent congestion of the scrap stock which falls through the openings in the die. If some such means of relief were not provided, the scrap would pile up between the handle and the lower holder as the handle is brought back and forth under the openings in the holder.

The multiple slotting die illustrated in Fig. 9 is a modification of the die just described and is used in performing the same operation. It was first thought that where the die openings must be close together, a design such as was later developed would not be sufficiently strong to perform the services required of it efficiently. The results obtained with the die to be described prove, however, that this idea was a fallacy. In this design forty-eight punches *D* are carried in the punch-plate *C* instead of twenty-four, as in the other die. The stripper *E* is backed up by one set of four coil springs, instead of two sets of sixteen as in the other case, and is connected with the lower holder *B* by means of two machine-steel stripper rods, which furnish additional stability to the punches. Forty-eight die sections *G* are set into the die-block or plate *F*, and the knock-outs *H* which operate in the die openings are supported by pins which rest on three knock-out plates *J*. These knock-out plates form a ring and are set into the lower holder, each ring section being, in turn, supported on the knock-out ring *L* by means of the two supporting pins *K*.

A positive knock-out mechanism on the machine is employed to operate the knock-out ring for the purpose of ejecting the scrap material from the die openings on the upward traverse of the press ram. This knock-out mechanism (not shown in the illustration) is connected by rods to the press ram and functions with it on every ascent. In this respect

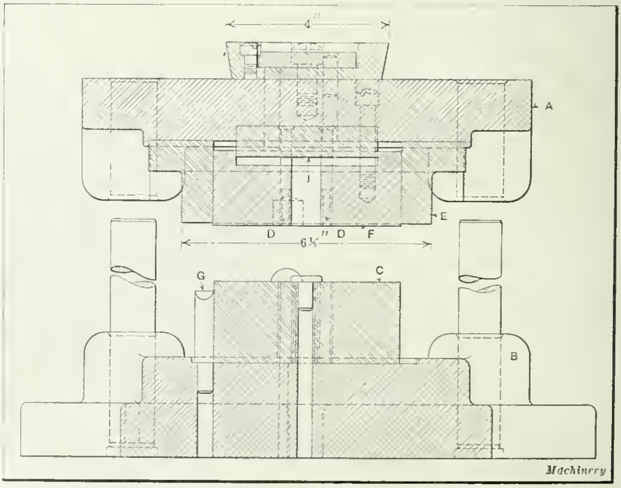


Fig. 6. Sectional View of the Sub-press illustrated in Fig. 5

it will be seen that the design is quite different from that shown in Fig. 7, and that the narrowness of the knock-out sections makes it imperative that rather slender supports be used, so that the interposition of the knock-out plates is necessary to provide a more substantial construction. The operation of this sub-press will be readily understood.

The operations required in the manufacture of these rotor stampings are performed on Ferracute inclined presses, one of which is shown in Fig. 11, set up for the slotting operation. This illustration shows the two-stroke type of sub-press described in connection with Fig. 7. The operator is using a pair of pliers to remove the work from the press. This is a safety measure which is taken by the General Electric Co., as the use of the hands to remove work from power presses is forbidden, and this rule cannot, under any conditions, be violated by the operator.

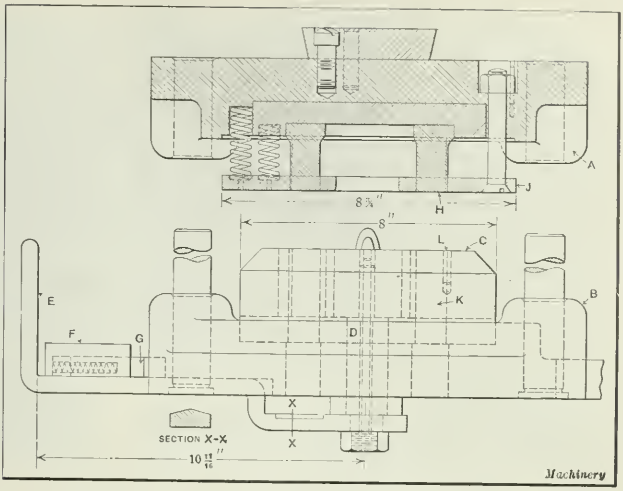


Fig. 7. Detailed View of the Two-stroke Multiple Slotting Die shown in Fig. 8

Dies for Punching Center and Air-space Holes in Rotor Stampings

Another type of the numerous armature stampings used in motor construction is shown in Fig. 10, together with the sub press employed in the production of the work. A sectional view of this sub-press is shown in Fig. 13. The upper holder *A* carries the punch *H* and the knock-out plate shown in section in the head-block, by means of which the stripper *J* is operated. This stripper operates against three coil springs which are set into it and into the punch-plate, after the general arrangement of similar stripping mechanisms. Three air-space punches *G* are attached to the punch-plate through a hole in which punch *H* operates. This provides for advancing punch *H* ahead of the air-space punches, and enables greater concentricity of the center hole and the air spaces than would be realized if all the punches worked in unison. During a preliminary operation the work is blanked out, and it is then set on die *C* of holder *B*, on which it is located concentrically by means of three jaws *E*, the radial position of which may be adjusted in the adjusting ring *F*, to compensate for any variation in the periphery of the blank or any slight irregularity that may exist. This adjustable feature consists simply of three elongated holes in the bottom ring *D*, in which shoulder screws are used to fasten the jaws in place, and three coil springs which act radially against these screws. The construction is clearly shown in the sectional view.

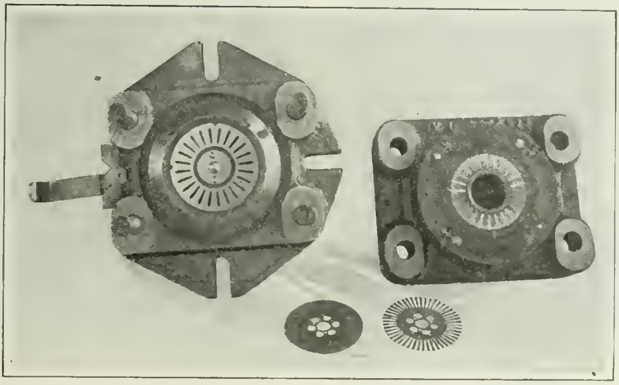


Fig. 8. Two-stroke Multiple Slotting Die with Indexing Arrangement

In operation, the stripper *J* first comes into contact with the locating jaws, after which punch *H* punches the center hole and enters a hole in the die, so that on the continued downward stroke of the press ram the blank is held in such a manner that the air spaces will be punched concentric with the center hole. The general appearance of the die and of the adjusting ring may be more clearly seen by referring to Fig. 10, and the set-up by referring to Fig. 14. This operation is performed on a Ferracute press, and the sub-press is of the two-pillar type, being different in this respect from the sub-presses described in connection with the production of sewing machine motor stampings.

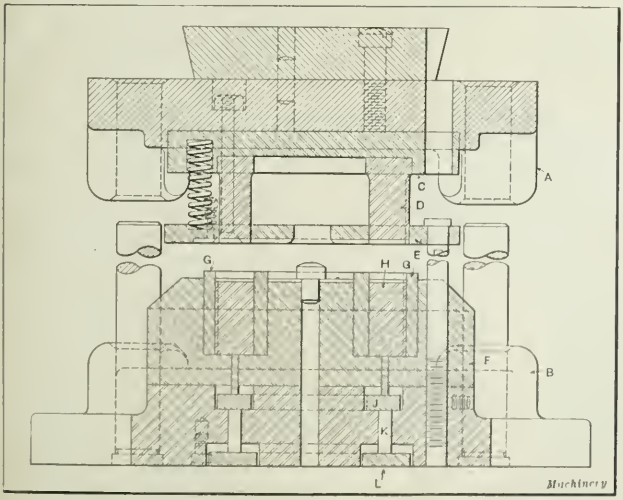


Fig. 9. Single-stroke Multiple Slotting Sub-press Die for Rotor Stampings

Example of Follow-die Design

The follow-die shown in Fig. 15 is employed in the production of brush-holder levers, one of which may be seen lying on the die-block in Fig. 12. This illustration shows a press set up for this operation. After the strip stock is fed under the die-plate, spring-stop *A* is used to locate it from the end, while two holes are pierced by punches *D* and *E*, Fig. 15. The relation of these two holes to each other is illustrated in the plan view of the die, which is shown in the lower part of the illustration. At this time punch *F* has performed no work, but on the second stroke of the press ram the stock is advanced against the left-hand stop *B*, Fig 12, so that at the same time that the finished stamping is being produced by this punch the punches *D* and *E*, Fig. 15, are operating in the follow-up position. It will be noticed that punch *F* carries a pilot which engages the large hole previously punched and insures concentricity of the surrounding stock with the hole.

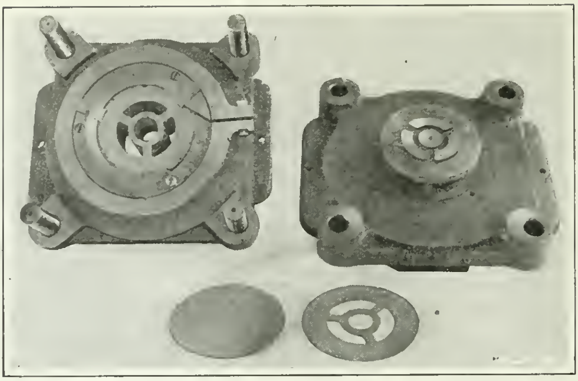


Fig. 10. Sub-press Dies and the Motor Stampings which are punched out

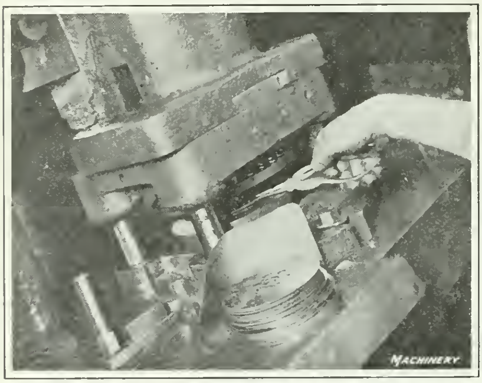


Fig. 11. Inclined Power Press set up with Sub-press Dies for slotting Rotor Stampings

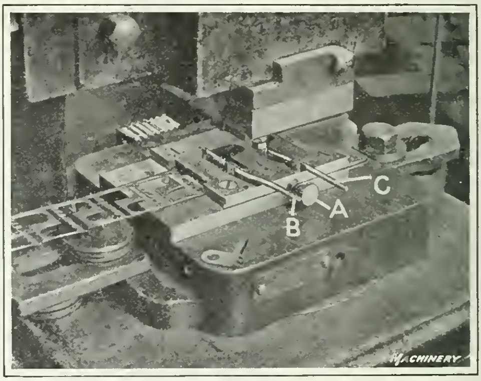


Fig. 12. Set-up of Punch Press equipped with the Dies illustrated in Fig. 15

Stop *B*, Fig. 12, engages the hole left in the stock after the stamping has been punched out. The operation is then simply an ordinary power press operation, in which each stroke of the press produces a complete stamping. After the strip stock has been passed entirely through the die, it is reversed and fed in from the same direction for the purpose of making use of the scrap stock remaining. While the stock is passing through the die the second time, stop *C* is used. This stop engages the narrow section of the opening produced in the scrap stock while it was previously passing through the dies.

The brush-holder levers stamped out in the follow-die described do not require to be exact duplicates. If it were necessary to meet this condition, a die of the follow type would not be suitable for the work, since it is only in the rapid production of the rougher class of stampings that the follow-die finds special application. The sub-press, which stands for the highest degree of accuracy in stamping work, represents such a large initial cost that it cannot replace the follow-die for the quantity production of work such as has just been referred to.

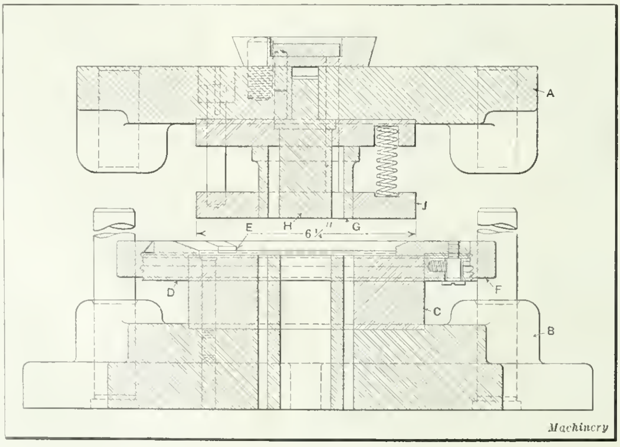


Fig. 13. Sectional View of the Center-hole and Air-space Die for producing Induction Motor Armature Stampings

The present installment reviews in some detail the design and operation of various types of compound blanking and perforating dies of the sub-press type of construction, including, for the sake of completeness, a description of one follow-die. The examples presented embody all the vital mechanical features found in blanking and piercing or slotting dies commonly employed in an electric motor shop. There are, of course, a multiplicity of shapes and designs of stampings being constantly produced in the General Electric Co.'s plant, but a rehearsal of additional examples, dif-

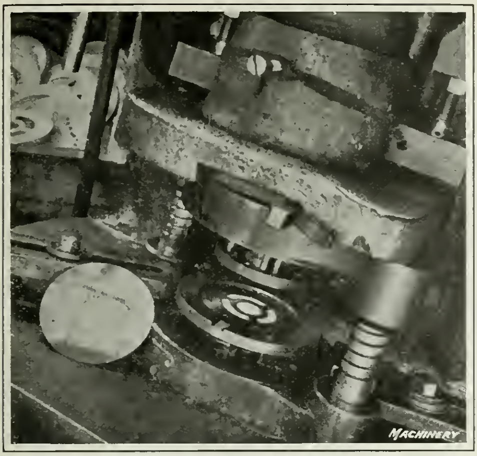


Fig. 14. Inclined Press set up for punching the Center Hole and Air Spaces in Induction Motor Stampings

fering only in the contour of the work and not in the construction of the die, would serve no purpose.

The concluding installment of this article, which will be published in the December number of MACHINERY, will describe the power press equipment used in the production of street railway motor gear-cases; the two types of dies used in making turbine motor stampings; an automatic feeding mechanism and stop for power presses; and the indexing mechanism and work-holding devices used on notching presses when producing electric motor stampings.

* * *

The first steel works and rolling mill in South America has recently been placed in operation by the Argentine Iron & Steel Works, Ltd., a company started in 1912 mainly with British capital, and which, up to the present has manufactured bolts, nuts, rivets, nails and wood saws.

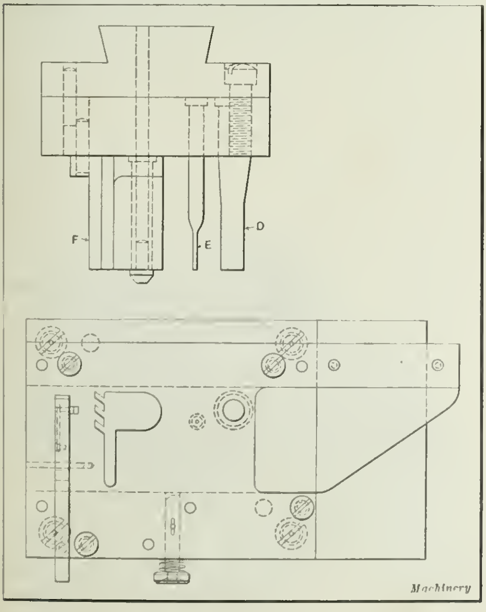
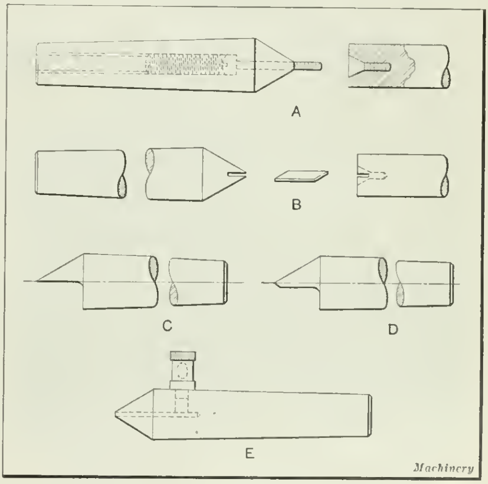


Fig. 15. Punch and Die of the Follow Type used in producing Brush-holder Levers from Strip Stock

SPECIAL LATHE CENTERS

By H. H. PARKER

The illustration shows a few types of lathe centers which frequently prove useful on occasions when ordinary centers are unsatisfactory. When desiring to turn small work having insufficient room to accommodate a dog or some other holder employed for driving purposes, or when the entire length of the piece must be machined at one setting, a screw-point live center such as shown at *A* may be of value. This center has an inserted screw with its threaded end projecting beyond the end of the center. The screw is held in place by means of a locking set-screw in the tapped hole of the center which bears upon the head of the inserted screw. In preparing the work to be used in connection with this center, the end is drilled as usual, and is then drilled in further and tapped to suit the screw, upon which it is mounted when placed in the lathe. If the point of the screw should become broken, it can be driven out and another screw substituted. In instances similar to those mentioned, a live center such as shown at *B* can also be used. It will be seen that the ends of the center and the work have a narrow slit. A small, flat, spring-steel key is inserted in these slits to accomplish the rotation of the work. The centers described in the foregoing are, of course, only suitable to be used in supporting small work on which light cuts are being taken.



Types of Centers employed for Special Purposes

Sometimes a "half" center is used in the tailstock if it is desired to get close to the center of the work when facing the end, or when turning a piece of small diameter. Often, however, the "half" center is constructed too literally, as shown at *C*. Such a center acts much as a reamer or a cutter and destroys the center hole in the work. The proper construction for such a center is shown at *D* in which less than half of the point is cut away, thus leaving a small cone-shaped point which fits into the center hole. The result obtained by the use of this center is the same as when a very small dead center of the design ordinarily used is employed.

A dead center having an oil-hole drilled longitudinally through the point and a larger hole drilled at right angles to it into which a small oil-cup is driven, is shown at *E*. This feature permits ready lubrication of the point and reduces the likelihood of the center becoming burnt. It is somewhat difficult to harden a center of this type after the holes are drilled, but if sufficient care is taken this may be accomplished satisfactorily.

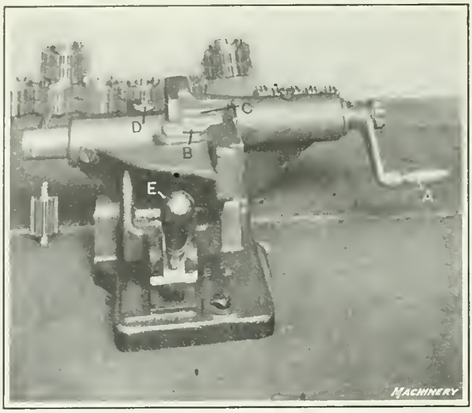


Fig. 1. Fixture for testing Concentricity of Pitch Circle, Pitch Diameter, Tooth Thickness, and Freedom from Rolling Interference in Oil-pump Pinions

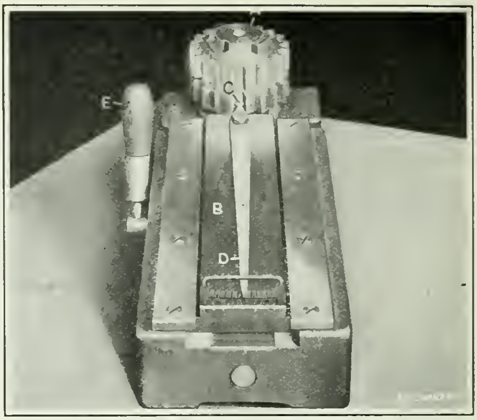


Fig. 2. Fixture for testing Relationship between Position of Keyway and Gear Teeth in Crankshaft Sprockets. Limits of Tolerance, ± 20 Minutes

Fixtures for Testing Automobile Gears

If the engine and transmission of a motor car are to run without noise, it will be apparent that the gears must be accurately cut. In some automobile plants, a great deal of study has been devoted to the development of methods for producing gears that will attain the highest degree of accuracy; but even where the utmost care is exercised in gear-cutting, it is not assumed that the product is satisfactory until each gear has been subjected to the most searching inspections to make sure that all of its dimensions are within the required limits of tolerance. For making such inspections, a number of interesting fixtures have been developed. All of these fixtures were made for testing various gears which enter into a well-known automobile; but with slight modifications of design, such fixtures could be employed with satisfactory results for testing the gears used in a great variety of products besides motor cars.

Testing Concentricity of Pitch Circle, Pitch Diameter, Tooth Thickness, and Freedom from Rolling Interference

In Fig. 1 there is shown a fixture that provides for testing the concentricity of the pitch circle with the bore, the accuracy of the pitch diameter and tooth thickness, and the freedom from rolling interference in the gear teeth. As shown in the illustration, this fixture is employed for making these tests on small oil-pump pinions, but similar fixtures are used for testing various other gears. The gear to be tested is carried on an arbor supported by a swinging bracket, the gear being in mesh with a master pinion and mounted on its arbor in such a way that it is free to rotate. In using this fixture, the turning of crank-handle *A* causes the master gear *B* to rotate and thus turns the gear *C* to be tested, which is in mesh with the master. It will be evident that if the pitch diameter and tooth thickness are uniform, and if the pitch circle is concentric with the bore of the gear and there is no rolling interference in the teeth, there will be no tendency for the bracket on which the test gear is mounted to have an oscillatory movement imparted to it. But if the gear under test is imperfect, the bracket will have to swing on its pivotal support.

Secured to the swinging bracket there is a plunger which engages the contact point of a Lowe test indicator *D*, and any inaccuracy of the gear is shown by the movement of the indicator needle. While turning crank *A* to revolve the gears, the operator holds lever *E* which provides for keeping the swinging bracket in such a position that the gears are held firmly in mesh with each other. In using this fixture

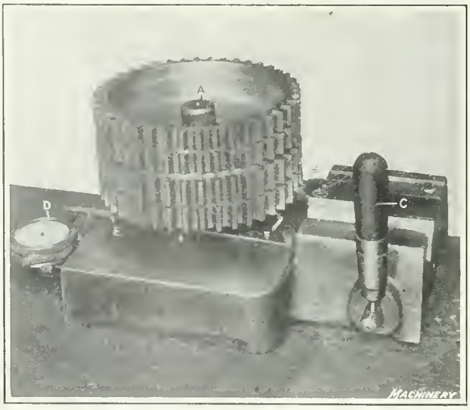


Fig. 3. Fixture for testing the Concentricity of the Pitch Circle, the Tooth Thickness, and the Pitch Diameter of Camshaft Sprockets

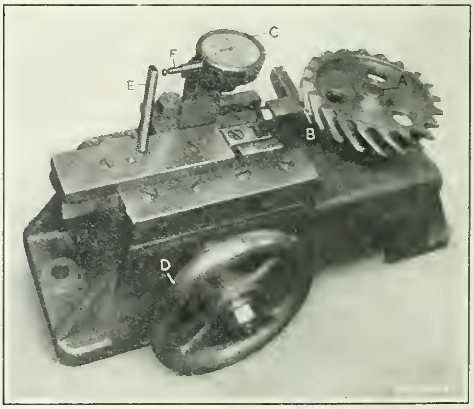


Fig. 4. Fixture used for testing Pitch Diameter, Concentricity of Pitch Circle, and Tooth Thickness of Oil-pump Shaft Spiral Gears

the master gear is not continually employed. It is used in making tests from time to time, the actual method of procedure being to use the master gear to select a "standard" gear which will run properly with it. Then this standard gear is employed for testing until there is possibility of its having been sufficiently worn to allow inaccurate gears to pass inspection. This test gear is then discarded and the master gear is employed to make another selection of a standard gear for use on the fixture. In conducting these tests, oil-pump pinions are required to have the pitch diameter and the concentricity of the pitch circle accurate within ± 0.001 inch, while the tooth thickness and freedom from rolling interference must be accurate to within 0.0005 inch. Errors of the first two kinds are shown by gradual fluctuations of the indicator needle, but if errors of either of the latter kinds are present in the gear, the needle makes abrupt movements.

Testing Relationship between Position of Keyway and Gear Teeth

In order to obtain the proper timing between the crankshaft and camshaft, it is necessary for the position of the keyway in the crankshaft sprocket to be located within limits of ± 20 minutes of arc of its proper position. For use in testing the accuracy of location of this keyway, the fixture shown in Fig. 2 is employed. It is of quite simple design, consisting of an arbor on which the gear is mounted, with a key on the arbor that enters the keyway in the gear. Mounted on the body of the fixture there is a slide *B* which has an indicator needle pivotally supported on it. The forward end *C* of this needle is shaped to fit into the space between the gear teeth, and the ratio of the arms of the needle is made sufficiently great so that the point *D* has sufficient movement to enable the graduations of the scale over which it swings to be widely spaced to facilitate easy reading.

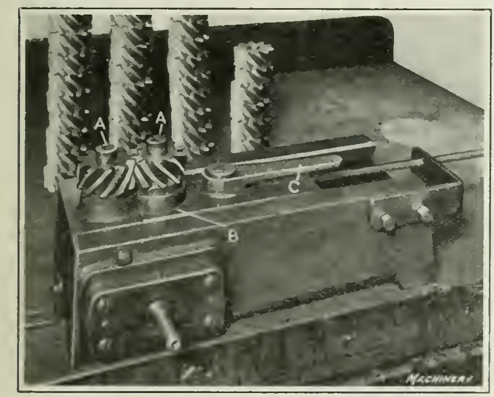


Fig. 5. Fixture for testing Running Action of Spiral Gears. Interchangeable Parallel Arbors and Adjustment of the Center Distance provide for testing Various Sizes of Gears on this Fixture

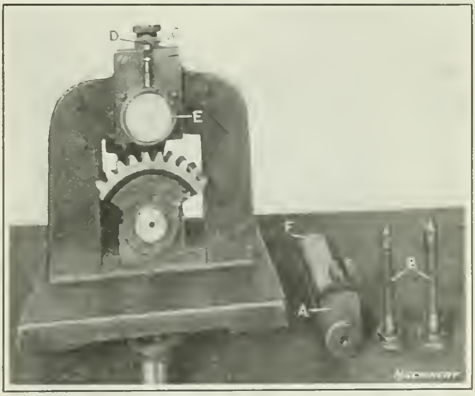


Fig. 6. Fixture used for testing Root, Pitch, and Throat Diameters of Worm-wheel Sector for Steering Gear. Three Plungers are used interchangeably for making these Measurements

In using this fixture, slide *B* is moved back and forth by hand-lever *E*, the method of procedure being to advance point *C* of the indicator needle between two gear teeth and then note the position of point *D* of the needle over its scale. After this has been done, the slide and its needle are withdrawn from the gear, and after turning the gear through a quarter revolution, the needle is advanced into the next tooth space which it is to occupy, and another indicator reading is then taken. This operation is repeated four times. The gears to be tested have twenty teeth and the keyway is required to be centered on a diametrical line passing through the center of the space between two teeth. Hence, if the relationship between the keyway and the gear teeth is accurate, the indicator needle will not be deflected from its central position when advanced into the space between the gear teeth. Testing the location of the keyway from four positions gives added assurance of accuracy.

Testing Pitch Diameter, Concentricity of Pitch Circle, and Tooth Thickness of Camshaft Sprockets

Fig. 3 illustrates an apparatus of quite different design from the fixture shown in Fig. 1, although it is employed for making the same general kind of tests. In the present case, the gear to be tested is a camshaft sprocket and it is required to have the concentricity of the pitch circle and the pitch diameter accurate to within 0.002 inch, while the tooth thickness must be accurate to within 0.001 inch. The method of conducting the test is quite simple. It will be seen that the gear to be tested is supported on an arbor *A* and that a contactor point *B* is arranged to straddle a gear tooth. This contactor is so designed that its points come down and engage opposite sides of a gear tooth at the pitch circle. Provision for advancing the contactor toward or withdrawing it from the gear is made by means of lever *C* that manipulates a slide on which the contactor is supported. In setting up the fixture, a master gear is mounted on arbor *A*, and contactor *B* is brought into engagement with it, after which the indicator *D* is set to zero. Then with a regular production gear set up on arbor *A*, it will be apparent that so long as the three dimensions under investigation are accurate, contactor point *B* may be brought into engagement with the gear without causing the indicator needle to be deflected from its zero position. Connection between the indicator *D* and the slide that carries contactor *B* is made by means of a bellcrank lever *E* having a ratio of 5 to 1, so that even the slightest errors in the dimensions of the gear will at once become apparent.

Testing Pitch Diameter, Concentricity of Pitch Circle, and Tooth Thickness of Spiral Gears

Fig. 4 illustrates a fixture of quite different design from the one shown in Fig. 3, although it provides for making the same tests that are conducted on that apparatus. The present fixture is employed for testing spiral gears for assembly on oil-pump shafts. In setting up this apparatus, a standard gear is first mounted on arbor *A*, and after bringing the contactor point *B* into engagement with a gear tooth, the indicator *C* is set to read zero. Then a regular production gear is substituted, and the testing fixture is used by advancing the contactor point *B* into engagement with successive teeth as the gear is indexed one tooth space at a time. Advancing the contactor point to the work and withdrawing it to enable the gear to be indexed is accomplished by means of a handwheel *D* which traverses the slide on which contactor *B* is mounted.

It will be apparent that at the rear end of this slide there is a post *E* that engages the plunger *F* of indicator *C*. So long as there is no error in the dimensions of the gear, this indicator needle will remain over the zero graduation, but if either the pitch diameter, the concentricity of the pitch circle, or the thickness of the gear teeth is inaccurate, it will be evident that contactor *B* will not advance inward to its normal position, and hence the indicator needle will not come to rest over the zero graduation, where it was set while the contactor point was in engagement with the tooth of a standard gear. These oil-pump shaft spiral gears are required to have the concentricity of pitch circle and the pitch diameter accurate within ± 0.001 inch, while the thickness of the gear teeth must be accurate within ± 0.0005 inch. The work-holding pilot *A* on this fixture is adjustable for holding three different gears, all of which have teeth of the same pitch so that it is unnecessary to change the contactor point *B*. If an error is detected by either of the fixtures shown in Figs. 3 and 4, the kind of error may be identified by the way in which the indicator needle is deflected.

Testing Running Action of Spiral Gears

For use in determining the smoothness with which small spiral gears are able to run, a testing fixture shown in Fig. 5 is used. It will be seen to consist of a pair of parallel arbors *A* over which two gears are dropped so that they mesh with each other. The right-hand arbor is carried by a slide *B*, the position of which may be adjusted along the bed of the fixture and clamped by means of a lever *C* that operates an eccentric binder, in order to make provision for varying the center distance to enable gears of different pitch diameters to be set up for testing. The gears shown in this illustration are spiral gears for use on the water-pump shaft, but these are only one of many types of gears that are similarly tested. The inspector places two gears in mesh on arbors *A* and then proceeds to roll them, using the palms of his hands on the outside of the gears to apply the necessary tractive force. In this way he is able to feel instantly any irregularity in the rolling action.

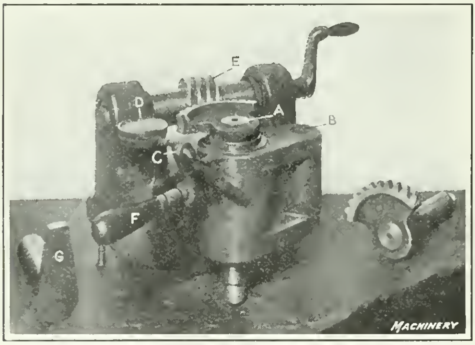


Fig. 7. Fixture for testing the Pitch Radius of Worm-wheel Sectors for Steering Gear

It has been found that an arrangement of parallel arbors of this kind affords a more sensitive test than a fixture arranged with arbors at right angles. In addition to providing for adjusting the center-to-center distance of the gears, the arbors *A* may be changed to provide for setting up gears which have bores of other diameters. Attention is called to the fact that this test is purely for the smoothness of running action and that it has no reference to any tendency of the gears to produce noise while running. For use in testing their freedom from this objectionable property, all important gears are tested on a special machine on which a gear is driven at high speed while in mesh with a master gear.

Testing the Root, Pitch, and Throat Diameters of Worm-wheels

For use in determining the accuracy of the root, pitch and throat diameters of worm-wheel sectors for steering gears, a fixture such as shown in Fig. 6 is used. As in previous outfits which have been described, the different tests are made by using a dial indicator to show any lack of accuracy that exists in the work. In setting up this fixture, a master segment *A* is employed, which is mounted under the indicator so that the latter may be set for a zero reading that corresponds with an accurate condition of the work. As it is necessary to measure the root, pitch, and throat diameters of these worm-wheel segments, it will be apparent that three tests must be employed, and there are three separate contactors, two of which are shown at *B*, that provide for reaching the different points on the work where measurements have to be made. These plungers are set up successively in a slide shown at *C*, and it will be noticed that each plunger has a knurled head and a threaded portion directly below the head, which provides for screwing the plunger into a tapped hole provided in the slide for that purpose.

Slide *C* is pushed down against a compression spring to provide for bringing the contactor into engagement with the work, and a cross-pin *D* on the slide comes into engagement with the plunger of the indicator *E*. If the worm-wheel segment under test is accurate, the slide will continue to go down until the contactor strikes the work, leaving the indicator needle standing over the zero position on the scale. On the throat and root diameters the limits of tolerance are ± 0.005 inch and on the pitch diameter the limits of tolerance are ± 0.001 inch. It will be apparent that the contactors *B* are not changed for making tests on a single worm-wheel segment. Each segment has a shank, as indicated on the master at *F*, which is pushed into a bearing in the fixture. All of the root diameters are tested on a series of worm-wheel segments, then all of the pitch diameters, and finally all of the throat diameters. Such a procedure avoids the necessity of losing time in changing the contactors that come into engagement with the work at different points.

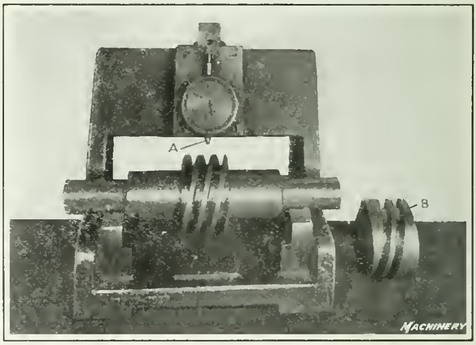


Fig. 8. Fixture used for testing the Included Angle and the Pitch Diameter of Worms

Testing Pitch Radius of Worm-wheel Sectors

Fig. 7 shows a fixture that provides for testing the pitch radius of worm-wheel sectors for steering gears. It will be apparent that the sector to be tested is mounted on an arbor *A* carried by a bracket that swings on pivot *B*. At the opposite end of this bracket from the pivot, there is an arm *C* that comes into contact with the plunger of a dial indicator *D* when the worm-wheel segment is brought into mesh with the master worm *E* by pushing over handle *F*. In setting up this fixture, a master gage *G* is used in place of the worm-wheel segment, the radius of this gage being such that when it comes into engagement with the arbor on which the worm *E* is carried, the indicator may be set to zero. In other words, the radius of the test arm *G* plus the radius of the arbor is equal to the center-to-center distance of the worm-wheel sector and the worm. It is apparent that when the worm-wheel sector and worm are brought into mesh, arm *C* comes into contact with the plunger on dial indicator *D*, and if the pitch radius of the worm-wheel sector is accurate, the indicator needle will come to rest over the zero graduation on the dial. The pitch radius of the worm-wheel sectors is made slightly over size at the center, so that wear which occurs more rapidly at this point will not show serious results for a long period of time. Owing to this practice of making the sector slightly over size at the center, the test of the pitch radius is conducted at that point.

Testing Included Angle of Worm Threads and the Pitch Diameter

For testing the included angle of worm threads and the pitch diameter, a fixture such as shown in Fig. 8 is used. It will be seen to consist of a dial indicator provided with a plunger *A*, the form of which corresponds to that of the included angle of the thread of the worm to be tested. This plunger is made with knife-edges so that it drops into engagement with the worm thread and not only tests the pitch diameter by the indicator, but by having the fixture standing in front of a window, the form of the thread may be checked against that of the templet *A* by the familiar light test. Should it happen that the included angle of the thread is wrong, this condition will be shown by failure of the indicator point *A* to engage the thread uniformly; and any error in the pitch diameter will be made apparent by the fact that the plunger *A* does not come to rest in its normal position, and hence the indicator needle is deflected from the zero graduation on the dial. In setting up the fixture, the usual practice is followed of using a master, shown at *B*, against which the indicator is set to zero. In testing these worms it is required that the pitch diameter shall be within ± 0.001 inch of the specified size.

Advantages of Testing Gears as they are Produced

It goes without saying that in a plant where so much care is taken in testing all of the important dimensions on gears, a corresponding amount of attention will be paid to the tooling and operation of all types of gear-cutting machines. In connection with the work of the gear-cutting department, it is important to note that as rapidly as gears are cut, they are sent to the inspectors who use the various gages which have been described for checking all important dimensions.

* * *

TABLE FOR CALCULATING OUTSIDE DIAMETER OF WORMS

An article showing the derivation of a formula for checking the outside diameter of standard worm threads by the three-wire system, without the use of special wires for each thread pitch, was published in the August number of MACHINERY on page 1131. A table presented with that article gave the width of flat at the top of the thread, and a value for one of the unknown quantities in the formula, corresponding to each pitch of thread. Some of the values as tabulated were incorrect; the correct figures are given below.

TABLE USED TO MEASURE PITCH DIAMETER OF STANDARD WORM THREADS BY THREE-WIRE METHOD

No. of Threads per Inch	Pitch, P	Thickness, t	(P — t)	3.8666 (P — t)
1	1.0000	0.3350	0.6650	2.5713
1½	0.6667	0.2233	0.4434	1.7145
2	0.5000	0.1675	0.3325	1.2856
2½	0.4000	0.1340	0.2660	1.0285
3	0.3333	0.1117	0.2216	0.8568
3½	0.2857	0.0957	0.1900	0.7347
4	0.2500	0.0838	0.1662	0.6426
5	0.2000	0.0670	0.1330	0.5143
6	0.1667	0.0558	0.1109	0.4288
7	0.1429	0.0479	0.0950	0.3673
8	0.1250	0.0419	0.0831	0.3213

Machinery

SIMPLE METHOD OF MILLING DOVETAIL GROOVES

By DONALD A. HAMPSON

Machining dovetail grooves is one of the most difficult operations frequently performed in the ordinary shop. When the dimensions of the groove are small, a great amount of skill is necessary if a nice sliding or driving fit must be made with the mating piece. The grooves are usually machined with end-milling cutters having the required contour or with planing tools. These tools are often so frail that they are likely to break, thus retarding production. It is customary to relieve this condition by roughing out the groove to the shape of a square or to that of a dovetail of smaller size. Larger grooves, like those on the saddles of machine tools, are finished at higher production rates because the size of the grooves permits more rugged cutting tools with a longer life, to be used. When a gib is used to fit the parts at assembly, the grooves may be cut somewhat less accurately, because then a difference in size of several thousandths of an inch can be readily compensated for. Vertical and horizontal milling machines are most frequently used in performing the work under discussion. Shops unprovided with machines of the horizontal type perform the operation by using angular end-milling cutters and either the vertical or horizontal feeds of the machine. The presence of any backlash during the operation may prove disastrous especially if the material is as tough as steel.

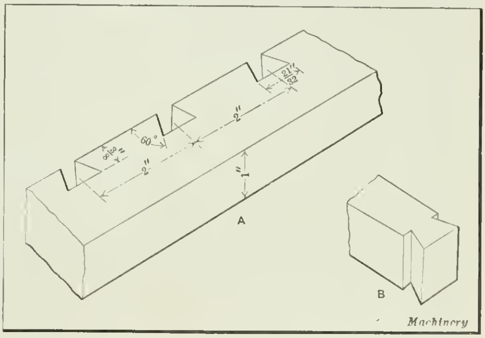


Fig. 1. (A) Section of Steel Bar provided with Three Dovetail Grooves at Center. (B) Dovetail Tongue on Ends of Bar used in tying together Two Bars of the Type shown at A

Original and Present Methods of Machining Dovetail Grooves in Long Steel Bars

Fig. 1 at *A* shows a section of a steel bar 80 inches in length that is used in pairs with the dovetail grooves of one bar opposite those of the other. The two bars are joined in that relation by means of a center bar provided at the ends with a dovetail tongue as shown at *B*. These tongues must fit the grooves so closely that the center bar can be pushed in and out by hand but will not fall out due to its own weight. One of the bars in each pair is 1½ inches wide, the other being 2 inches wide. The three grooves in each bar must be accurately spaced, and in some cases the central groove is required to be in the middle of the bar length within a tolerance of 0.004 inch. It was originally the custom to rough out the grooves on a shaper with an ordinary parting tool having a width 1/64 inch narrower than the mouth of the grooves, the tool being fed the full depth. If the stock of cutters was low the grooves were further roughed out by under-cutting them about 15 degrees, this operation also being performed on the shaper. However, cutters of the size required for finishing these grooves are extremely fragile, and would break regularly.

Fig. 3 shows the arrangement subsequently employed for the job which permitted the operation to be accurately and readily performed. It consists of a fixture which holds two bars at a time on the machine table at an angle of 30 degrees with the milling cutter spindle. A long tongue on the bottom of the fixture insures accurate angular location. A special arbor is provided on which is mounted a 60-degree high-speed steel milling cutter. The vertical hand feed of the table is used to feed the work to the cutter.

The method of securing the work on the fixture will be readily understood by referring to the diagram shown at *A*, Fig. 2. Clamps *D* and *E* hold the two bars in place on the fixture, being aided by the block *F* which is necessary on account of the different bar widths. The two bars are also held together by clips which can be seen in Fig. 3. These clips are tightened after the bars have been properly set in an endwise direction.

Detailed Description of Procedure Followed in Performing the Operation

The first step preparatory to machining the grooves is to lay out carefully the center line of the middle one. Then by use of a templet and a sharp scriber, the outlines of the three grooves are marked off, these lines being later used in setting the cutters for taking the first cut. In order to set the bars accurately for machining a second groove after a cut has been finished on the first, a block 2 inches long, to suit the distance between each groove, and a slip of cigarette paper are placed tightly between a measuring boss on one of the clips and one on the fixture. Then after a cut has been taken on the first groove, clamps *D* and *E* are loosened and the bars slid along the fixture until the paper is again held tightly between the boss on the clip and that on the fixture. The clamps are then retightened and the cut taken on the second groove. The work is located by the same means for machining the third groove.

When a cut has been taken on one side of each groove, the bars are turned over so that the wide bar is uppermost, the position of the clips, however, remaining unchanged. This brings the other side of the middle groove in line with the cutting edge of the milling cutter. It is necessary to measure the location of the middle groove in order to obtain an accurate location. However, the second and third grooves are located by the use of a 2-inch block in the same manner used in locating them when taking the cuts on the opposite side of the groove.

The width of the milling cutter is as great as the mouth of the groove will permit. After the second cut has been taken in any one of the grooves, its appearance is as shown at *B*, Fig. 2, there still being metal in the bottom that cannot be removed by the cutter and which must be hogged out later in a separate operation. However, as the work must be inspected before it is removed from the milling machine, it was necessary to design a gage which would permit the grooves to be tested before the excess metal was hogged out. The measuring end of the gage used for the purpose is shown at *C*, Fig. 2. The bar is always so located for the first cut on the second side of each groove that the size will be a trifle small, the succeeding cuts being then taken until the gage can be fitted properly.

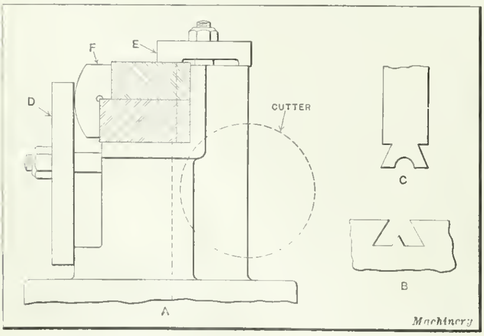


Fig. 2. (A) Diagram showing Method employed in holding Bars on Milling Fixture. (B) Appearance of Groove after Both Sides have been machined. (C) End of Gage used in inspecting the Grooves

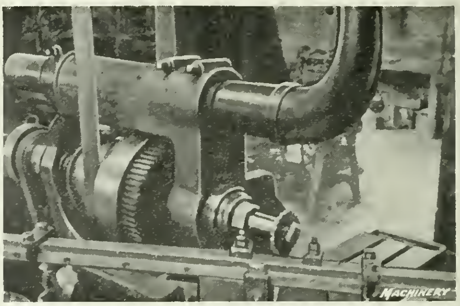


Fig. 3. View showing Set-up of Work on Machine Table, and Special Cutter and Arbor employed

When it is required that the middle groove be in the exact center of the bar length, a slightly different order is followed. In this case the first cut is made just inside the scribed line of the middle groove. Then an extension rod with a screw stop is set to the end of the bars, the bars turned upside down with the opposite ends placed against the stop, and a cut taken on the second side of the same groove. This results in a groove in which the gage fits too tightly, but by the use of proper feelers between the stop and bars, and by turning the bars once or twice, taking a cut each time they are turned, the desired fit can be obtained with the middle groove in the exact central location. The other grooves are located with respect to the cutter by making 2-inch shifts as previously described.

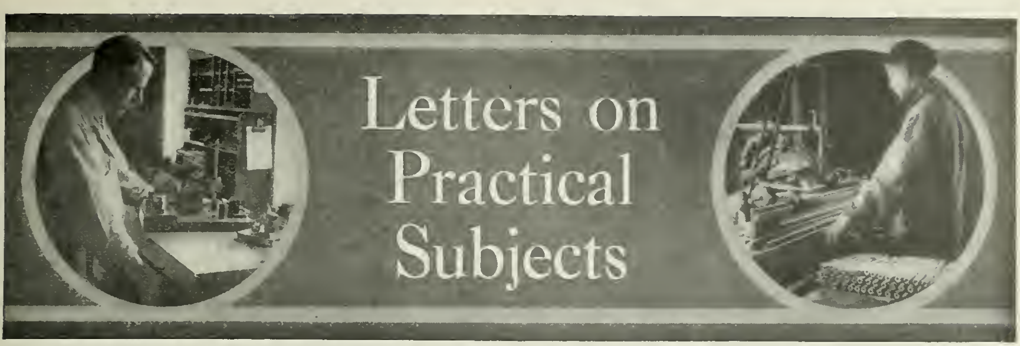
It will be noticed that in the methods described, there is no backlash harmful to the tools, and the possibility of misreading dials and misinterpreting rules is eliminated. Where it formerly took one-half day to produce three grooves of varying fits, the arrangement described finishes a set of bars in 1½ hours, including the time consumed in setting up and dismantling the work. This method overcame the necessity for a special machine and reduced tool breakage 95 per cent.

* * *

THE AUTOMOBILE INDUSTRY

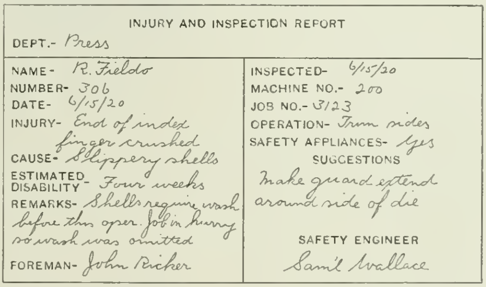
The automobile business is the largest manufacturing business of finished goods in the world. This year the total volume of the automobile, accessory and supply business in this country alone will reach $4,400,000,000, of which over $2,000,000,000 will represent passenger cars and trucks. There is one car in use for approximately every 13 persons in the United States, as compared with one for every 2182 persons in the rest of the world—268 in England, 402 in France, 684 in Germany, and 5300 in Russia. Europe has 449,000,000 people and only 437,000 automobiles. It is estimated that 45 per cent of the automobiles sold in this country are bought by farmers and the inhabitants of small towns. The average life of a car is estimated at five years.

There are about 800,000 trucks in operation in the United States, hauling an average of 4½ tons per day each, which amounts to a total of 3,600,000 tons per day, or 360,000,000 tons per year. It is stated that railroad locomotives haul 2,400,000,000 tons per year. Figures show that the average ton-mile cost of motor-truck haulage is 18 cents, as against 0.96 cent by railroad locomotive; but the railroad terminal charges are large, and time is saved by the motor truck. Haulage by horse is estimated to cost 24 cents per ton-mile, and it is said that truck haulage has released 3,600,000 horses for various other purposes in the United States. The automobile accessory and supply business, including tires, gasoline and oil, has reached a volume greater than that of the automobile business itself.



FORMS FOR REPORTING INJURIES OF WORKMEN

An editorial comment on page 1030 of the July number of MACHINERY called attention to the fact that the power press is today the most dangerous machine in the metal-working trades, and cited an instance where the general superintendent of a concern was unaware of the large number of injuries occurring to his employes. Sometimes an operator is actually injured by the misuse of a safety device on the machine. The common reply to an inquiry as to the cause of an accident on a power press is that the ram descended twice; but a subsequent inspection usually shows that the operator, rather than the machine, was at fault. Disregarding the moral viewpoint, the prevention of accidents should receive the same careful attention that executives give to other details of their business, because each injury means money lost to the employer and interferes with production to some extent. One way to reduce accidents is to remind the machine operator constantly to be careful, because the more familiar a workman becomes with the machine he operates, the more careless he becomes of danger resulting from its operation.



INJURY AND INSPECTION REPORT

DEPT.- Press

NAME- R. Fieldo
NUMBER- 306
DATE- 6/15/20
INJURY- End of index finger crushed
CAUSE- Slippery shells
ESTIMATED DISABILITY- Four weeks
REMARKS- Shells require wash before this oper. Job in hurry so wash was omitted
FOREMAN- John Ricker

INSPECTED- 6/15/20
MACHINE NO.- 200
JOB NO.- 3123
OPERATION- Trim sides
SAFETY APPLIANCES- Yes
SUGGESTIONS
Make guard extend around side of die

SAFETY ENGINEER
Sam'l Wallace

Fig. 1. Report of Injury filled out by Foreman of Department and Safety Engineer

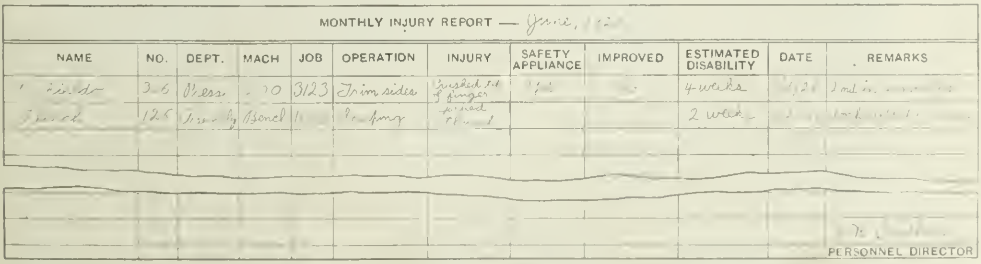
Above all, the superintendent of a plant should be kept informed of all accidents causing injuries to employes. It is not necessary that he investigate each case personally, or that it even be reported to him the moment it occurs; a monthly report of all accidents happening during the preceding month is adequate, and this report can be made by the director of the personnel department from reports furnished him by the safety engineer and foreman of the department in which it occurs. A convenient form for the use of the safety engineer and department foremen is shown in Fig. 1, suitably filled out for a supposed injury to an employe. It will be noted that this report contains all essential information regarding the accident and allows space for suggestions as to how the machine can be safeguarded to prevent a similar occurrence.

The items "injury" and "estimated disability" should not be filled in until the patient has been examined by a doctor, after which they may be added by the personnel director. From this report a requisition should be made to carry out the improvements suggested. The monthly report, prepared from the cards of this type which accumulate during a month, is illustrated in Fig. 2. From this record the superintendent can know the exact condition of affairs and give his immediate attention if a similar accident is liable to occur on account of no improvements having been made in the safety devices on the machine. The information required by various states concerning injuries can also be furnished from the card shown in Fig. 1. In conclusion, employes should be instructed to report all injuries to their foremen, no matter how insignificant they may appear, because frequently such injuries have serious results.

Rutherford, N. J. GEORGE F. KUHNE

HANDY MICROMETER ATTACHMENTS

A standard micrometer head is often useful in lathe work when making precision settings, centering work, and checking the concentricity or parallelism. Fig. 1 shows a cast-iron bracket *A* suitable for holding the head *B* in place on the tool-slide. The distance from the bottom of the bracket to the center of the head should be such as to bring the



MONTHLY INJURY REPORT — June, [illegible]

NAME	NO.	DEPT.	MACH	JOB	OPERATION	INJURY	SAFETY APPLIANCE	IMPROVED	ESTIMATED DISABILITY	DATE	REMARKS
[illegible]	[illegible]	Press	[illegible]	3123	Trim sides	Crushed [illegible] finger	[illegible]	[illegible]	4 weeks	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Bench	[illegible]	[illegible]	[illegible]			2 weeks	[illegible]	[illegible]

PERSONNEL DIRECTOR

Fig. 2. Form filled out by Personnel Director Each Month and submitted to Plant Superintendent

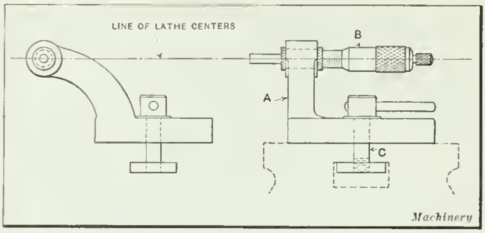


Fig. 1. Bracket for mounting Micrometer Head on Tool-slide of Lathe

center line of the latter in the same horizontal plane as that of the centers of the lathe. The base is held on the tool-slide by means of a clamping screw *C*, which is provided with a square nut contained in the T-slot on the tool-slide. Bracket *A* may be swiveled around the clamping screw, and so can be clamped parallel with the lathe bed in order to test work which has been faced; or it may be clamped at right angles to the bed for the purpose of testing the concentricity and parallelism of parts.

A bench stand for holding various sizes of micrometers at any angle from the vertical to the horizontal, and either to the right or left, to facilitate the measuring of work, is illustrated in Fig. 2. The device is simply but substantially constructed and has a neat appearance. The stand proper consists of a round cast-iron base *A*, part *B*, which may be either a piece of steel tubing or iron pipe, and cap *C* which is pressed into the top of part *B*. The cap is drilled to suit a long stud that is screwed in the base and in bracket *D* and thus holds the parts together. Bracket *D* is provided with a knurled thumb-screw that secures the swiveling block *E* to it, a small toolmaker's clamp *F* being fastened to block *E* by screws, for the purpose of holding the micrometer. A *C*-clamp drilled to suit the pivot screw in bracket *D* could also be used for this purpose. The pivot screw holds the clamp in position at any angle suitable for the convenient reading of the graduations on the micrometer. The entire stand should be machined smooth and polished, the knurling on cap *C* being chiefly for appearances.

When calipering work with a micrometer in places where the light is poor, it is often difficult to read the scale. Sometimes the design of the work also prevents the reading of the graduations. In Fig. 3 at *A* is shown an auxiliary dial attachment for micrometers which magnifies the thousandth of an inch readings and has the scale at right angles to the spindle. This, in the cases cited, is frequently a more convenient position for reading the graduations than the ordinary one. Provision is only made for reading thousandths of an inch, which is sufficient for work such as reducing the diameter slightly, or in checking repetition work. It will be seen that a spring steel clamp *D*, which is shown in detail at *B*, fits over the micrometer frame. A lug on this clamp is drilled to suit rod *E* which supports dial *F*. Another spring clamp *G* fits over the thimble of the micrometer and has a steel pointer *H* riveted to it. Rod *E* should slide stiffly in clamp *D*, but it should be possible to push it in or out as the thimble is rotated, in order to bring the face of the dial up against the pointer. As the pointer clamp is held on the thimble by friction, it may be rotated to any position relative to the thimble graduations, and held there. The dial is made of sheet steel, and after being calibrated the graduations were engraved and the numbers stamped on it. While the dial illustrated is a sector of a circle, an entire circular dial could be used. If the work is only to be checked to determine whether it is between limits, lugs or small screws may be provided on the dial to serve as limit stops. A sector provided with screw limit stops is shown at *C*.

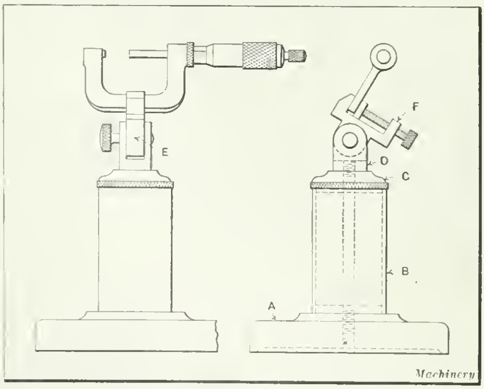


Fig. 2. Bench Stand for holding Micrometer in Angular Positions to facilitate the Measuring of Work

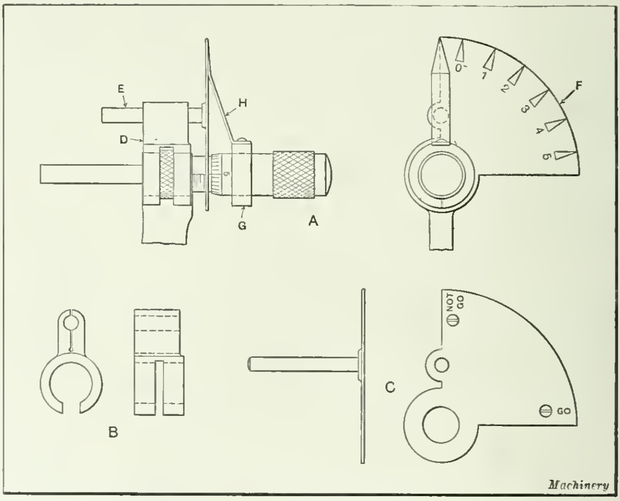


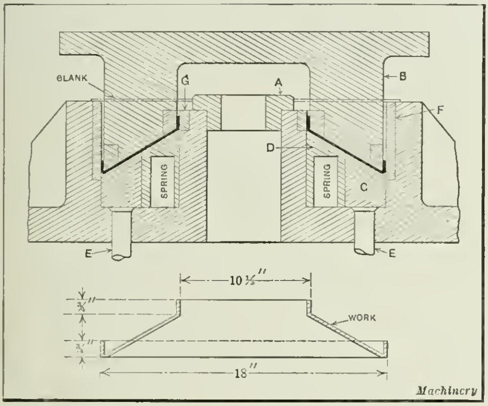
Fig. 3. Attachment which permits the Reading of Thousandths of an Inch on a Dial at Right Angles to the Spindle

Oakland, Cal. H. H. Parker

DIE FOR DRAWING FLANGED CONICAL RINGS

The punch and die used for drawing the flanged conical rings which form the sides of a certain type of blower fan are shown in the illustration. An idea of the size and shape of the rings may be obtained by referring to the drawing shown beneath the die; the material from which these rings are made is 0.065 inch thick. Two operations are required before the blank is ready for the drawing operation; the first is performed on a plain blanking die which shears the blank to the correct outside diameter. In the second operation, a hole is cut in the center of the blank, the diameter of this hole being the same as the diameter of plug *A* on the die. This permits the blank to be placed on the die as indicated by the dot-and-dash lines, and insures its proper location.

It will be noted that the illustration shows the relative positions of punch *B* and the movable parts of the die, at the time that the shaping of the work is completed. Prior to an operation, the punch is, of course, in position above the die, and rings *C* and *D* are also in a raised position. Ring *C* is raised by pins *E* which are actuated by a rubber buffer, while ring *D* is raised by means of compression coil springs. The blank is then placed on the die as previously mentioned, and is forced into the die as the punch descends, the flange on the outside of the ring being formed from the metal that extends past the punch when the latter first comes in contact with the blank. This flange is held between the punch and die ring *F* as the punch continues to descend and, as the inner flange is similarly held, the remainder of the blank is forced to the desired shape. Ring *C* exerts pressure against the work during part of the downward stroke and so assists in preventing the outside flange from being drawn between the tapered surfaces of the punch and the die ring *C*.



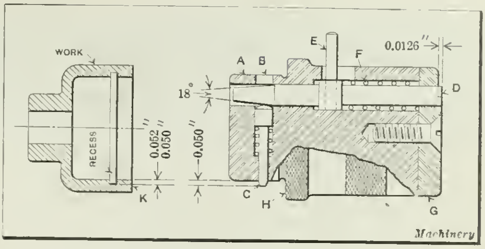
Construction of Punch and Die for drawing Blower Fan Part

The work is ejected from the die on the upward stroke of the punch by rings *C* and *D* as they are raised in the manner previously described. All the working-surfaces of the punch and die are made from tool steel, and are hardened and ground. The outer circumference of the drawing ring *F* is ground to a taper of ½ degree, the surface of the hole, however, being ground straight. This ring is a press fit in the die-block, and after it is forced into place, the inside surface is again ground to size. Ring *G* is also a press fit on the die-block, while the two inserted rings on the punch are a similar fit on that member. The performance of this punch and die has been entirely satisfactory.

Toledo, Ohio J. Bingham

FLUSH-PIN DEPTH GAGE FOR INTERNAL GROOVES

The flush-pin gage shown in the accompanying illustration was designed by the writer for the purpose of testing the depth of an internal groove or recess in parts produced in large quantities. The depth of the groove in this instance was required to be held within close limits of accuracy, as indicated in the illustration. As the gage proved a very satisfactory means of testing the work, it is believed that a description of its construction will be of value to others having similar gaging problems.



Flush-pin Gage for gaging Depth of Internal Recess

The body of the gage, which is made of machine steel, is pack-hardened and has an end *A* ground to fit the hole in the part to be gaged. The counterbored hole *B* carries a plunger *C* provided with a gaging point which is brought directly over the recess when end *K* of the work is pushed over plug *A* and into contact with shoulder *H*. The top of the gaging plunger *C* works against the tapered end of a registering plunger *D*, which fits in a hole at right angles to hole *B*. Both plungers are backed up with springs as shown, so that contact is maintained at all times between the rounded end of *C* and the tapered end of *D*. When in its normal position, the point of plunger *C* extends beyond the surface of plug *A* an amount slightly greater than the greatest allowable depth of the recess to be gaged, and is normally maintained in this position by the action of spring *F*. A pin *E*, fitted in plunger *D*, projects through an elongated slot in the gage body and permits the registering plunger to be pulled back so that the spring actuating plunger *C* will push the gaging point back a sufficient amount to allow the work to be slipped on or off the gage.

Plate *G* is hardened and has a step ground on it which indicates whether the work is within the required limits. This plate is secured to the body of the gage by a screw and dowel-pins. The step is 0.0126 inch high and indicates a difference of 0.002 inch in the depth of the recess as the relative movements of the two plungers are in a ratio of about 6.3 to 1. Therefore if the end of the plunger *D* is moved from a position in which it is flush with the lower step, to a position in which it is flush with the higher step, the end of gaging plunger *C* will have moved 0.002 inch. By comparing the dimensions of the work and of the gage it will be seen that the recess being gaged is within the required limits of accuracy when the indicating end of plug *D* lies between the two steps. The 18-degree angle determines the ratio between the movements of *C* and *D*, and while it is not necessary to use this angle, it is generally advisable to use an angle not less than 18 degrees. A smaller angle would require too great a movement of the registering plunger when taking off or putting on a piece of work, unless the depth of groove to be gaged were very small.

Bridgeport, Conn. Gustave F. Bahr

MOLDING A SPECIAL I-SHAPED CASTING

In constructing a pattern, the patternmaker always predetermines the manner in which a mold is to be made. Nevertheless, it frequently happens that when the pattern is received at the foundry it is seen that the molding operation would be much simpler if carried out in a different way from that intended by the patternmaker. Slight modifications are then sometimes made in the design of the pattern to permit the molding operation to be performed as desired by the molder. When a patternmaker has access to the foundry, valuable knowledge can be obtained by observing molding

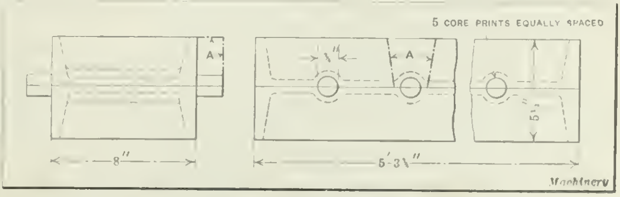


Fig. 1. Drawing of Pattern provided for molding an I-shaped Casting having Five Cored Holes

methods; however, when this is impossible much information can be had by examining castings after they are delivered to the machine shop.

Fig. 1 shows a drawing of the pattern for a special I-shaped casting having a web continuing around the ends and requiring five equally spaced ¾-inch diameter cored holes. The pattern was split along the center, the patternmaker thinking that one half should be molded in the drag and the other half in the cope. This method is considered good practice, but on account of the flimsy construction the sections were badly warped when received by the molder. This warping was corrected by nailing the two parts together, which, of course, prevented the molding of the casting as previously intended, so the mold was made entirely in the drag with the parting line along the top of the pattern. The core-prints for the five holes projected 1½ inches beyond the pattern, and so it was necessary to provide means of withdrawing the pattern from the mold in such a way that the walls of the mold would not be destroyed by these core-prints.

For this purpose two "ram-up" cores, such as indicated by the heavy dot-and-dash lines *A*, were provided for each core. The ram-up cores were cut from slab cores of the same thickness as the distance that the core-prints project beyond the pattern, and extended to the center of the pattern, the lower ends being sawed out and filed to fit the core-prints and cores. When the pattern was placed in the drag for ramming, the ram-up cores were placed in position on the core-prints. After the pattern had been rammed, the cope was lifted, the ram-up cores were withdrawn, and the pattern was extracted from the drag without having the mold marred by the core-prints. The hole cores were next placed in position, the ram-up cores put on the ends of these cores, and the cope again mounted on the drag.

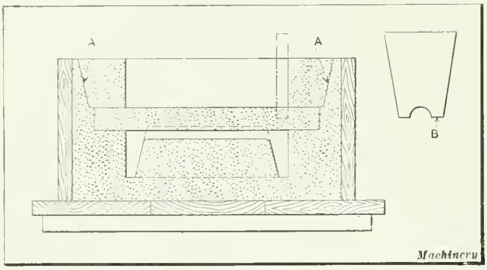


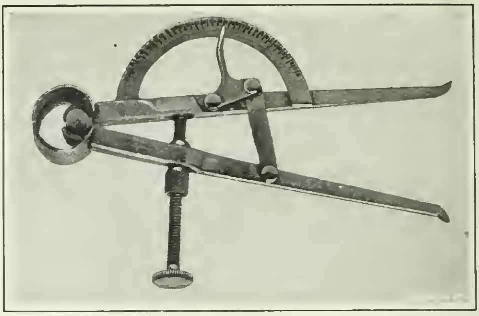
Fig. 2. Method in which Casting could have been molded in the Drag without Special Ram-up Cores

Another way in which a mold could have been made in the drag without the use of ram-up cores is illustrated in Fig. 2. The pattern is placed in the drag and the sand of the drag and cope is rammed. Then, after the cope is lifted, pockets are dug in the drag as indicated by lines *A* to permit the core-prints to be raised with the pattern. After the cores have been placed in position, these pockets are again filled in and rammed, a small board about ½ inch thick, sawed to the shape shown at *B* being placed on each core as the corresponding pocket is being rammed, in order to permit the wall to be formed properly.

Kenosha, Wis. M. E. DUGGAN

INSIDE CALIPER WITH GRADUATED SCALE

The illustration shows a pair of inside calipers provided with an attachment consisting of a graduated scale and an indicator which points to the graduation on the scale corresponding to the distance across the measuring points of the legs. This eliminates the necessity of using a measuring scale or a micrometer in setting this caliper or in examining it from time to time to ascertain whether the setting has been changed. A glance at the position of the indicator is sufficient to find out whether the setting has become altered in laying the caliper down or in having it come in contact with some object. The scale is graduated to indicate the dimensions of holes ranging from ¾ to 2⅝ inches in diameter. An important advantage derived from the attachment is the determination of the diameter of a recess or groove in a hole. This is impossible with an ordinary caliper, because the setting of the measuring point must be changed before the caliper can be withdrawn from the recess for measurement.



Inside Caliper provided with Graduated Scale and Indicator for showing the Setting

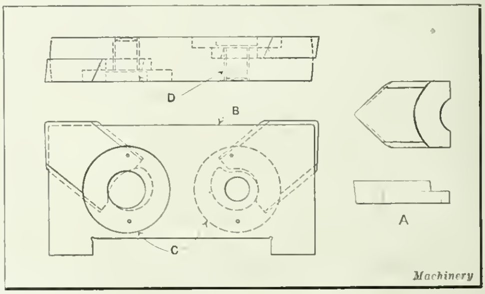
Beverly, Mass. PETER J. LINNAHAN

DUPLEX INSERTED-BLADE BORING-BAR CUTTER

The accompanying illustration shows a boring-bar cutter having two inserted blades, the cutting positions of which can be adjusted by means of cams. This feature makes possible the use of the cutter on holes of various diameters, or permits frequent regrindings without the tool becoming too small, when the cutter is constantly used for boring holes of one size. A detail of the cutter blade is shown at *A*, from which it will be seen that a circular step is milled on the rear end. The sides of each cutter are ground to an angle of 15 degrees to suit the slots in holder *B*.

Cam parts *C* have large circular portions which fit into holes counterbored in holder *B* and rest on the steps of the blades. The cam on each of parts *C* is on the inner side, the ends of the cams resting against the bottom of the slots in which the cutter blades are contained. The cam surfaces bear against the rear ends of the cutter blades so that the positions of the latter are altered when the cam parts are turned by means of a pin wrench inserted in the small holes in their outer surfaces. The parts *C* are tightened down on the blades by means of screws *D*, the heads of which enter counterbored holes in parts *C*. It will be noted that the blades are placed in the holder on opposite sides as well as at opposite ends.

Lakewood, Ohio H. G. FRANTZ



Boring-bar Cutter having Blades which can be adjusted by Cams

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

DISK AND V-BLOCK METHOD OF DETERMINING THE RADIUS OF A CIRCULAR SEGMENT

A. R. N.—In the August number of MACHINERY, page 1176, a method of determining the radius of a disk was explained. A 90-degree V-block, a depth micrometer, and a standard disk are used, and the object is to find the radius of a smaller disk. The writer assumes that this method is intended more especially for obtaining the radii of circular segments between 90 and 180 degrees, in view of the fact that the radius of any segment larger than 180 degrees or the radius of a complete disk would be determined ordinarily by first measuring the diameter, the V-block and disk method not being necessary. One or more examples illustrating the practical application of this method would be appreciated.

ANSWERED BY GEORGE WARMINGTON, BEVERLY, MASS.[1]

The V-block method is particularly applicable for finding the radius of a circular segment, as for example the radius r of the part shown at A, Fig. 1. If the radius R (see diagram B, Fig. 1) of the standard disk equals 1.25 inches, and the dimension H is found by measurement to equal 0.256 inch, then applying the previously published formula $r = R - H\ (2.4142)$, we have

$$r = 1.25 - 0.256\ (2.4142) = 0.632 \text{ inch}$$

The writer considers the following derivation of this formula for radius r simpler than the derivation given in the August number of MACHINERY.

Referring to diagram B, Fig. 1,

$$\text{Cos 45 degrees} = \frac{R - y}{R + H}$$

$$y = R - (R + H) \cos 45 \text{ degrees} \qquad (1)$$

and

$$\text{Cos 45 degrees} = \frac{r - y}{r}$$

$$y = r - r \cos 45 \text{ degrees} \qquad (2)$$

Then, from Equations (1) and (2),

$$r - r \cos 45 \text{ deg.} = R - (R + H) \cos 45 \text{ deg.}$$

$$r = R - \frac{H \cos 45 \text{ deg.}}{1 - \cos 45 \text{ deg.}} = R - H\ (2.4142)$$

As the 90-degree V-block cannot be used for arcs less than 90 degrees, the so-called "bridge-iron" method will be explained. The required equipment consists of two disks or plugs each having the same radius r (see Fig. 2); a parallel which is placed in contact with the disks; and a plate in which there is an elongated slot, which permits the disks to be clamped in different positions. The radius r is known, and the dimensions A and H are obtained by measurement.

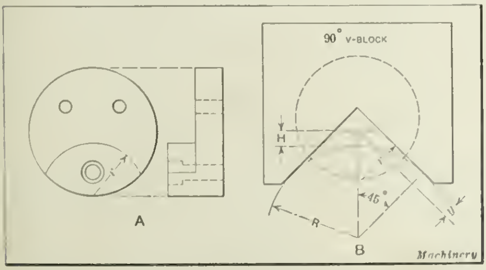


Fig. 1. Part having Circular Segment, and Method of determining its Radius by using V-block and Disk

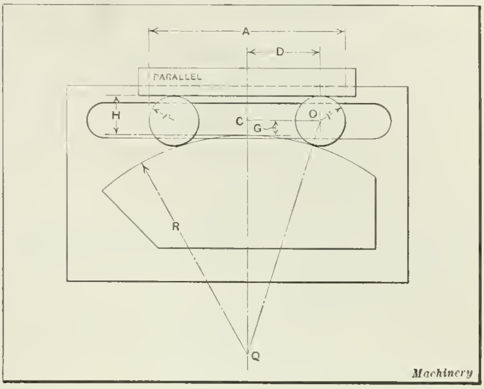


Fig. 2. Another Device for determining Radii of Segments

$$D = \frac{A - 2r}{2} \qquad G = H - r$$

In the triangle QCO,

$$(R + r)^2 = (R + G)^2 + D^2$$

$$R^2 + 2Rr + r^2 = R^2 + 2RG + G^2 + D^2$$

Cancelling R^2 from each side of the equation and transposing,

$$2Rr - 2RG = G^2 + D^2 - r^2$$

$$R = \frac{G^2 + D^2 - r^2}{2\ (r - G)}$$

If the segment-shaped section of the part shown at A, Fig. 1, were less than 90 degrees, the radius could be readily determined by the bridge-iron method, which can be applied to various classes of work, although the exact arrangement may require more or less modification. For example, if a radius of a slot were to be determined, it might be necessary to use plugs or pins small enough to enter the slot. Care should be taken to see that the value of G in the formula for radius R, is equal to the vertical distance between the center lines of the plugs or disks and the top of the arc which is in contact with the plugs. For instance, when determining the radius of a curved slot, G should equal the distance from the center line of the plugs to the top of that side of the slot which is in contact with the plugs.

PROBLEM IN TRIGONOMETRY

L. M. S.—Will you please show how to find the angles A and B from the angle and dimensions given in the accompanying illustration?

A.—From trigonometry we have the relations:

$$r^2 = b^2 + c^2 - 2bc \cos B \qquad (1)$$

$$r^2 = a^2 + c^2 - 2ac \cos A \qquad (2)$$

Subtracting (2) from (1)

$$b^2 - a^2 - 2bc \cos B + 2ac \cos A = 0 \qquad (3)$$

$$A = 15 \text{ degrees} - B$$

$\text{Cos } A = \cos (15 \text{ deg.} - B) = \cos 15 \text{ deg.} \times \cos B + \sin 15 \text{ deg.} \times \sin B$

Substituting this value for $\cos A$ in (3)

$b^2 - a^2 - 2bc \cos B + 2ac\ (\cos 15 \text{ deg.} \times \cos B + \sin 15 \text{ deg.} \times \sin B) = 0$

Expanding, combining, and arranging terms,

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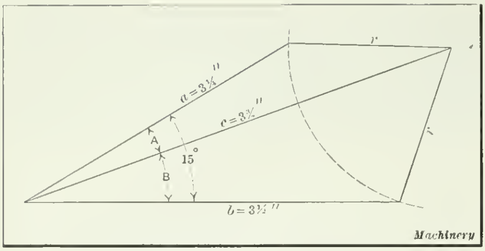
[1] Another derivation which is also simpler than the one previously published was submitted by Gustaf E. Nordstrom, Worcester, Mass.—Editor



Problem in Trigonometry

$$2c\ (a \cos 15 \text{ deg.} - b) \cos B + 2ac \sin 15 \text{ deg.} \sin B = a^2 - b^2 \qquad (4)$$

This is an equation of the form

$$m \cos B + n \sin B = q \qquad (A)$$

in which

$m = 2c\ (a \cos 15 \text{ degrees} - b)$

$n = 2ac \sin 15 \text{ degrees}$

$q = a^2 - b^2 = (a + b)\ (a - b)$

Solving this equation by the methods of trigonometry

$$\tan x = \frac{m}{n} \qquad (B)$$

$$\text{Sin}\ (x + B) = \frac{q \sin x}{m} \qquad (C)$$

Inserting numerical values in (4) we find m, n, and q. From (B)

$x = 156$ degrees 47 minutes

Then from (C)

$(x + B) = 165$ degrees 46 minutes

$B = 165$ deg. 46 min. — 156 deg. 47 min. = 8 deg. 59 min.

$A = 15$ deg. — $B = 15$ deg. — 8 deg. 59 min. = 6 deg. 1 min.

W. W. J.

SAFE SPEED OF FLYWHEEL

A. L. G.—A flywheel 21 feet in diameter makes 100 revolutions per minute. The weight of a cubic foot of the material is 448 pounds. If the safe stress permissible in the material is 6000 pounds per square inch, what is the greatest speed at which the wheel can be run with safety? What is the intensity of stress on a transverse section of the rim when running at 100 revolutions per minute?

A.—Assuming that the stress on the rim is unaffected by the arms, then the unit stress in the flywheel rim due to centrifugal force is found as follows: In the general equation of force, $F = ma$, the acceleration a in the present instance is $\frac{v^2}{r}$, in which v = velocity of rim in feet per second, R = radius of rim in feet, W = weight of rim in pounds, and g = acceleration due to gravity. Hence, centrifugal force $= F = \frac{Mv^2}{R} = \frac{Wv^2}{gR}$.

The resultant of half of this force tends to disrupt one half of the rim from the other half. This rupture is resisted by the two sections of the rim at each end of the diameter. The total tension T in a cross-section of the rim is to one-half the sum of half of the radial forces as the diameter of the flywheel is to half its circumference.

Therefore

$$T = \frac{F}{2\pi} = \frac{Wv^2}{2\pi Rg}$$

Let $W = \frac{2\pi RAw}{144}$, in which A = area of cross-section of rim in square inches, and w = weight of rim material in pounds per cubic foot.

$$T = \frac{Awv^2}{144g}$$

Let $T = AS$, where S = stress per unit area of cross-section of rim.

$$S = \frac{wv^2}{144g}$$

(S is independent of the radius and depends only on the rim velocity.)

Let $v = \frac{\pi Dn}{60}$, in which D = mean diameter of rim in feet, and n = number of revolutions per minute.

$$S = \frac{w(\pi Dn)^2}{60^2 \times 144g} \qquad (1)$$

Solving for n,

$$n = \frac{720}{\pi D}\sqrt{\frac{Sg}{w}} \qquad (2)$$

Letting $D = 21$, $n = 100$, $w = 448$, $S = 6000$, and $g = 32.16$ and substituting these values in Formulas (1) and (2) $S = 1170$ pounds per square inch stress on a transverse section of the rim when running at 100 revolutions per minute, and $n = 226$ revolutions per minute, the greatest speed at which the wheel can be safely run without exceeding a fiber stress of 6000 pounds per square inch in the material.

W. W. J.

DIEMAKER'S PROBLEM

L. M. S.—The illustration shows a problem in connection with the designing of dies for blanking a sheet-metal piece. Please show how to find the radius x.

A.—Referring to the illustration, we have

$$(x + 3/16)^2 = (1/4 - x)^2 + (x + 3/32)^2$$

Then,

$$\left(\frac{16x + 3}{16}\right)^2 = \left(\frac{1 - 4x}{4}\right)^2 + \left(\frac{32x + 3}{32}\right)^2$$

Expanding, clearing of fractions, and combining,

$$1024x^2 - 704x + 37 = 0$$

This may be written

$$1024x^2 - 2(352)x + 37 = 0$$

Solving this quadratic equation,

$$x = \frac{352 \pm \sqrt{352^2 - 1024 \times 37}}{1024} = \frac{352 \pm 64\sqrt{21}}{1024}$$

$$x = \frac{11 \pm 2\sqrt{21}}{32}$$

Taking the minus sign before the radical, in this case, we find $x = \frac{11}{32} - \frac{\sqrt{21}}{16} = 0.34375 - 0.28641 = 0.05734$ inch.

W. W. J.

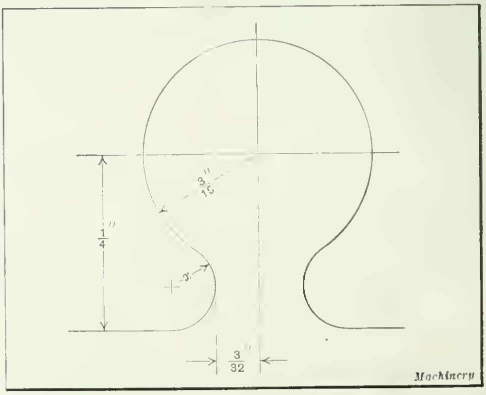


Diagram illustrating Diemaker's Problem

MEASURING SCREW THREADS BY THREE-WIRE METHOD

G. H. D.—Will you kindly show me how to deduct a formula for finding the pitch diameter of a screw by the three-wire method?

ANSWERED BY V. E. AYRE, RICHMOND COLLEGE, VA.

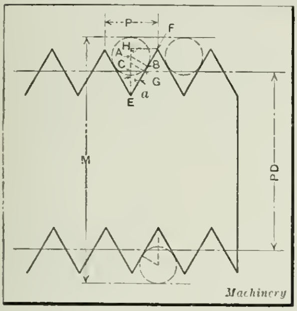


Diagram for Use in finding Pitch Diameter by Three-wire Method

The use of three wires of equal diameters for measuring the pitch diameter of screws has long been employed. The outside diameter should not be considered as a factor in any pitch diameter formula, and is not used in the following deduction, in connection with which reference should be made to the diagram, where the following notation is used:

M = micrometer reading over wires;
D = diameter of wires;
d = radius of wires;
a = one-half angle of thread;
PD = pitch diameter of screw;
P = pitch of thread.

In the triangle EHF,

$$HF = \frac{P}{2};\quad EF = \frac{HF}{\sin a} = \frac{P}{2 \sin a}$$

Then

$$EG = \frac{EF}{2} = \frac{P}{4 \sin a}$$

In the triangle ABE,

$$AB = d = \text{radius of wire};\quad AE = \frac{AB}{\sin a} = \frac{d}{\sin a}$$

In the triangle CGE,

$$CE = EG \cos a;\ EG = \frac{P}{4 \sin a}$$

Therefore

$$CE = \frac{P}{4 \sin a} \times \cos a = \frac{P}{4} \cot a$$

$$AC = AE - CE$$

Substituting the values of AE and CE in the above equation,

$$AC = \frac{d}{\sin a} - \frac{P}{4} \cot a$$

$$PD = M - 2d - 2AC$$

$$= M - D - 2\left(\frac{d}{\sin a} - \frac{P}{4} \cot a\right)$$

$$= M + \frac{P}{2} \cot a - D\left(1 + \frac{1}{\sin a}\right)$$

If the above equation is written

$$PD = M + \left[\frac{P}{2} \cot a - D\left(1 + \frac{1}{\sin a}\right)\right]$$

that part of the equation which is enclosed in brackets is a constant factor having a negative value and may be expressed by the letter K, so that the formula then becomes

$$PD = M + (-K)$$

or

$$PD = M - K$$

A table of values for the constant K may be made for threads of various angles and pitches. If possible, the "best size" wires, that is, wires which will be tangent to the sides of the thread at the pitch line, should be used. The diameter D of the "best size" wire may be determined as follows:

$$d = \tan a \times EG$$

But

$$EG = \frac{P}{4 \sin a}$$

Consequently

$$d = \tan a \times \frac{P}{4 \sin a}$$

and

$$D = \tan a \times \frac{P}{2 \sin a}$$

or

$$D = \frac{P}{2} \sec a$$

Example—Find the pitch diameter of a screw, having eight threads per inch, the included angle between the threads being 60 degrees.

$$\frac{P}{2} = 0.0625 \text{ inch}$$

$$a = \frac{60}{2} = 30 \text{ degrees}$$

$$D = \frac{P}{2} \sec 30 \text{ deg.} = 0.0721 \text{ inch}$$

The constant K, then has the following value:

$$K = 0.0625 \times 1.7321 - 0.0721 \times 3.0000$$

or

$$K = -0.10805 \text{ inch}$$

This value added to the measurement M taken over the wires will give the pitch diameter, that is

$$M - 0.10805 \text{ inch} = PD$$

DIFFERENCE BETWEEN A HELIX AND A SPIRAL

B. H.—What is the difference between a helix and a spiral?

A.—The curve followed by a screw thread is a helix, whereas an ordinary watch spring is an example of a spiral curve, although it may not be a perfect spiral. A helix is the curve traced by a point which rotates uniformly over a cylindrical surface and advances at a uniform rate along the axis. A spiral is located in one plane and has a constantly increasing radius of curvature. The word spiral is often incorrectly applied in mechanical work. What are known as "spiral gears" are really helical gears, because the teeth follow helical curves. A right-hand helix advances in a clockwise direction and a left-hand helix, counter-clockwise or to the left as viewed from the end or in line with the axis.

KIND OF STEEL FOR THREAD-CUTTING DIES

W. B. B.—Should thread-cutting dies be made of carbon or high-speed steel?

A.—Carbon steel dies or die chasers are usually preferred for cutting very accurate smooth threads, as they retain a fine cutting edge better than chasers made of high-speed steel. The latter, however, may be operated at considerably higher cutting speeds, and the quality of the work is satisfactory for a great many classes of work. The difference of opinion regarding the relative merits of carbon steel and high-speed steel for dies are doubtless due in part to variations in the composition of the steels used and to the different methods of heat-treatment.

* * *

French foreign trade figures for the period January 1 to July 31, 1920, show an increase of 2,738,502,000 francs in imports and 7,230,220,000 francs in exports over the same period of 1919.

Die-castings[1]

By CHARLES PACK, Doehler Die-Casting Co., Brooklyn, N. Y.

DIE-CASTINGS may be defined as castings made by forcing molten metal, under pressure, into a metallic mold or die. It is erroneous to assume that all die-castings have similar properties, since it is apparent that the properties of die-castings will depend upon the nature of the alloy used. The die-casting process is best adapted to alloys of comparative low fusing points which, for convenience, may be divided into the following groups:

1. Zinc alloys, consisting essentially of zinc alloyed with tin, copper, or aluminum.
2. Tin alloys, consisting essentially of tin alloyed with copper, lead, or antimony.
3. Lead alloys, consisting essentially of lead alloyed with tin or antimony.
4. Aluminum alloys, consisting essentially of aluminum alloyed with copper.

Composition and Properties of Zinc Alloys

A typical zinc alloy suitable for die-casting consists of 87.5 per cent zinc, 8 per cent tin, 4 per cent copper, and 0.5 per cent aluminum. The properties of this alloy are as follows:

Color	Silver white
Weight per cubic inch	0.253 pound
Melting point	780 degrees F.
Initial fusing point	275 degrees F.
Tensile strength	16,100 pounds per square inch
Elongation	2 per cent
Compressive strength	27,670 pounds
Hardness number (Brinell)	64.6

The weight of the die-castings made from this alloy is generally not more than 8 pounds. The minimum limit of the wall thickness varies from 0.1 inch for larger castings to 1/16 inch for smaller castings. The variations in dimensions per inch of diameter or length may be held to 0.001 inch. Twenty-four threads per inch is about the finest pitch that can be cast on external threads, while the number of threads per inch that can be cast on internal threads depends on the conditions in each case. The minimum diameter of cast holes is 1/32 inch, but this depends largely upon the shape and thickness of the casting. The draft necessary for cores is 0.001 inch per inch of length or diameter, and for side walls 0.001 inch per inch of length. The sections of the castings should be as uniform as possible. Sharp corners should be avoided and fillets should be added wherever permissible. Under-cuts in casting should be avoided wherever possible.

Alloys of this type are corroded by any alkaline or aqueous solution of salts. The castings may be polished to a high luster, but soon tarnish when exposed to ordinary atmospheric conditions. Castings made from this alloy may be readily plated with nickel, copper, brass, silver or gold. When they are properly plated, such castings will retain their luster as well as those that are made from either brass or bronze.

Castings made from this alloy should not be used for parts that are subjected to severe stress or sudden shock in service. They are used extensively for parts of phonographs, calculating machines, drinking cups, vending machines, magneto housings, automobile-body trimmings, pencil-sharpening machines, time-recording devices, stamp-affixing machines, and for a great many other devices that are of a kindred nature.

Composition and Properties of Tin Alloys

The following table gives five typical tin alloys generally used for die-castings:

	Tin, Per Cent	Copper, Per Cent	Lead, Per Cent	Antimony, Per Cent
1	90	4.5	0	5.5
2	86	6	0	8
3	84	7	0	9
4	80	0	10	10
5	61.5	3	25	10.5

Alloy No. 1 is a so-called "genuine babbitt" metal, and was used very extensively during the war for main-shaft and connecting-rod bearings on all American-made airplanes and motor trucks. No. 2 is somewhat harder, and is used extensively for bearings of internal-combustion engines. No. 3 is somewhat harder than alloy No. 2, and is the S. A. E. standard for high-grade internal-combustion-engine bearings. No. 4 is in general use for light bearings on stationary motors. No. 5 is a bearing metal for light duty, and is used on a large number of moderate-priced automobiles for main-shaft and connecting-rod bearings.

In addition to the five compositions mentioned, hundreds of similar alloys may be made, having various specific properties. The die-casting process is applicable to any of the alloys of this group, and it may be left with the engineer to specify the alloy best suited to his requirements.

The maximum fusing point of tin alloys is about 450 degrees F.; the maximum weight for castings made from these alloys, about 10 pounds; the limit in wall thickness, 1/32 inch; the variations from the given dimensions per inch of diameter or length, 0.0005 inch; and the finest pitch of thread that can be cast externally, 27 threads per inch, while the number of internal threads depends upon various conditions. The minimum diameter of hole that can be cast is 1/32 inch, but this diameter depends on the depth of the hole and the type of the casting. The required draft for cores is 0.0005 inch per inch of length or diameter, and for side walls, 0.001 inch per inch of length.

Tin alloys find their largest field of application in their use as bearings for internal-combustion engines. They are also used for parts of soda fountains, cream separators, milking machines, surgical apparatus, galvanometer parts, player pianos, etc., where a tensile strength of over 8000 pounds per square inch is not essential and where resistance to corrosion is of importance. They are not affected by water, weak acid or alkaline solutions, and when free from lead, are extensively used for food-container parts.

Composition and Properties of Lead Alloys for Die-castings

The following table gives the composition of typical alloys in the lead-alloy group which are used for die-castings:

	Lead, Per Cent	Tin, Per Cent	Antimony, Per Cent
1	83	0	17
2	90	0	10
3	80	10	10
4	80	5	15

Alloy No. 1 is generally known as C. T. (coffin trimming) metal, due to its extensive use in the manufacture of coffin trimmings. This alloy is also a good bearing metal for light duty, and is used for thrust washers and camshaft bearings on light internal-combustion engines. No. 2 is somewhat softer and more ductile than No. 1. No. 3 is used extensively for light bearing duty, being somewhat tougher and stronger than Nos. 1 and 2. No. 4 is somewhat harder than No. 3, but less ductile.

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[1] Abstract of a paper presented before the American Society of Mechanical Engineers.

The maximum fusing point of alloys of this type is about 600 degrees F.; the maximum weight for castings made from lead alloys, 15 pounds; the maximum wall thickness, 1/32 inch; the variation from the given dimensions per inch of diameter or length, 0.001 inch; the finest number of threads that can be cast externally, 24 per inch; the number of threads cast internally depends upon various conditions. The minimum diameter of cast holes is 1/32 inch, depending, however, on the depth and general design of the casting. The draft for cores is 0.0005 inch per inch of length and diameter, and for side walls, 0.001 inch per inch of length.

Lead alloys may be used where a metal of non-corrosive properties is desired and where a tensile strength of not over 8000 pounds per square inch will suffice. They are used extensively for fire-extinguisher parts, low-pressure bearings, ornamental metalware, and many parts that come in contact with corrosive chemicals. They should not be used for parts that may come in contact with foods or that may be handled often in service, on account of the poisonous properties of lead and lead alloys. The main advantage of these alloys lies in their comparatively low cost, but their high specific gravity must be considered, some lead alloys having a specific gravity double that of the zinc alloys.

During the war, lead alloys were used for all hand-grenade fuse parts and many millions of these parts were made. Lead-alloy die-castings were also used for grenades, trench-mortar fuse plugs and many other parts where non-corrosiveness is an essential requirement.

Composition and Properties of Aluminum Alloys

A typical aluminum alloy for die-casting is composed of 92 per cent aluminum and 8 per cent copper. The properties of this alloy are as follows:

Color	Silver white
Weight per cubic inch	0.115 pound
Melting point	1150 degrees F.
Tensile strength	21,000 pounds per square inch
Elongation	1.5 per cent
Hardness number (Brinell)	60.5

The maximum weight of castings made from aluminum alloys is about 5 pounds, with a minimum wall thickness of 1/16 inch and a variation from the given dimensions of 0.0025 inch per inch of diameter or length. The finest thread that can be successfully cast is 20 threads per inch externally; internal threads are rarely cast. Frequently, the external threads are cast 0.010 inch over size and are finished to size by a cutting tool. The maximum diameter of cast holes is about 3/32 inch and these holes cannot be made deeper than 1 inch. Larger holes may be cast much deeper, and smaller holes may be spotted to facilitate drilling. The draft of cores should be 0.015 inch per inch of diameter or length, and the draft of side walls 0.005 inch. Cores less than ¼ inch in diameter do not need more than 0.005 inch draft per inch of length.

The aluminum alloy used for die-casting is well known in the trade as No. 12 alloy and it is used extensively for automobile and airplane parts. By varying the copper content, harder or softer alloys may be obtained, all of which may be die-cast successfully.

Aluminum die-castings find wide employment in the manufacture of parts of automobiles, such as spark and throttle control sets, magneto parts, battery ignition and lighting systems, speedometers, etc. They are also used for parts of vacuum sweepers, phonographs, milking machines, vending machines, etc.

Brass and Bronze Die-castings

Die-castings made from various types of brasses and bronzes were put on the market as early as 1910, but have never been successful commercially. At the present time there is only one die-casting manufacturer producing brass die-castings in any appreciable quantity. It is a comparatively simple matter to produce a small quantity of simple brass die-castings, but no material has yet been found for die-making purposes which will withstand the continuous action of molten brass and at the same time retain its shape, surface, and size. The die-casting of brass and bronze must be considered as in the experimental stage at the present time, with little or no immediate prospect of the solution of the problem.

Developments Due to the War

The most important development in the art of die-casting during the war was the perfection of the process of die-casting aluminum and its alloys. A suitable steel was developed for making the dies for this process that would withstand the action of molten aluminum without cracking, a problem the solution of which was essential to the development of the industry. The part that this development played in the winning of the war will be readily appreciated when it is stated that at the cessation of hostilities there were being produced about one million aluminum die-castings daily in this country for parts of gas masks, machine guns, airplanes, motor trucks, motor ambulances, surgical instruments, canteens, field binoculars, etc.

Comparative Cost of Die-castings

The cost of die-castings cannot be computed on the pound basis, since it depends on the design of the piece, the number and position of the cores, the quantity to be produced, and certain other factors. For comparative purposes it may be stated that at the present time tin-alloy castings are the highest in cost, being followed by those of aluminum alloy, zinc alloy, and lead alloy in the order named.

In considering the use of die-castings it is well to bear in mind that on a pound basis die-castings are far more expensive than iron sand castings, if the machining cost is not considered. As the zinc alloys, whose properties are similar to cast iron, cost from $200 to $275 per ton in ingot form, it is apparent that the substitution of a die-casting for an iron casting can only be considered when the machining cost is sufficient to compensate for the difference in cost of the raw materials.

* * *

NEW YORK SECTION OF AMERICAN WELDING SOCIETY

A meeting to consider the organization of a New York or Metropolitan Section of the American Welding Society was held Thursday, October 14, 1920, in the Engineering Societies Building, 29 W. 39th St., New York City. The meeting was called to order by F. W. Tupper, chairman of the Sections Organization Committee. Mr. Tupper stated that in view of the fact that active sections had already been organized in Philadelphia, Chicago and Pittsburg, it was now time that a New York Section be organized. He then called upon Professor C. A. Adams, past president of the American Welding Society, to give an account of the aims and history of the society and of its sections. W. E. Symons, treasurer, was then called upon to explain the need for a New York Section. Professor Adams was chosen as chairman of the meeting and Howard Odiorne as secretary. On motion by Roy Wanser, seconded by A. E. Glassman, it was unanimously voted that a New York or Metropolitan Section should be organized. On authorization of the meeting, the chairman appointed a nominating committee to present a slate of officers and directors for the section, to be voted on at the next meeting. At the request of the meeting the chairman also appointed a rules committee and instructed them to prepare constitution and by-laws for the New York Section for consideration at the next meeting. Membership and organization committees were then appointed, and the date of October 25 was fixed upon as the time for the official organization of the New York section to be consummated.

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The world's production of coal during 1919 was 15 per cent less than the production in 1913, and, in fact, even 10,000,000 tons less than the production in 1910.

A NEW BOOK ON MECHANICAL DRAWING

Mechanical Drawing. By Franklin D. Jones. 342 pages, 6 by 9 inches; 175 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $3.

This book is a treatise on the drawing of mechanisms and machine details, and covers comprehensively the making of different classes of drawings; the dimensioning, reading, and checking of working drawings; numbering and filing systems for drawings, and general drafting-room practice. Numerous text-books have been published on mechanical drafting practice, but many of these are purely books for classroom use and overlook the important side of the use of mechanical drawing in industry. This book is, therefore, added to the list of publications on this subject, because it is believed that there is a need for a treatise dealing more thoroughly with methods that are actually employed in well-managed drafting-rooms.

Many books on mechanical drawing have covered such subjects as geometrical drawing problems, orthographic projection, the development of intersecting surfaces, etc., but the application of these principles and the real object of mechanical drawing as related to machine and tool manufacture has often been dealt with vaguely. The student has been taught certain details, but he has not been given a clear conception of the work of draftsmen and designers in the drafting-rooms of machine-building plants. This book presents the subject in a way that will enable the student to understand what the term "mechanical drawing" really means in its broadest sense, the essential features of modern drafting practice, and the difference between the mere representation of a design by a suitable drawing and the more valuable work of originating and developing the design.

A special effort has been made to secure a well-balanced treatise in which the various elements of mechanical drawing are dealt with according to their relative importance. For instance, little space is given to lettering, because making fancy letters in numerous styles is not the work of a draftsman in a well-managed drafting-room, although this subject has been greatly emphasized in many books. The aim has been to present methods that are in actual use rather than exercises in drawing which do not conform to the practice in manufacturing plants. An elaborate drawing of a bevel gear with all of the teeth accurately reproduced may be an attractive and impressive feature in a text-book on mechanical drawing, but it is misleading, because working drawings are not made in that way.

This book, in its arrangement and scope, is based on the assumption that it is essential for the student of mechanical drawing—whether in the school or in the shop—to understand the purpose of drawings as applied to machine and tool construction, how various mechanical devices may be represented by means of drawings, the necessity of making drawings that completely and clearly show what they are supposed to show, and the relation between *drawing* and *designing*. Special attention has been given to the dimensioning of drawings, and the importance of using printed instructions to make a drawing entirely clear is emphasized.

In dealing with the numerous details of the draftsman's work, an effort has been made to present methods that are sanctioned by common usage and to explain the reasons for the more important variations in practice. To accomplish this, the methods and systems of many of the representative drafting-rooms were studied, and much valuable information was also secured from articles pertaining to different features of drafting practice published in Machinery.

The comprehensive scope of the work will be understood from the chapter headings: Drawings and their Use in Machine and Tool Construction; Projection as Applied to Mechanical Drawing; Mechanical Drawing Instruments and Materials; How Designs are Originated and Procedure in Making Drawings; Sectional Views and the Reading of Drawings; Methods of Dimensioning Working Drawings; Instructions on Working Drawings and Procedure when Checking; Printing Processes and Apparatus for Printing, Washing and Drying; Engineering Standards and Drawings of Machine Details; Designing or Laying Out Cams; Geometrical Drawing Problems and the Development of Intersecting Surfaces; Drafting-room Systems, Equipment and Arrangement; and Sketching and Perspective Drawing.

* * *

WELL-KNOWN MACHINE TOOL MANUFACTURERS RESIGN

Two of the best known machine tool builders in the country—Charles E. Hildreth and Albert E. Newton—recently resigned from the management of the Whitcomb-Blaisdell Machine Tool Co. and the Reed-Prentice Co. which they respectively headed, and it is reported that they intend to associate themselves with business enterprises outside of Worcester. Mr. Newton, as is well known, is president of the National Machine Tool Builders' Association and of the National Metal Trades Association, and Mr. Hildreth is general manager of the former association.

Both the first named companies, as well as the Becker Milling Machine Co., have been controlled by the same interests, and according to a statement given out by Arthur H. Reed, president of the Reed-Prentice Co. and the Becker Milling Machine Co., changes were decided on last spring for the purpose of effecting economies and adding to the efficiency of the operating management of the three plants. A central selling office was established at 53 Franklin St., Boston, and the product of all three companies was sold direct, under the charge of John P. Ilsley, formerly general manager of the Becker Milling Machine Co. Branch sales offices have been established in the principal cities of this country and a foreign sales agent employed for Europe. F. O. Hoagland, lately vice-president and general manager of the Bilton Machine Co., Bridgeport, Conn., has become general manager of the Becker Milling Machine Co., the Whitcomb-Blaisdell Machine Tool Co., and the Reed-Prentice Co.

It was stated that both Mr. Newton and Mr. Hildreth offered their resignations some time ago, but at the request of the management agreed to continue at least until January 1, next.

* * *

ENGINEER APPOINTED ON POSTAL ADVISORY COMMITTEE

Mortimer E. Cooley of the University of Michigan, and past-president of the American Society of Mechanical Engineers, has been appointed a member of the Postal Advisory Committee which is assisting the joint Senate and House Post Office Committee in their investigation of the postal system. It will be necessary for the Advisory Committee to deal with the construction of mail tunnels, tubes, and other mail transportation and handling devices. It is gratifying to realize that the Government is becoming alive to the importance of selecting engineers to fill important positions allied with or involving engineering problems.

* * *

AERONAUTIC SECTION OF THE A. S. M. E.

Considerable cooperative engineering work has been done in the field of aviation, standards have been established, details of construction perfected, and interchangeability secured. Nevertheless, there still exists an opportunity to promote the broad engineering development of aerial navigation, and with this in view, the American Society of Mechanical Engineers has organized an aeronautic section. A number of men who were prominent in the aeronautic field during the war have registered in this section.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Davis Duplex Continuous Milling Machine. Davis & Thompson Co.. 251 Reed St., Milwaukee, Wis. 285
Newton Continuous Milling Machine. Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. 286
Reynolds Screwdriving Machine. Reynolds Machine Co., Massillon, Ohio 288
Warner & Swasey Geared-head Turret Lathes. Warner & Swasey Co., Cleveland, Ohio 289
"Meno" Rust Remover and Cleanser. Peter A. Frasse & Co., 417 Canal St., New York City 289
Craftsman Continuous Rotary Milling Machines. Craftsman Tool Co., Conneaut, Ohio 290
Webster & Perks Plain Manufacturing Grinding Machine. Webster & Perks Tool Co., P. O. Box 1301, Springfield, Ohio 291
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Hammond Portable Crane. Barrett-Cravens Co., 171 N. Ann St., Chicago, Ill. 298
Black & Decker Two-spindle Drill. Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. 299
Canton Drill Clamp. Poyser-Bucher Co., Canton, Ohio 299
Snellex Frictionless Center. Snellex Mfg. Co., Rochester, N. Y. 299
Badger Vertical-spindle Disk Grinder. Badger Tool Co., Beloit, Wis. 299

Davis Duplex Continuous Milling Machine

The keen competition in the manufacture of automobiles demands that the parts be machined as cheaply as possible without impairing the required accuracy. The duplex continuous milling machine built by the Davis & Thompson Co. was designed for milling to length automobile camshafts, crankshafts, transmission shafts, etc., at such high rates of production that the cost of this operation is materially reduced. The automatic clamping apparatus used for some kinds of work is an unusual feature, which simplifies the operation and accelerates production.

A CONTINUOUS milling machine for milling to length forgings such as automobile camshafts, crankshafts, worm and transmission shafts, and axles, or small castings used on tractors and automobiles, sad irons, etc., has been placed on the market by the Davis & Thompson Co., of 251 Reed St., Milwaukee, Wis. This machine is known as the No. 1 continuous duplex four-spindle milling machine. A full view of the machine is presented in Fig. 1, which shows its main features.

It will be noted from this illustration that there is a horizontal bed on which two housings are mounted. Each of these housings contains two cutter-spindles, one spindle being provided for rough-facing the work as the latter is rotated past it, and the other for finish-facing it. The mandrel which supports the fixture on which the work is held has a bearing in the upper portion of each spindle head, and is driven through a large bronze worm-wheel at its left end, which engages with a hardened steel worm. This worm, in turn, is driven by a motor on the top of the machine, through a single-pulley drive and gearing, including change-gears. By means of the change-gears, which are placed at the back of the machine, the number of revolutions per minute of the work-holding mandrel can be varied to suit any desired feed of the work past the cutters.

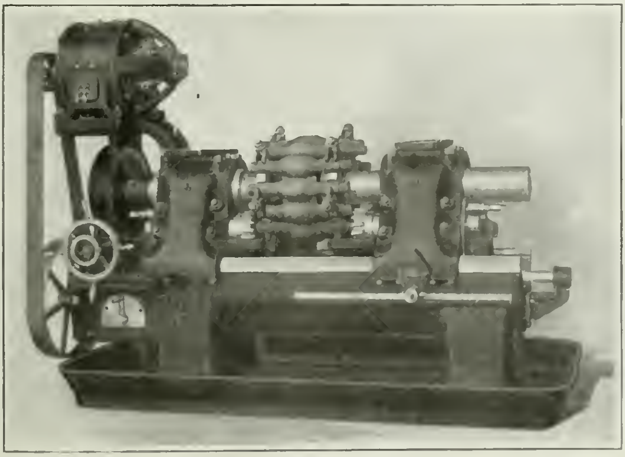


Fig. 1. Davis No. 1 Continuous Duplex Four-spindle Milling Machine for Automobile Camshafts, Crankshafts, etc.

The spindle head at the right end of the machine is adjustable along the ways of the bed similarly to the tailstock of a lathe, and after being set in any desired position it is clamped to the bottom of the ways. This arrangement adapts the machine for work of various lengths dependent upon the length of the bed. Each cutter-spindle has an endwise micrometer adjustment of two inches to permit accurate settings to be obtained. The spindles can be locked in place after the settings have been made. Two changes of speed for the cutters are obtained from speed-change gears placed in the left end of the bed. These gears are contained in a compartment filled with transmission oil, which insures adequate lubrication to all bearings and gears. A large oil reservoir is also provided in each spindle head to supply lubricant to the bearings and gears of these units.

The design of the work-holding fixture mounted on the mandrel depends upon the nature of the work to be machined, and different fixtures must be provided for each individual class. These fixtures are made in halves, clamped and keyed to the mandrel, and so can be mounted or removed easily. In some cases the fixture is supplied with clamps for holding the work to it, as shown in Fig. 1, where the machine is arranged for milling the ends of worm-shafts. However, in many instances, an automatic clamping apparatus is supplied.

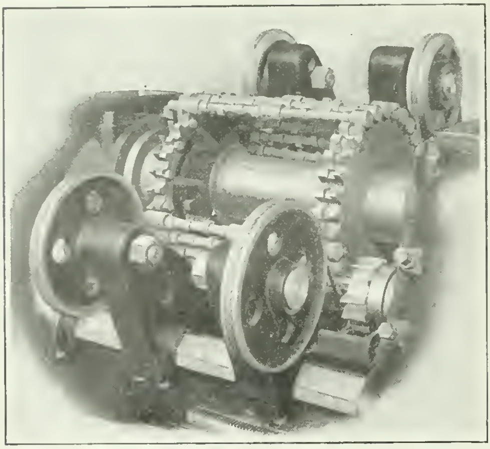


Fig. 2. Wire-cable Arrangement for keeping Parts on Work-holding Fixture

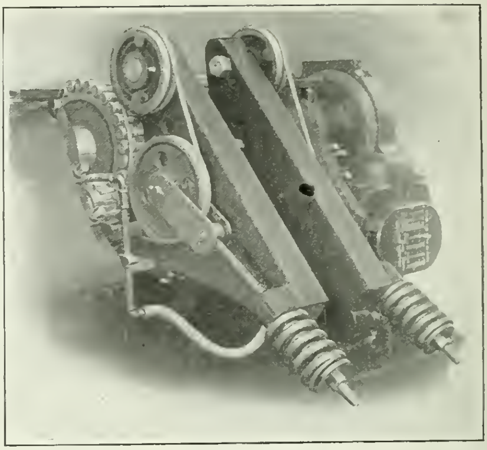


Fig. 3. Tension Device attached to Rear of Bed for keeping Cables taut on Pulleys and around Work

This clamping apparatus (Fig. 2) consists of two endless wire cables which pass over pulleys and beneath the work-holding fixture, thus preventing the work from falling out of the fixture when on the under side and being fed past the cutters. The pulleys are supported on brackets attached to the front and rear ways of the bed, and the cables are kept taut by heavy springs placed at the back of the machine, as shown in Fig. 3. With this arrangement the production of the machine is greatly increased as the work of the operator only consists of dropping the pieces in the notches of the fixture and removing them after they have been milled. This cable attachment can be easily removed from the machine when desiring to hold work on the fixture by other means. On account of roughing and finishing cutters being provided on each head, coarse feeds can be employed as the finishing cutters insure a high finish on the parts.

It is claimed that the rate of production depends entirely upon the operator, as the machine can be set to mill work as fast as the operator can insert and remove the parts. In milling camshafts with a cable-clamping arrangement, the average output is about 350 pieces per hour. However, if the work were held in place by clamps and bolts, the production would not be more than 100 pieces per hour on account of the time involved in clamping and unclamping the work. When milling castings with a cable-clamping arrangement it is sometimes necessary to make a jaw receptacle on the fixture for holding the castings in place, which insures a good path for the cable to travel in and prevents acute bends in the cable. The machine is built with beds of any desired length.

NEWTON CONTINUOUS MILLING MACHINE

In the October number of MACHINERY a continuous rotary milling machine built by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., was illustrated and described. In the present number another model of continuous milling machine, brought out by the same company, is shown. As will be apparent by reference to Fig. 1, the same general principles of construction referred to in

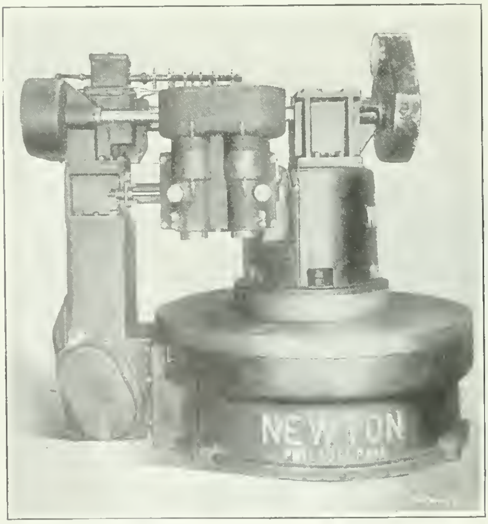


Fig. 1. Continuous Rotary Milling Machine built by the Newton Machine Tool Works, Inc.

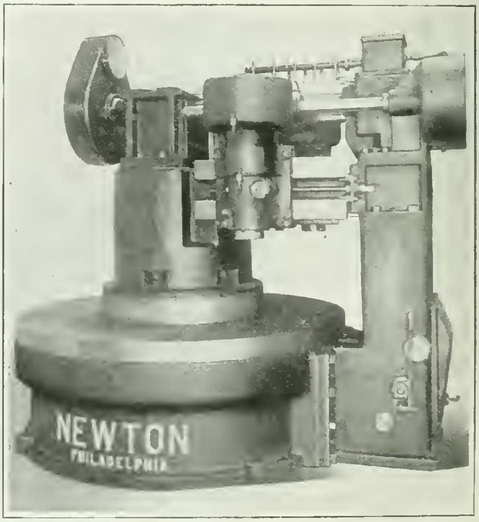


Fig. 2. Opposite View of Machine shown in Fig. 1, illustrating Finishing Spindle

the previous description have been applied. The base of the machine is circular and is provided with a central tapered column. The table casting is fitted over this tapered column, and, in addition, is supported by an annular bearing close to the periphery of the table. The table is 84 inches in diameter, and the depth from the annular bearing to the top of the table is 12 inches. In the center of the table there is a finished hub, 42 inches in diameter, which assists in locating jigs. The smallest diameter of the taper fit between the base column and the table is 36 inches.

As shown in Figs. 1 and 2, there is a central column, bolted and keyed to the base. This central column is made in one piece with a cross-rail upon which the spindle heads are carried. The object of making the cross-rail and the column in one piece is to eliminate, as far as possible, bolted connections. On the cross-rail, in the front of the machine, Fig. 1, there are two spindles for the roughing cuts, mounted in one housing. On the back of the cross-rail, as shown in Fig. 2, there is a single spindle for the finishing cut. This spindle is located at a distance of 42 inches from the center line passing through the two front spindles. The housings or heads in which the spindles are mounted may be moved along the cross-rail to any required position, so that the machine may be used for a variety of work, and so that the jigs and fixtures employed for holding the work may be designed in the most convenient manner. The outer end of the cross-rail is supported by a column which is bolted and doweled both to the base of the machine and to the cross-rail.

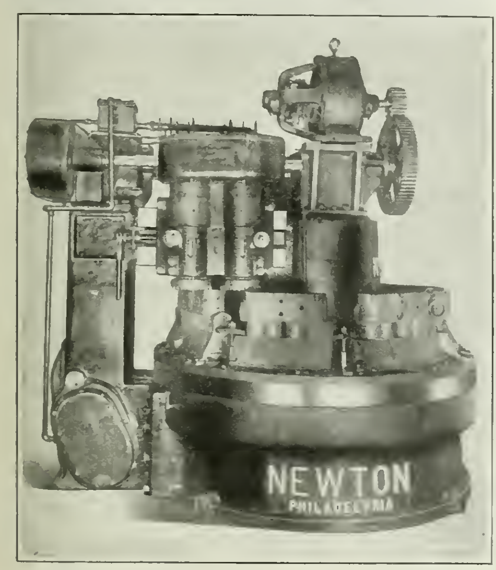


Fig. 3. Roughing Cutters at Work on Cylinder Castings

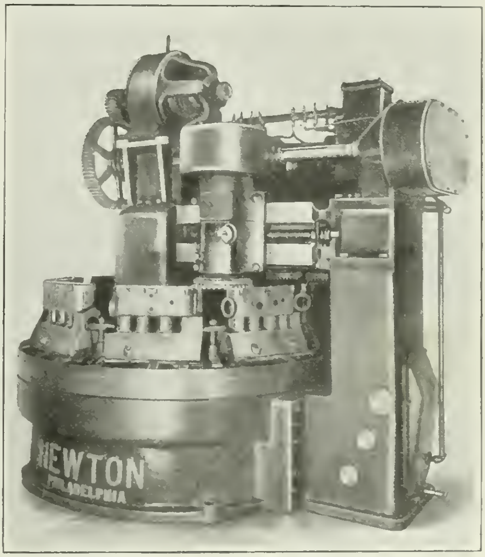


Fig. 4. Finishing Cutter at Work on Same Castings as shown in Fig. 3

Method of Driving the Machine

The motor by which the machine is driven is mounted on the top of the central column as shown in Fig. 3, and drives the jack-shaft through gearing, as indicated. At the extreme outer end of the cross-rail there is a gear-box from which motion is transmitted to the roughing and finishing spindles. The arrangement permits the rotative speeds of the spindles to be varied independently of each other, so that, while the speeds are predetermined and fixed, they may be changed when the grade of material or size of cutters is changed.

The rotative movement of the table is controlled by a predetermined fixed feed, but provision is made for changing this rate of rotation, if necessary, to suit any change in the grade of material. However, there is no means whereby the operator of the machine can increase or decrease the production of the machine at will, because the rotative speed when once determined remains fixed, and there must always be a given number of stations per hour passing the loading station; hence a predetermined number of pieces will always be machined per hour, if the operator gives the proper attention to the work. The drive to the table is by means of a herringbone gear, 81 inches in diameter.

The machine, when arranged for a given piece of work, is provided with a housing having a fixed distance between the centers of the roughing spindles, but different sizes of housings may be provided, with varying center distances between the spindles, according to the dimensions of the work. Generally, however, these centers are either 12 or 14 inches apart. Both spindles rotate inward—that is, the left-hand spindle rotates clockwise, and the right-hand spindle, counter-clockwise. Each of the spindles is provided with individual adjustments for setting the cutters to gages.

With a distance of 42 inches from the center of the roughing cutters to the center of the finishing cutters, the roughing operation is performed on any given casting before the finishing operation commences. Hence, the finishing cut is not affected in any way by the roughing operation; and due to the slight cut taken by the finishing cutter, any inaccuracy resulting from either dull roughing cutters or inequality in the casting is easily rectified by the finishing cutter. By dividing the work between the roughing and finishing cutters, the number of grindings of the cutters is also reduced, and it is possible to operate at much higher cutting speeds and table feeds than would otherwise be practicable. In many instances, a high degree of finish is not required, but increased production is obtained by the correspondingly faster feeds permissible when a finishing cut is taken.

The general design of the machine has been carefully worked out. All bearings, except the spindle bearings, are oiled by the cascade method of lubrication, the oil being pumped from a reservoir in the outer upright to a box on the top of this column, from which point it is distributed. All gears are enclosed and run in oil, and all essential gears are hardened. All bearings are sealed to prevent the escape of lubricating oil.

Examples of Work Done on the Machine

Fig. 3 shows the machine in operation taking roughing cuts on a cylinder casting, about 22 inches long and 11¼ inches

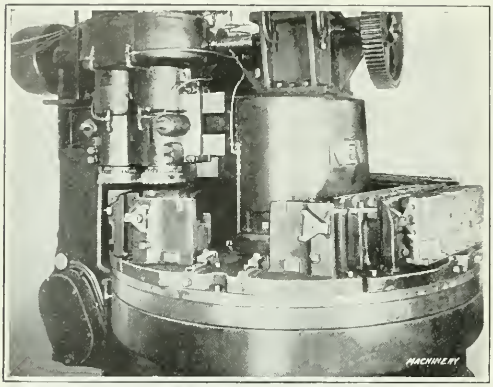


Fig. 5. Jigs for holding Cylinder Castings while rough-milling

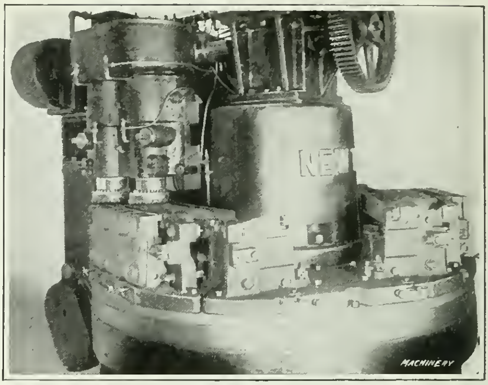


Fig. 6. Jigs used for Final Milling Operations on Cylinder Blocks

wide. Fig. 4 shows the finishing cutter at work on the same cylinder blocks. On this work a feed of 20 inches per minute on the maximum radius is used.

Fig. 5 shows a roughing operation and the method of jigging two castings in each jig, milling operations being performed on the base and manifold surfaces of cylinder castings. After the operations shown in Fig. 5 have been performed, the finished surfaces are bolted against the jigs for the subsequent operations of machining the top and the other side of the cylinder block, as shown in Fig. 6. From the illustrations, it will be noted that all the jigs are of the open front design, in order to permit of quick loading and unloading.

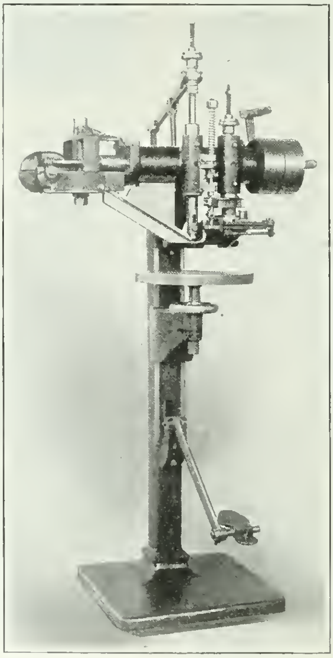
It will be noted that all the parts of these machines are extremely rugged, which is necessary on account of the fact that in many instances machines of this type are required to give service twenty-four hours per day. The machine is also made extremely heavy in order to absorb any of the vibrations caused by the three cutting actions that occur simultaneously. The character of the work usually milled on machines of this type does not require a great range of adjustment; hence, in a standardized model, such as shown any adjustment that is required is taken care of by the adjustment of the spindles and by the variations possible in the height of the jigs themselves.

The jigs are sometimes mounted on a sub-plate, as shown in Fig. 5. This is done because the particular factory for which the machines shown were designed makes four models of engines. Hence, it is often necessary to change quickly from one group of jigs to another. By having a sub-plate made in two pieces, only two sections have to be handled in changing from one model to another, and such a change is sometimes made two or three times in one week without inconvenience or undue delay.

Referring to Fig. 5, it will be noted that the roughing cutters do not mill upon the same radial line. The inner or right-hand cutter is further advanced than the left-hand cutter, so that it mills considerably in advance of the outer cutter. In this way, the two spindles, with a center distance of 14 inches, equipped with 12-inch cutters, are enabled to completely cover the surface of the work without any interlocking between the cutters, which latter method is generally recognized as a troublesome and difficult method of operation.

REYNOLDS SCREWDRIVING MACHINE

A machine which sets and drives small screws in place, and thus facilitates the assembling of light work, has been developed by the Reynolds Machine Co., Massillon, Ohio, and is shown in the accompanying illustration. Some of the applications for which the machine is especially suited are in driving electrical binding screws, switch-box screws, etc. This concern has hitherto built machines which automatically feed and drive screws of ordinary proportions, but the new machine handles screws having a length less than the diameter of the head. While designed especially for driving short screws, the machine is not limited to short work, and screws of ordinary lengths and sizes of heads can also be driven.



Machine built by the Reynolds Machine Co. for setting and driving Screws in Light Assembly Work

In operation, the screws are thrown at random into the magazine at the right of the machine, in which they are automatically arranged in single file and with the heads upward. They are delivered in this position into the inclined chute leading from the magazine to the lower end of the spindle. Opposite to and closing the lower end of the chute, is a finger provided with a recess in which one screw is received at a time and held in line with the spindle. A screwdriver bit is inserted in the socket of the spindle, and as the spindle is lowered by operating the foot-lever, the bit is engaged with the slot across the head of the screw, and the finger and screw are carried downward until the point of the screw comes in contact with the work. When this occurs, the finger is automatically withdrawn and the screw driven in place. The spindle is driven by friction, which can be adjusted to make it cease rotating when the screws are driven as tightly as desired. If preferred, the screws may be merely started into the work or driven to a uniform depth.

The table is 12 inches in diameter, and may be adjusted on the column to take work of various heights up to 15 inches. A screw is provided for permitting close adjustments to be made. The foot-lever is pivoted well above the pedal to give an easy swinging action, and the position and amount of resistance can be adjusted to suit the operator. By operating the machine with a foot-lever, both hands of the workman are left free to handle the work. The spindle may be run at several hundred revolutions per minute, and the screws are driven tight almost instantly. The machine may be furnished with a pulley drive as shown, or with individual motor drive.

WARNER & SWASEY GEARED-HEAD TURRET LATHES

In this day of specialized manufacture, the feeds and speeds that can be used to the best advantage in machining any particular part are usually predetermined; therefore a turret lathe of enough flexibility to machine several surfaces of different diameters on one piece, or pieces made of different materials and to different dimensions, must necessarily have ample power and a wide range of both feeds and speeds. The Nos. 4 and 6 turret lathes now manufactured by the Warner & Swasey Co., Cleveland, Ohio, have a geared-head construction which is said to deliver four times the power transmitted by the ordinary geared friction head of the same size machine, and twice the power of the double friction back-geared type. Even with this increased power, less effort is required to move the controlling levers; consequently the machine is easier to operate.

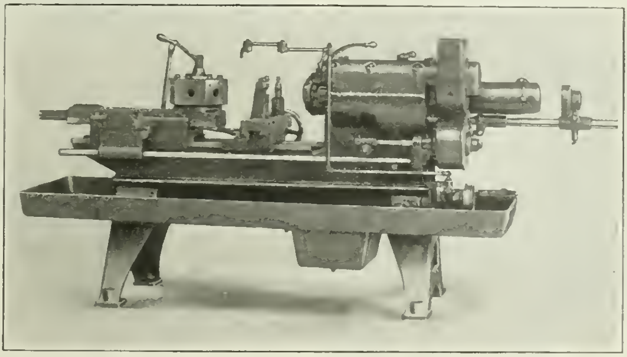


Fig. 2. Rear View of Geared-head Turret Lathe illustrated in Fig. 1

The front view of the No. 6 turret lathe with a geared head is illustrated in Fig. 1, while the rear view of the same machine may be seen in Fig. 2. The first model of this type built, has been thoroughly tested under every condition that might be encountered in service, and six machines of each size have been installed in outside shops for similar experimenting. The results obtained from all these machines have been very satisfactory.

Fig. 3 shows a view of the geared head with the cover removed, from which it will be seen that the steel gears are of a coarse pitch and have wide faces. The gears run in a bath of oil which also lubricates the bearings. Two sets of gears are mounted on the front shaft, while a third set and the reverse friction clutch are mounted on the back shaft. Twelve spindle speeds and a reverse rotation are obtained. Another advantage claimed for machines of the geared-head construction is their adaptability to the various types of motor drive. The head may be geared directly to the motor or driven from it by means of a chain or belt.

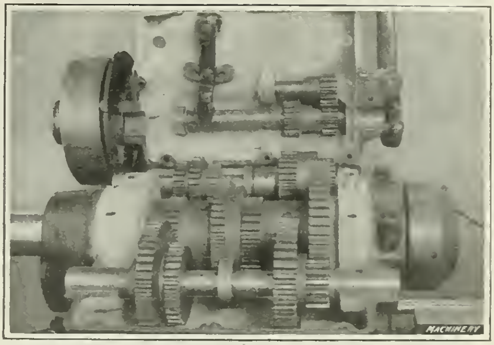


Fig. 3. View of Geared Head with Cover removed showing Gears in Place

The No. 6 turret lathe can be equipped with the standard carriage used on Warner & Swasey turret lathes one of which is shown on the machine illustrated, or with a heavy-duty carriage that is specially valuable when taking heavy cuts or performing heavy forming operations. A range of six power cross-feeds is provided on this heavy-duty carriage for facing, forming, and cutting off work at various speeds. The No. 4 turret lathe is equipped with a standard carriage. The maximum capacities of this turret lathe are as follows: Diameter of bar stock, 1½ inches; length turned, 10 inches; swing over bed, 16 inches; and swing over cross-slide, 7 inches. The maximum capacities of the No. 6 turret lathe are as follows: Diameter of bar stock, 2¼ inches; length turned, 12 inches; swing over bed, 20⅜ inches; and swing over cross-slide, 9¼ inches.

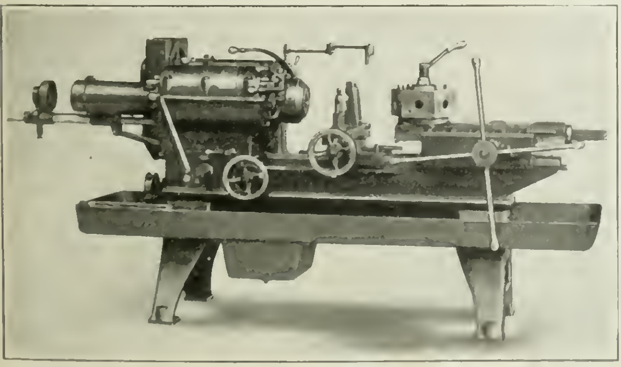


Fig. 1. Warner & Swasey No. 6 Geared-head Turret Lathe

"MENO" RUST REMOVER AND CLEANSER

The "Meno" rust remover and cleanser is a scientific combination and blending of certain chemical ingredients, which in combination produce an electro-chemical action resulting in rapidly loosening and dissolving rust, grease, oil, dirt, carbon, paint or any other foreign substance adhering to metal, irrespective of its age or hardness. The action of the cleanser is said to cease automatically when contact between the cleanser and the metal is established, so that it will not injure or mar the surface of the metal itself in any way. There are two methods of using the preparation, as follows: (1) Apply it to the machine or part with a brush and allow it to remain for a short time, then brush or rub it off, leaving the metal bright and clean. (2) Mix the preparation in a vat, tank or container with water, then attach the machine or parts to a wire or chain so that they will hang in the solution. No further attention is required, since the process of cleaning goes on while the parts are immersed. It is stated that the preparation is absolutely safe in every way and that it will not burn or explode. Another important point claimed is that it will not cause corrosion or rust to form; in fact, it protects the metal and makes it exempt from corrosive or disintegrating action for a long period after it has been treated by this preparation. The same solution may be used many times as it does not deteriorate or lose its cleansing power. Peter A. Frasse & Co., 417 Canal St., New York City are the sole distributors.

CRAFTSMAN CONTINUOUS ROTARY MILLING MACHINES

The line of continuous rotary milling machines here described and illustrated is built by the Craftsman Tool Co., Conneaut, Ohio. The machine shown in Fig. 1 is the first of this line to be placed on the market. It was originally designed for the purpose of castellating small nuts, but its success when used not only for castellating operations, but for a wide range of light milling operations as well, led to the building of the No. 2 and No. 3 machines, shown in Figs. 2 and 3, respectively. As will be noted from the illustrations, the latter machines are designed along the same general lines as the No. 1 machine, with the exception that each is provided with two chucks.

Reference to the illustrations will show that these machines are designed to combine rigidity with simplicity. The frames are composed of heavy castings, which rest upon substantial cast-iron bases. The principal feature is the continuously rotating chuck. For the Nos. 1 and 2 machines this chuck is made 10½ inches in diameter. Each chuck consists of three carburized machine-steel plates. The standard outer plates used for either castellating or screw slotting are about ¾ inch thick, but special plates of various thicknesses are supplied for other operations.

Referring to the single chuck of the No. 1 machine, the left-hand plate is attached to a cast-iron bushing, which, in turn, is pinned to the central shaft of the machine. The right-hand plate is slotted to a depth varying from 2 to 3 inches, thus forming an independent jaw for holding each part to be milled. The central plate is furnished in varying diameters according to the operation to be performed, and the standard chuck is supplied with three of these plates of varying thicknesses and diameters. The right-hand plate runs loose on the shaft, so that it is permitted to swivel or tilt.

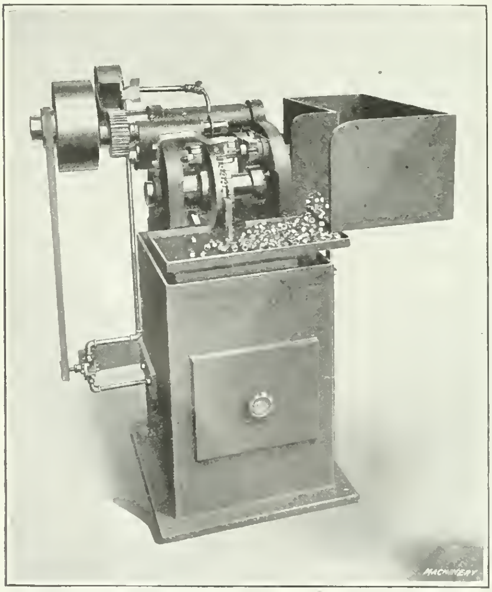


Fig. 1. Craftsman No. 1 Continuous Rotary Milling Machine

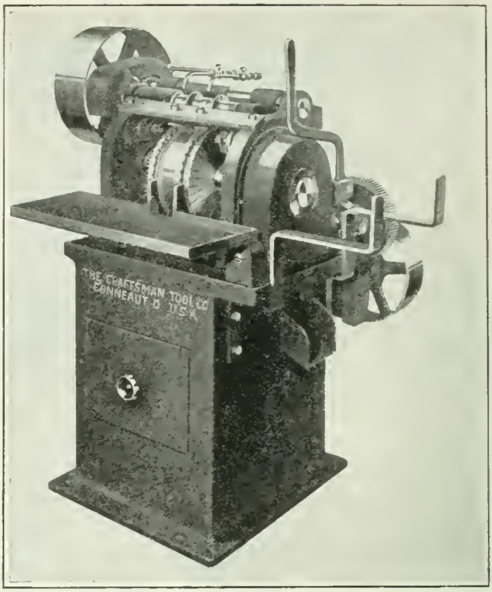


Fig. 2. Craftsman No. 2 Continuous Rotary Milling Machine, which has Two Work-holding Chucks

The chuck rotates between two steel rollers located at the point where the work comes in contact with the cutter. As each part is held independently, difficulty arising from variations in size is overcome. A spreader is placed in the front of the chuck which serves to keep the chuck continuously open at the point where it is fed. The cutter is driven by a hardened and ground steel spindle carried in a rocker arm. The rocker arm provides a means of adjustment for the depth of slot and variations in size. The cutter-spindle is back-geared, and the central shaft, which propels the chuck, is worm-driven, thus insuring ample power. The worm drive is provided with a clutch controlled by a conveniently located handle, and slip gears are supplied, giving ten changes of feed for the Nos. 1 and 2 machines.

When performing milling operations, the work is placed in the chuck as it rotates so that the operation is continuous. As each independent jaw of the chuck approaches the cutter, it is closed automatically by two roller bearings between which it passes; the work which rests upon the central plate is thus positively held in position while being machined. As the work leaves the cutter, the chuck opens automatically, and the parts drop out and pass from the machine through a chute into a suitable receptacle. Slab milling, straddle milling, and plain milling operations are performed on a wide variety of parts. The machines are regularly equipped with a pump and lubricating tank located in the base. A metal container such as shown in Fig. 1 for holding the parts to be milled is also included with each machine and also a countershaft. The total weight of the No. 1 machine and countershaft crated for domestic shipment is 1430 pounds.

The No. 2 continuous rotary miller shown in Fig. 2 is equipped with two chucks, and consequently has a wider

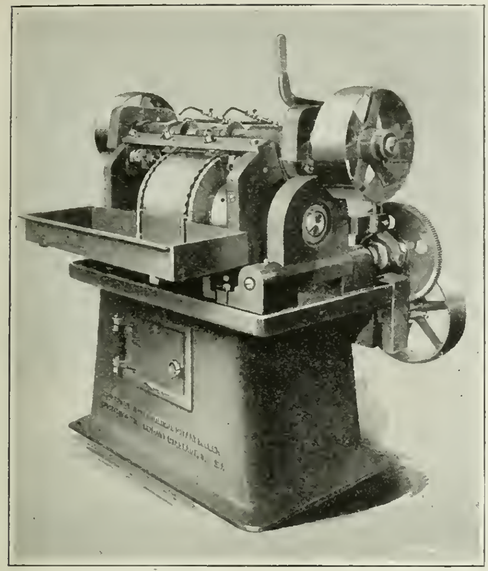


Fig. 3. A Larger and Heavier Design of Continuous Rotary Milling Machine

housing and larger pulleys than the No. 1 machine. By applying two chucks, a much higher production is obtained, except on very small parts where one chuck will mill the parts as fast as they can be inserted by the operator. When castellating ½-inch nuts, the No. 1 machine is limited to the production of 1200 slots per hour, or 400 complete nuts; whereas, the No. 2 machine will give a production of 2400 slots per hour, when the operator becomes accustomed to the increased speed. The machine frame is constructed with pillow blocks, so that the shaft which carries the chucks can be rolled out of the machine and a change of chucks effected with very little delay. This feature is made necessary by reason of the chuck-plate support or middle disk being shrunk on the shaft, which makes it impossible to remove the shaft from the side of the machine, as is conveniently done in the No. 1 machine.

While the No. 3 machine shown in Fig. 3 follows closely the design of the No. 2 machine, there are some essential differences of construction. The No. 3 type is provided with two rocker arms and two driving pulleys. This gives greater power and at the same time permits two adjustments for depth of cut to be made so that two separate operations can be handled by the machine at the same time. The larger chucks and heavier construction of the No. 3 machine give it an increased range, so that parts up to 2½ inches in diameter by 6 inches in length can be readily machined and proportionately heavier cuts made. The compound feed-gears with which the No. 3 machine is equipped give thirty changes of feed. The domestic shipping weight of this machine is 3400 pounds.

WEBSTER & PERKS PLAIN MANUFACTURING GRINDING MACHINE

The Webster & Perks Tool Co., P. O. Box 1301, Springfield, Ohio, has recently brought out a 6- by 30-inch plain cylindrical grinding machine, which is shown in the accompanying illustration. This machine is designed for use as a rapid production manufacturing grinder for either tapered or straight cylindrical grinding on centers. Rigid construction and accuracy in building the machine are claimed as the features that make it possible to obtain a high productive capacity on work having very close tolerances.

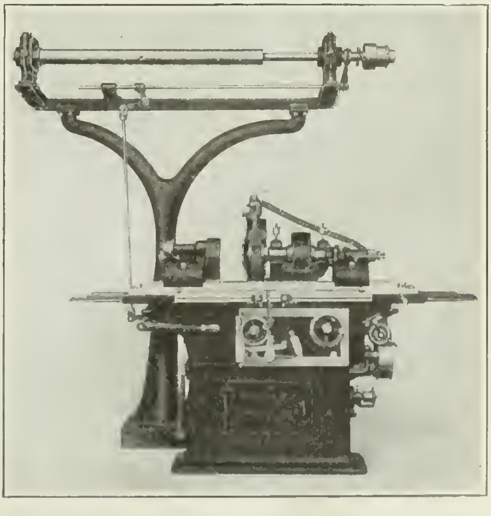
The machine is furnished with either an overhead countershaft for suspension from the ceiling or a countershaft attached to the floor at the back of the machine. The latter type of countershaft may be driven directly from the lineshaft, through the medium of tight and loose pulleys, or the pulleys may be eliminated and a motor connected to the main shaft of the floor stand by means of a coupling. The work drive drum in this case is supported by a column secured to the countershaft base.

The base of the machine, including a large water reservoir, is cast in one piece. Three planed pads are provided on the bottom of the base to facilitate leveling up the machine. The bed is secured to the base by means of large cap-screws and is ribbed to secure stability and alignment of the ways. The vee- and flat-ways are made deep and wide to give large bearing surfaces, and are provided with roller oilers to insure proper lubrication. The sliding table is of rigid construction and is provided with large bearing pads which support the swivel table. The table travel is automatic, and controlled by adjustable dogs secured to the edge of the table by means of a T-slot. The dogs are provided with screws and lock-nuts for fine adjustments. A smooth and steady movement is imparted to the sliding table through the medium of accurately cut spur gears operating at a ratio of 64 to 1 from the transmission drive.

The swiveling table, mounted on the sliding table, swivels on a large hardened and ground center stud fitted in a hardened and ground steel bushing pressed into the table. An adjusting screw and clamps at both ends of the table provide means of adjusting and clamping the table at any "degree" or "inch" graduation marked on the right-hand clamp.

The headstock spindle is driven by fully enclosed gearing which runs in oil. Either live or dead center grinding may be done. The spindle is made of chrome nickel steel, is hardened, ground, and lapped, and runs in long bronze bearings with provision for adjusting to compensate for wear. The footstock is provided with an adjustable spring for holding the center in the work, and with a lever for withdrawing. A locking device is also provided to hold the center rigidly. The wheel-truing device is mounted on the footstock to facilitate truing the wheel without removing the work.

The wheel stand is provided with gibs to prevent its rising in case of accident. The wheel-spindle is made of chrome-nickel steel, hardened, ground and lapped, and mounted in bronze bearings with provision for adjusting to compensate



Plain Manufacturing Grinding Machine built by the Webster & Perks Tool Co.

for wear. These bearings are mounted in ball and socket type bearing housings to secure proper alignment.

The cross-feed, table drive and reversing mechanisms are assembled in a single unit and bolted to the front of the machine, making all working parts accessible for adjustment or repair. The largest diameter that can be ground with a full-sized wheel is 10¼ inches, and the greatest length between centers is 32 inches. The swivel table is graduated to grind tapers up to 3½ inches per foot and up to 8 degrees. The smallest amount of reduction by automatic cross-feed is 0.00025 inch, and the greatest amount 0.005 inch. The cross-feed handwheel is graduated to indicate reductions of 0.00025 inch. The four work-speeds range from 48 to 192 revolutions per minute, and the eight table speeds give traverse speeds of from 6 to 94 inches per minute. The two grinding wheel speeds are 1680 and 1920 revolutions per minute. The machine with unit countershaft secured to the floor at the rear of the machine occupies a floor space of 66 by 116 inches, and weighs approximately 5050 pounds.

OAKLEY NO. 3 UNIVERSAL TOOL-ROOM GRINDER

The No. 3 universal tool-room grinder now being manufactured by the Oakley Machine Tool Co., Oakley, Cincinnati, Ohio, has incorporated in its design certain new features intended to insure, during the life of the machine and under all working conditions, such essential features as accuracy, rigidity, and convenience of control. The longitudinal feed may either be hand-operated or driven by power. The fast hand feed is operated through a rack and pinion, either from the front or rear of the machine by a long hand-lever (see Fig. 1). A small handwheel in front of the saddle controls the slow hand-feeding movement. The power feed is driven by a single belt from a countershaft, and constant belt tension is maintained irrespective of the position of the knee. There are three feed changes obtained through a cone pulley.

The operating and reverse levers are directly under the operator's hand. Hardened chrome-nickel steel is used for all reverse mechanism clutches. The cross-feed is operated by a large diameter handwheel, either from the front or rear of the machine, and there are micrometer dials at both ends of the cross-feed screw. Another large handwheel is used for the vertical feed, which has a micrometer dial on the elevating shaft. The thrust is taken by ball bearings.

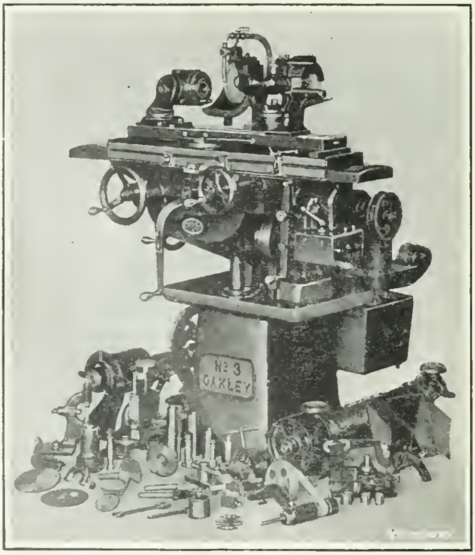


Fig. 1. Oakley No. 3 Universal Tool-room Grinder

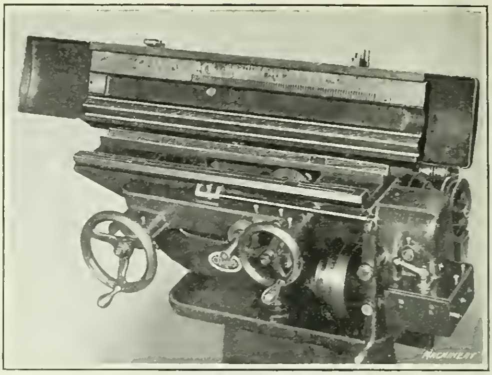


Fig. 2. Detail View of Slide and Saddle

The slide of the machine is aligned to the saddle by vee and flat bearings of liberal dimensions. This slide is designed to maintain true alignment during the life of the machine, and it is easily removed from the saddle for cleaning (see Fig. 2). The saddle and knee have V-bearings; and in the case of the slide, saddle, and knee there are no gibs or adjustments for the operator to tamper with. The entire slide bearings are oiled through one centralized oil-cup. The wheel-head swivels on the column 180 degrees either side of the central position. The wheel-spindle runs in dustproof, taper, bronze bearings. The work-head has a No. 12 B. & S. taper for receiving the shanks of large end-mills. This work-head swivels in horizontal and vertical planes.

The range of this machine is as follows: Longitudinal movement, 17 inches; vertical movement, 10½ inches; cross movement, 9 inches; maximum swing, 10 inches; maximum distance between centers, 20 inches. The table surface is 5¾ inches wide, and 33¾ inches long. The automatic feeds are 6½ inches, 11⅜ inches, and 19½ inches per minute.

LANDIS CAMSHAFT GRINDING ATTACHMENT

The efficiency of an automobile engine depends to a great extent upon the accuracy of the camshaft, and in the development of engines up to their present high stage, the tolerances allowed on the cam surfaces of these members have been gradually reduced until it has become necessary to employ grinding machines in order to produce them within the required limits of accuracy. To meet this condition, the Landis Tool Co., Waynesboro, Pa., has developed a grinding attachment which is shown in Fig. 1 mounted on a Landis 10-inch plain self-contained grinding machine. This attachment swivels on shaft *A* which runs along its entire length, rocking the work back and forth against the grinding wheel to suit the contour desired on the various cam surfaces of the camshaft. The rocking movements are controlled by a master cam and roller contained in the headstock of the attachment.

In Fig. 3 this headstock is shown with the cover removed, while Fig. 2 shows the details of construction. By referring to these illustrations, a description of the manner in which the oscillatory movements of the attachment are controlled can be readily followed. The work is placed between the centers of the headstock and tailstock and driven by means of a dog attached to the headstock end which has an arm located between lugs on driver *A*, Fig. 2. This driver is mounted on spindle *B*, and is adjustable to facilitate the setting of the camshaft in the proper relation to the master cam *C*. The spindle is driven through the worm-wheel *D*

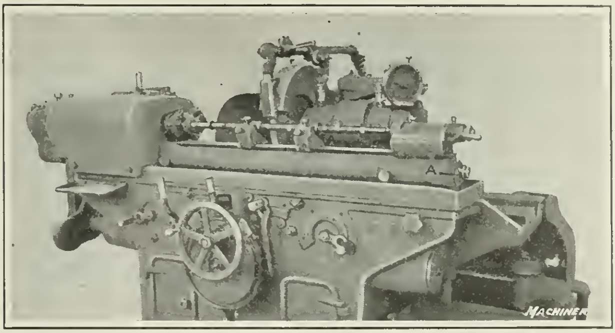


Fig. 1. Landis 10-inch Plain Self-contained Grinding Machine provided with Attachment for grinding Automobile Camshafts

near the left end of the headstock. The master cam consists of a series of cam surfaces to suit the cams on a camshaft, but they are much larger in diameter than the camshaft surfaces so as to reduce errors. This master cam is made of a solid piece of steel, is a taper fit on the spindle, and is held in the proper location by means of nut *E*.

Roller *F* is brought in contact with the master cam when the surface of a camshaft is being ground, and as spindle *B* revolves and a lobe of the master cam comes in contact with the roller, the entire attachment is rocked toward the wheel to suit the work. The master cam is kept in contact with the roller by means of compression springs, the tension of which is adjustable to suit various conditions. When any cam surface of the camshaft is completed, roller *F* must be shifted to the surface on the master cam corresponding to the cam on the camshaft which is to be ground next. This is accomplished by turning lever *G*, Fig. 3, which causes the rotation of shaft *I*, Fig. 2. It will be noted that shaft *I* is provided with a continuous groove into which a plug attached to the roller projects, and as the shaft is turned one revolution, the roller is advanced an amount equal to the pitch of the groove and thus brought into position on the next cam surface of the master cam. The relative positions of the roller along the master cam are indicated by pointer *H*, Fig. 3. Brake *J* is provided at the left-hand end of the spindle for the purpose of compensating for any lost motion at the time the pressure of the work against the grinding wheel is reversed when the latter passes over the lobe of a cam.

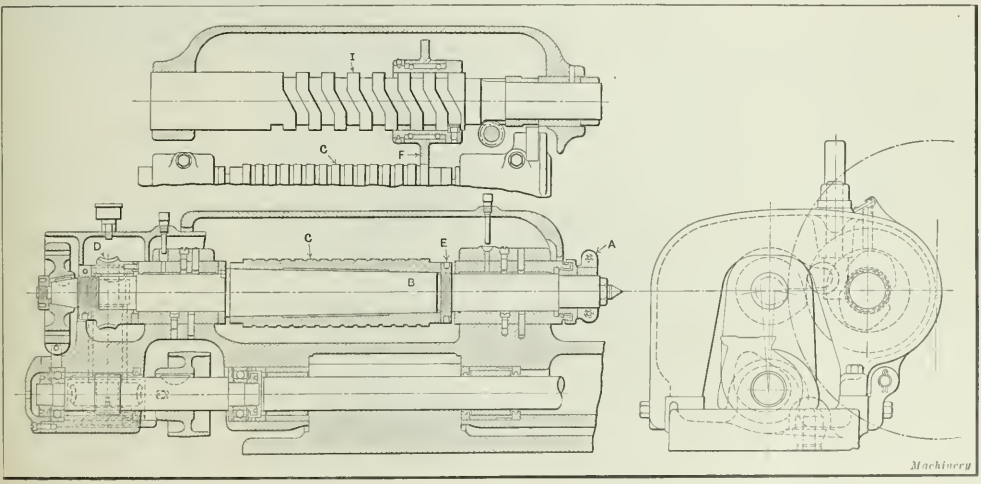


Fig. 2. Headstock End of Grinding Attachment developed for machining Automobile Camshafts

In designing this attachment, rigidity has been obtained by making the main casting or swinging bracket of a tubular cross-section, by having it well supported directly under the master cam, and by locating the work-centers close to the machine bed. It is claimed that this construction balances the swinging bracket and eliminates strain. On account of the work being held directly above the fulcrum center, its vertical movement is reduced and the point of contact between the grinding wheel and the work is kept within a small arc, thus making negligible the difference in the contour of cams caused by the changing diameter of the grinding wheel. As the master cam is mounted directly on the headstock spindle and is substantially connected and in line with the work, lost motion and errors are eliminated.

The most accurate results are secured when the grinding wheel is of the same diameter as the roller used in contact with the model cam when the master cam is being generated. This condition results from the point of contact between the work and grinding wheel traveling above and below the wheel center.

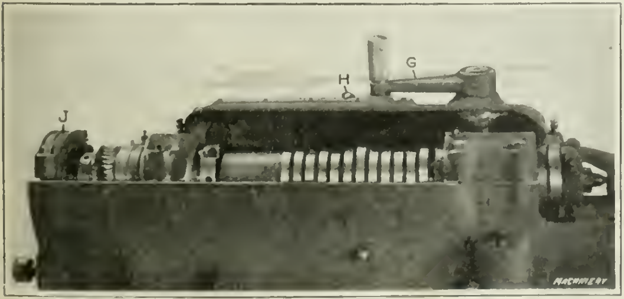
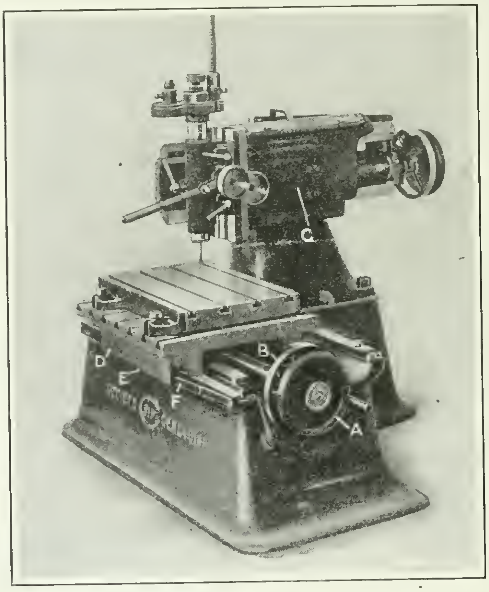


Fig. 3. Headstock End of Grinding Attachment with Cover removed, showing Master Cam and Roller used to give Oscillatory Movements to Attachment

The more this contact point varies from the horizontal center line of the wheel, the more pronounced the variation in the contour of cams ground with different sized wheels. However, as previously mentioned, there is little vertical movement of the work so that the movements are practically in a horizontal plane and the travel of the grinding point above and below the wheel center is at a minimum. The grinding attachment described in the foregoing can be furnished in the following sizes: 5½ by 26½ inches; 5½ by 36 inches; and 5½ by 52 inches.

S. I. P. LOCATING MACHINE

The accurate locating of holes on work of a precision nature, such as jigs and fixtures, by means of the customary button or disk methods is necessarily a long operation, and the results obtained are limited by the skill of the workman and the care taken in making the settings. In order to facilitate such work and to permit the holes to be accurately drilled or bored while located, the Société Genevoise d'Instruments de Physique of Geneva, Switzerland has developed the machine shown in the illustration, and known as the S. I. P. locating machine. The sales agent for this machine is the Golden Co., 405 Lexington Ave., New York.



S. I. P. Locating Machine developed for the Accurate Locating and Drilling or Boring of Holes in Jigs and Fixtures

In using this machine, the work is placed on the table which can be adjusted in a longitudinal direction by means of a lead-screw that engages with a nut on the under side of the table. This lead-screw is rotated by turning handwheel *A*. An index-wheel *B*, which is graduated to 0.0005 inch and has a vernier reading to 0.0001 inch, is provided for accurately indicating any amount of movement given to the table. A scale is provided at the rear of the bed to indicate the position of the table in relation to the zero mark.

The spindle of the machine is held in a bracket attached to the face of slide *C* which is mounted at the top of the column. This spindle can be moved transversely across the table by turning a lead-screw which engages with a nut on the slide. A handwheel and index-wheel similar to *A* and *B*, respectively, are also mounted on the end of this lead-screw, and the graduations and the vernier of this index-wheel are identical to those of wheel *B*. Both index-wheels are clamped in position by friction, and can be turned independently of the handwheels, so that they can be set to zero when changing the setting of the table or slide. Both lead-screws have a pitch of 0.1 inch. A scale is also provided at the top of the slide to indicate its position in relation to the column.

The table is provided with spring-supported rollers which relieve the weight of the table on the ways of the bed. This arrangement reduces the friction between the table and the bed and helps to maintain the precision of the machine. The tension of the springs that support the rollers is adjustable. An important feature of the machine is the device provided for correcting faults of the lead-screws used to secure movements of the table and slide. The correction device for the table screw can be seen in the illustration. It will be noted that a cam-plate *D* is attached to the front of the table; this cam-plate has a correction groove along its lower edge. As the table is moved along the bed, the irregular contour of this curve transmits an up and down movement to pin *E*, which, in turn actuates lever *F* and causes the vernier at index-wheel *B* to move in conformity with the faults of the screw. This arrangement automatically gives correct readings for any position of the table. The correction device for the slide screw is designed along similar lines and is placed along the top of the slide.

The accessories furnished with the machine include a locating microscope, a goniometric microscope, a calibration or correction control microscope, a calibrated standard scale, and a circular table about 10 inches in diameter. The locating microscope is provided with adjustable crossed hair lines, and magnifies 20 diameters. It is used for locating holes on new work, and for checking the centers of holes laid out by some other means, or holes already machined. It may also be used for testing the parallelism of lines drawn on any plane surface. The goniometric microscope has one stationary and one adjustable hair line and also magnifies 20 diameters. The graduated circle is divided into half degrees, and readings may be made to one minute by means of a vernier. It is designed for the measurement of angles and for use when laying out polar coordinates.

The calibration or correction control microscope is provided with two parallel hair lines and magnifies 50 diameters. It is used in conjunction with the standard reference scale to be described later. This microscope and the scale are designed for the periodic verification of the precision of the lead-screws. The calibrated standard scale just mentioned is graduated to 0.1 inch over a length of 8 inches. It is a nickel-steel bar having approximately the same coefficient of expansion as hard steel, and is enclosed in a metal case provided with a cover. The purpose of this case is to prevent the scale from coming in contact with any object which might mar its accuracy. The circular table is graduated in degrees and may be set to one minute of an arc by means of the vernier. This table is also designed for working to polar coordinates.

The machine described in the foregoing is built in four sizes, Nos. 1, 2, 4, and 5. The No. 1 machine has a table 3 inches square, and is intended for drills up to No. 60. The table on the No. 2 machine is 8 inches square, and drills up to No. 8 may be used. The table on the No. 4 machine is 16 by 20 inches; this machine is for drilling holes up to 1 inch in diameter or for boring holes up to 3 inches in diameter. The No. 5 machine is provided with a table 24 by 32 inches, and is suitable for the drilling of holes up to 1 inch in diameter, or for the boring of holes up to 4 inches in diameter.

LANGHAAR BALL BEARING

A ball bearing embodying in its design a number of new patented features has been brought out by the Langhaar Ball Bearing Co., Aurora, Ind., and is known as the Langhaar self-adjusting (L-S-A) ball bearing. In the design of this bearing it has been endeavored to produce a ball bearing which would fulfill the requirements and principles of ball bearing design that, from experience and tests, have been laid down by research engineers in the past and that were stated in the review of basic laws of ball bearings published in the Transactions of the American Society of Mechanical Engineers, May, 1907. These principles are briefly: (1) The load a bearing will carry increases with the size and the number of balls; hence, the largest possible balls and the greatest number in any given size of bearing is of first importance; (2) the ball races must be strong enough to resist bending and breaking; (3) each ball must have only two points of contact with the races; (4) the ball races must be curved and have a curvature slightly greater than the balls; (5) the design must provide for true rolling contact, as otherwise there will be sliding and grinding between the balls and races; (6) the bearing should have equal capacity for radial and thrust load; (7) perfect fit should be assured by a self-adjusting feature.

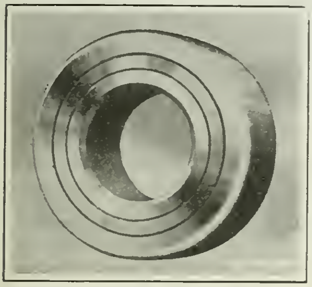


Fig. 1. L-S-A Ball Bearing

Fig. 1 shows the L-S-A ball bearing assembled, and Fig. 4 illustrates the various parts of which it consists. Fig. 3, which is a sectional view, gives the best idea of the design and action of the bearing. As will be seen, there are two rows of balls, each having independent ball cages *A*, Fig. 4. Between the rows of balls there are two independent rings *B*, between which are placed springs *C*, by means of which the right pressure upon the balls is assured, and a self-adjusting feature obtained. The inner ball race *D* is solid, but the outer ball race *E* is made in two parts as shown, the two sections interlocking with each other in practically the same manner as jaw clutches, and are pinned together so that they form a solid unit when assembled. The springs *C* are flat springs, slightly curved, and are assembled between the two rings *B* in the manner indicated in Fig. 2.

By referring to Fig. 3 it will be noted that proper ball rolling contact under load is obtained by having the lines of contact of the balls and races form cones like bevel gears. Each ball may be imagined to be a bevel gear rolling upon the races as bevel pinions in an automobile differential roll with their mating bevel gears. This method of construction obviates spinning and grinding motion and decreases wear. The small wear that evidently must always occur where two parts are in moving contact with each other is compensated for by the self-adjustment feature. Another advantage claimed is the independent separator for the two rows of balls, whereby the one row of balls will never act as a drag on the other. The double row of balls also makes the bearing wide enough in proportion to its diameter, so that it will seat itself properly in its housing. The two rows of balls will always carry an equal share of the radial load, because of the rings between the two rows. These rings keep the rows in balance, and likewise serve as a guide for their rolling motion. It will also be noted that in the design shown, the largest possible size and number of balls can be used in a given size of bearing.

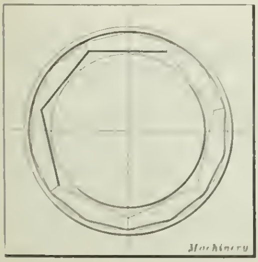


Fig. 2. Springs assembled between Ball Bearing Rings

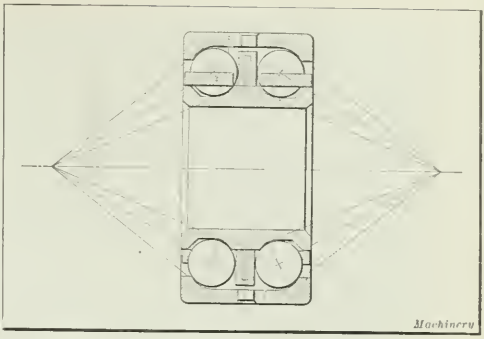


Fig. 3. Sectional View of L-S-A Ball Bearing

The method of uniting the outer races is patented. This joint provides for a solid metal-to-metal abutment, so that the bearing cannot be injured or compressed by an external lock-nut. The pins which hold the two sections together are made of hardened steel, and so proportioned that the strength of the assembled race will be many times greater than service requirements.

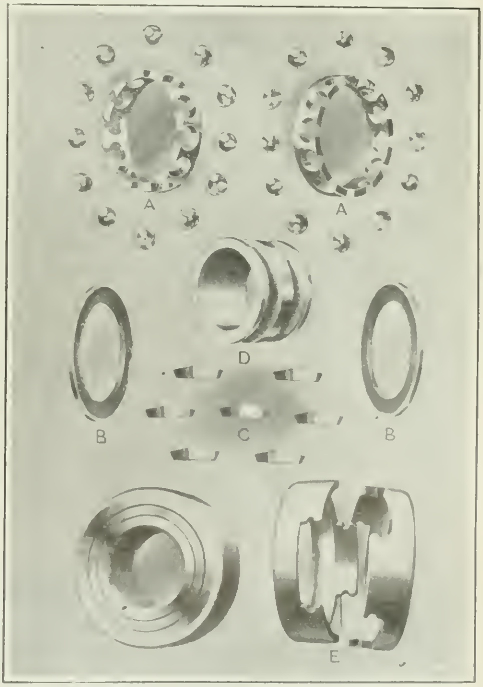


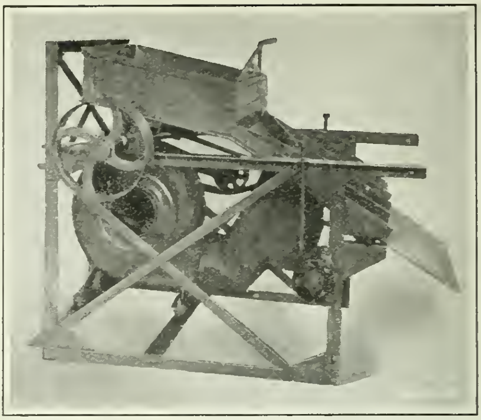
Fig. 4. Parts of Ball Bearing shown in Fig. 1

The self-adjusting feature is of considerable interest. As mentioned, it is obtained by making the ring between the two ball rows in two parts, as shown in Figs. 3 and 4. When these rings are placed back to back in the bearing, they just fit between the ball rows like a solid ring. The recess on the inner side of each ring section makes a space between the two sections when they are placed together, and in this recess are placed the springs already referred to, which are made of the proper strength for each size of bearing. These springs are not constantly compressed and expanded like automobile springs, but are simply placed between the rings to provide for a certain dead pressure. They have practically no movement, except that they provide for an automatic adjustment in the bearing, as required on account of the slight wear that will occur during a long period of use. The flanges on the edges of the two rings prevent the rings from being pressed together in such a manner as to place a load upon the springs greater than the original load when the bearing is first assembled; hence, these springs are not subject to any stresses that would break them, and may be considered as the most durable parts of the whole bearing.

The construction of this ball bearing is said to provide for a thrust capacity practically equal to the radial capacity of the bearing, and hence it becomes unnecessary to use oversize bearings for high thrust loads. Thrust or radial loads, separately or acting together, are claimed to be taken care of by this bearing at any speed with equal facility.

These bearings have been used with good results in grinding machine spindles, and have also been employed in woodworking machines where high speeds are necessary. As an evidence of durability, it is stated that bearings of this design have been in use in a wood carving machine spindle running at 8000 R.P.M. for over twenty months of continuous use, ten hours a day. These bearings are said to be still as good as new from an operative standpoint.

PNEUMATIC CHIP SEPARATOR


Pneumatic Chip Separator made by the Ideal Concrete Machinery Co.

The pneumatic chip separator shown in the accompanying illustration is made by the Ideal Concrete Machinery Co., Colerain Ave., Cincinnati, Ohio, for use in separating chips from screw machine products and work of a similar nature. It is claimed that by the use of this machine one operator can handle as much work as three men using riddles, or as much as six men picking by hand.

The work and chips are placed in the hopper of the separator as they come from the machines. The hopper and the inclined slide which is attached to it, have a compound vibratory motion. When the gate at the front of the hopper is opened, the vibratory motion causes the work and chips to slide down over the inclined slide. A properly located opening in the slide permits the work to drop into a tote box or pan, while the chips are passed over the opening by means of an air draft from the fan so that they fall off the end of the slide.

The distinctive feature in the operation of this machine is as follows: The compound vibratory motion which spreads out the work and chips as they come down the slide permits a light air draft from the fan to float the chips over an opening in the slide through which the work drops; this method of separating the chips requires a much lighter air draft than would be needed if the chips were blown up into the air, and at the same time effects a satisfactory separation of chips from small as well as large work. In addition, the work does not at any time pass through enclosed passages, a feature which renders it practically impossible to clog the machine by overloading.

The frame of the machine is constructed of angle iron, hot-riveted, and reinforced at the corners with heavy gusset plates. The bearings are lubricated by grease cups and sight-feed oil-cups.

GARDNER NO. 24 CONTINUOUS-FEED DISK GRINDER

The latest development of the Gardner Machine Co., 414 Gardner St., Beloit, Wis., is a continuous-feed disk grinder which is semi-automatic in operation, and designed to eliminate the unusual amount of labor expended in operating hand-operated disk grinders. Perhaps the most important feature of this machine is the constant production which is obtained from it. With any hand-operated machine, where the human element is the main factor in production, a uniform output all through the day cannot be obtained.

The machine carries one horizontal disk wheel 53 inches in diameter, and is provided with a revolving reel which carries four work-tables, as shown in Fig. 1. The work to be ground is attached to these tables by means of suitable fixtures mounted on them, and the revolving reel brings it over the surface of the grinding wheel. The tables are automatically lowered on the wheel. Pressure to insure quick removal of stock is secured through gravity, but by means of a compression spring this pressure may be adjusted. The weight of the table insures application of uniform pressure, which can be increased by adding extra weight if the character of the work necessitates it. A micrometer stop screw makes it possible to remove stock to definite dimensions.

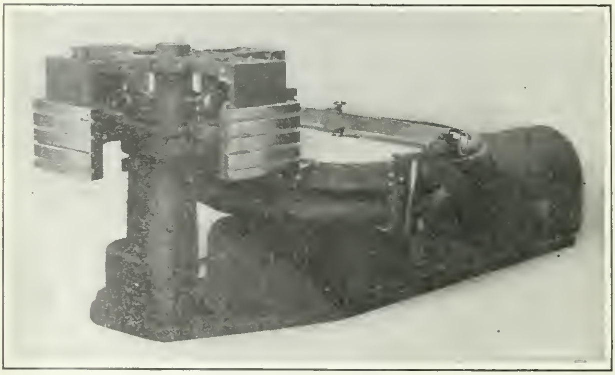


Fig. 1. Front View of Gardner No. 24 Continuous-feed Disk Grinder

Due to the construction just described, the operator simply places the work in the fixture and removes it when finished. (See Fig. 2.) The revolving reel is mounted on a vertical shaft 3½ inches in diameter, and is driven through worm, spur, and bevel gears from the gear driving the main spindle of the machine. By means of change-gears, the reel may be made to revolve ¼, ½ or 1 revolution per minute, thereby producing 1, 2, or 4 finished pieces per minute. Other speeds may be obtained by substituting special gears.

The driving shaft is provided with a friction clutch which is operated by a lever placed in a convenient position, which makes it possible to start or stop the feeding mechan-

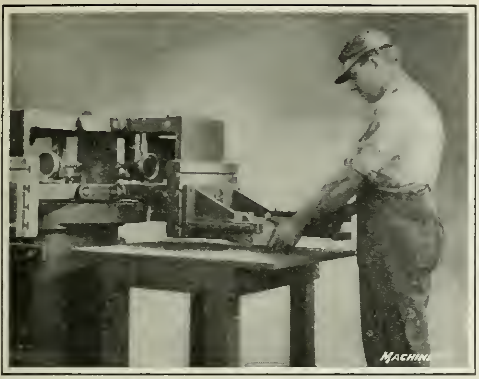


Fig. 2. Operator loads Machine by placing Work in Suitable Fixture carried on Work-table

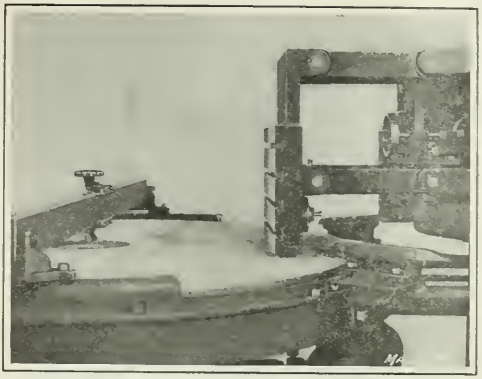


Fig. 3. Detail View of Table which is at Right Angles to Grinding Wheel, thus insuring Accurate Grinding

ism independently of the grinding wheel. The reel and the shaft which drives it are mounted in bronze bearings; all other shafts are carried in ball bearings. The gears are totally enclosed, which protects them from dust and dirt and allows them to be amply lubricated. The feeding stand is bolted directly to the baseplate upon which the machine is mounted, and to accommodate various sizes of work, has an adjustment of 6 inches along this baseplate. Because the work-tables are at right angles to the grinding wheel, accuracy of the work being ground is assured. (See Fig. 3.)

Rigidity and strength are important features of this machine. It weighs about 7600 pounds when crated for domestic shipment. The disk wheel is mounted on an extra large and heavy cast-iron flange. The driving spindle is of large diameter and runs in two self-aligning radial ball bearings. All down or end thrust is taken on a self-aligning ball thrust bearing which contains ten 1¼-inch diameter balls. Power is transmitted to the disk wheel by hardened special steel bevel gears. The ratio between the driving shaft gear and the spindle pinion is 2.4 to 1. These gears are also fully enclosed within the base of the machine, and provision is made for ample lubrication. They are completely protected from any grit or dust.

An extra pulley is mounted on the driving shaft for belting to an exhaust fan, which is set on the floor in back of machine. There is a dust channel cast into the base of the machine extending entirely around and underneath the outer edge of the disk wheel. When the guard ring is removed this channel is uncovered all the way around so that the grindings which might interfere with effective exhausting may be removed readily. A dust exhaust manifold is fastened into the bottom of this dust channel in four places and connected to an extra large exhauster, reducing the dust problem to a minimum. The cast-iron guard ring is fastened to the top of the base with collar head screws. Any portion of the guard ring is removable, permitting the grinding of work carrying a lug projecting above the plane of the ground surface.

This machine is adapted to a large variety of flat surface operations, such as crankcases; cylinder heads for automobiles, pumps and engines; transmission cases, valve chests, bearing boxes, steam chests and steam chest caps, pipe flanges, bearing caps; gear-cases, boxes and covers; hoisting machinery parts, stove parts, furnace parts, scale parts, etc.

RICKERT-SHAFER COLLAPSIBLE TAP

The Rickert-Shafer Co., 612 W. 12th St., Erie, Pa., has added to its line of threading machines and tools a new collapsible tap, which is shown in Fig. 1. The original and outstanding feature claimed for this tool is the method of withdrawing the chasers when the work is tapped to the required depth. The manufacturers claim that the tap is "positive acting" and cannot stick. This is a decided advantage in all cases of tapping, but will be found especially useful where work has to be tapped close to the bottom of the hole, as the chasers will be released at exactly the right point.

At the point of release the force of the cut pulls the head from the locking pins and revolves it. (See Fig. 2.) This action causes the cams on the core to act and pull the core back, drawing the chasers into the head and clearing them from the work. No dependence is placed upon springs for the purpose of collapsing. The method of making adjustments allows adjustments to be made to thousandths of an inch.

The Rickert-Shafer Co. guarantees that these taps will hold to size within the most exacting limits, and that sizing hand taps can absolutely be dispensed with when this collapsing tap is used. These taps have hardened and ground wearing parts, accurate chasers, and are chip-proof. They are manufactured in sizes from 1 to 10 inches, or larger, and can also be specially combined with boring, reaming, or chamfering tools, thus greatly increasing production by eliminating additional operations and set-ups.

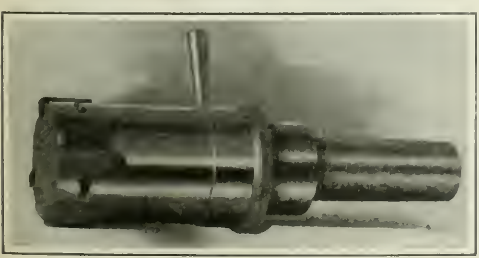


Fig. 1. Rickert-Shafer Collapsible Tap

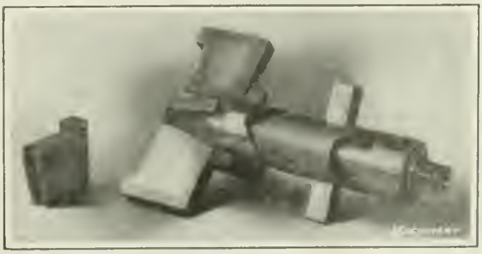
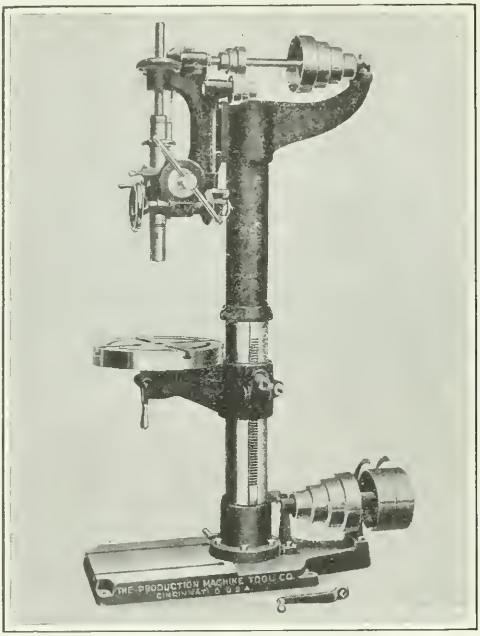


Fig. 2. Detail View of Rickert-Shafer Tap



Upright 22-inch Drilling Machine manufactured by the Production Machine Tool Co.

PRODUCTION DRILLING MACHINE

The twenty-two inch upright drilling machine illustrated herewith is now being manufactured by the Production Machine Tool Co., 629 E. Pearl St., Cincinnati, Ohio. This machine has a stationary head, power or hand feed, and a capacity for drilling, boring, and tapping holes up to and including 1¼ inches in diameter. All bearings are provided with bronze bushings. The base is of ample proportion and provided with T-slots. The column is of a tubular cross-section; it extends through the table arm and into the lower end of the over-arm, which is firmly bolted to it. The table arm is a casting of box construction and may be clamped in any position along the portion of the column on which it slides. It is also provided with a clamp for securing the table to it in any desired radial position.

As the table elevating worm and the table arm clamp are both on the right-hand side of the machine, the operator does not have to walk around the machine in order to lock the arm in place after the table has been set to the desired height. The over-arm provides sufficiently rigid support for mounting the motor on it when a direct motor drive is furnished with the machine. The over-arm is bored and fitted to the column. The head casting is also of box construction, and has the two spindle bearings cast integral, thus permitting both bearings to be bored and reamed at one setting and insuring an accurate alignment of the spindle.

The machine illustrated is driven from a countershaft, but if preferable, the machine may be driven by a geared or belted motor drive. The spindle is provided with a ball bearing to take care of thrust. Four spindle speeds are obtainable on the plain machine while four additional speeds are secured when back-gears are provided. The back-gears are of the sliding type; they are engaged by means of a positive clutch, and only revolve while being used. All gears and worms are covered with guards.

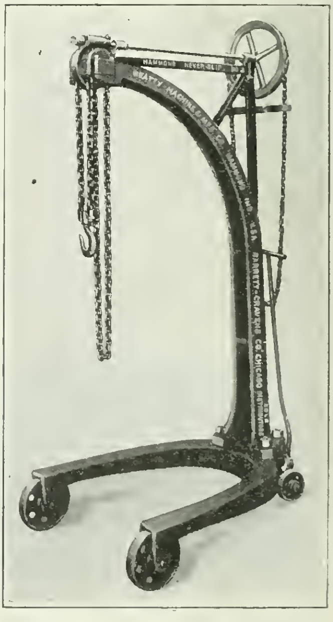
A trip is provided for automatically throwing out the power feed; and a positive clutch is used to disengage power-feed members when it is desired to use the hand feed. The spindle is counterbalanced by a weight enclosed in the column. The spindle sleeve is graduated a length of ten inches in sixteenths of an inch, permitting the automatic stop-collar to be set to throw out the power feed when the spindle has been lowered the desired depth.

Some of the principal dimensions of the machine are as follows: Distance from center of spindle to edge of column, 11 inches; minimum distance from spindle to base, 35 inches—maximum distance, 45 inches; minimum distance from spindle to table 9¾ inches—maximum distance, 25¾ inches. The spindle speeds obtainable with the back-gears in are 20, 33, 53, and 88 revolutions per minute; and with the back-gears out, 117, 196, 318, and 530 revolutions per minute. The power feeds per revolution of the spindle are 0.006, 0.010, and 0.015 inch per minute.

HAMMOND "NEVER-SLIP" PORTABLE CRANE

The Barrett-Cravens Co., 171 N. Ann St., Chicago, Ill., has recently brought out the Hammond "Never Slip" portable floor crane shown in the accompanying illustration. This crane is said to be the only machine of its kind on the market equipped with the worm and gear type of hoist. With this type of hoist the load can be raised to exactly the desired height, even to within a fraction of an inch. The load is automatically locked at all points of its travel, thereby assuring safety even when the hoist is used by a careless operator.

All-steel construction is employed, as experience has proved that iron castings will not stand up under the exceptionally heavy service required of a portable floor crane. The crane base and column are steel castings, and the hoisting device rests on the column arm. The wheels on which the crane is mounted are provided with chilled treads to insure good wearing qualities, while their webs are left soft to give strength. Hyatt roller bearings are used in all wheels so that heavy loads may be pulled easily. The hoisting mechanism consists of a worm-gear constructed of bronze, a screw cut from solid steel shafting, a steel sprocket designed with a wide factor of safety over the rated capacity, and an electrically welded chain intended to give the greatest strength with the least possible weight. The screw and worm are enclosed in an oil-tight housing to permit proper lubrication.



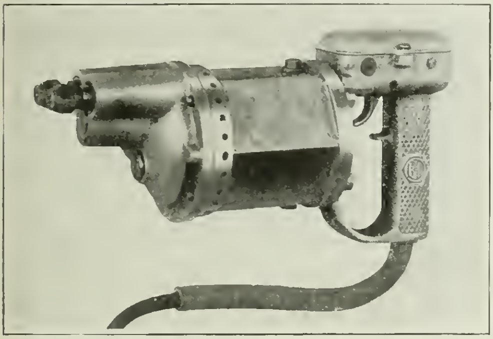
Hammond Portable Floor Crane

These cranes are made in six sizes. The smallest or No. 1 size has a lifting capacity of 2000 pounds; a total height of 6 feet; a lift of 4 feet 10 inches; an outside width of bed of 3 feet 6 inches; and an inside width of bed of 2 feet. The length of the bed is 3 feet, and the height 8 inches. The weight is 575 pounds. The largest or No. 6 size has a lifting capacity of 7000 pounds; a total height of 10 feet 8 inches; a lift of 8 feet 6 inches;

an overhang of 3 feet 8 inches; an outside width of bed of 4 feet 3 inches; and an inside width of bed of 3 feet 6 inches. The length of the bed is 4 feet 10 inches, and the height 12 inches. The total weight is 1400 pounds.

BLACK & DECKER TWO-SPINDLE DRILL

The Black & Decker Mfg. Co., of Towson Heights, Baltimore, Md., has recently designed a two-spindle drill. This particular design is specifically adapted for drilling holes for the Murphy top fastener, which is used for attaching automobile side curtains. When the base of the fastener is put on the automobile body, two holes ⅞ inch apart must be drilled, and this two-spindle drill drills the two holes the correct distance apart in the same operation.

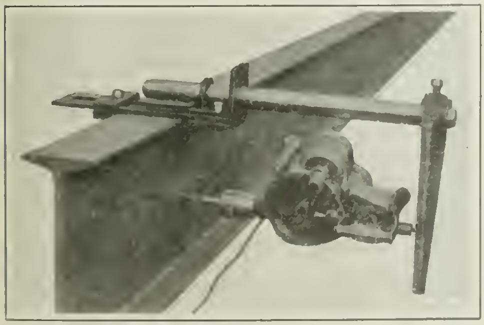


Black & Decker Two-spindle Drill

The handle of the drill is like that of an automatic pistol, and a pull on the trigger sets the two drill spindles in motion. A second pull stops the spindles, so that the operator can control the tool without changing the position of either hand. The gears for driving the two spindles are of steel, heat-treated. The two spindles have specially designed chucks.

CANTON DRILL CLAMP

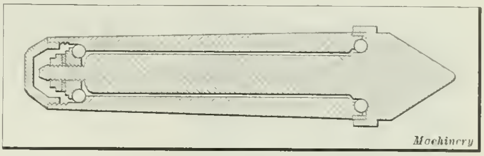
The Canton drill clamp and support shown in the accompanying illustration is made by the Poyser-Bucher Co., Canton, Ohio. This clamp is intended for use in drilling operations such as are generally performed on I-beams by the use of a "gooseneck" support or "old man." It is claimed that this new support enables the workman to drill sixteen holes in the time required for drilling one hole with the "old man" or "gooseneck" support. Referring to the illustration, it will be evident that with but one adjustment, any number of holes can be drilled in the top, bottom, or web of an I-beam.



Canton Drill Clamp and Support made by the Poyser-Bucher Co., Canton, Ohio

SNELLEX FRICTIONLESS CENTER

The center brought out by the Snellex Mfg. Co., Rochester, N. Y., is so constructed that the live center turns with the work on ball bearings. The arrangement of the bearings and general construction of the center is clearly shown by the accompanying sectional view. This center is designed to eliminate friction between the work and the center, to make it unnecessary to regrind centers, and to prevent worn or burned center holes in work. At the rear end of the center there is an adjustable cone for the bearings, together with a lock washer and check-nut, and the end is sealed by an oil-cap. The ball races are at an angle of 45 degrees, and it is claimed that as the result of a "spiral motion" the balls are kept round and uniform in size, thus insuring permanent accuracy of the center. These centers are made in four sizes, varying from No. 1 to No. 4 Morse taper.



Sectional View of Snellex Center

BADGER VERTICAL-SPINDLE DISK GRINDER

A vertical-spindle disk grinder known as the No. 142 has recently been added to the line of equipment manufactured by the Badger Tool Co., Beloit, Wis. The grinding wheel provided on this machine is a disk 42 inches in diameter which revolves in a horizontal plane at the speed of 600 revolutions per minute. The work to be ground is placed on top of the disk, suitable cross-bars or stops being furnished to prevent the work from rotating with the wheel. The weight of the work itself, or auxiliary weights provided, exerts sufficient pressure against the disk to cause the work to be ground.

Badger No. 142 Motor-driven Disk Grinder

A dust channel completely surrounds the outside of the wheel, this channel being accessible by removing the top guard ring. The grinder is driven by a fifteen-horsepower vertical motor provided with forced ventilation and being arranged for effective lubrication and dust exhaust. The spindle is mounted in radial and thrust ball bearings. The thrust bearing is placed adjacent to the wheel collar, the latter being 11 inches in diameter and 1½ inches thick.

This disk grinder is only built in the motor-driven type; this construction requires small floor space and permits the machine to be operated from any position, there being no obstructions to interfere with a man working at any point around its periphery. The complete equipment includes a 42-inch diameter steel disk wheel, dust exhaust system, improved type of wheel press, oil compensator, and an assortment of abrasive disks and other supplies. The total weight of the machine is 3000 pounds.

NEW MACHINERY AND TOOLS NOTES

Riveter: Baird Pneumatic Tool Co., Kansas City, Mo. The Baird "Close-corner" riveter intended for use in close corners where riveting by a hand hammer is impossible. A pressure of 50 tons is exerted on the dies, and 5/16-inch rivets can be driven cold.

Truck Body: Karry-Lode Industrial Truck Co., Inc., 98-100 Nott Ave., Long Island City, N. Y. An all-steel dumping body having a capacity of 40 cubic feet, designed for use on the trucks of this company's manufacture. The body is dumped over the end of the truck, and is especially adapted for handling coal.

Transveyor Truck: Cowan Truck Co., 16 Water St., Holyoke, Mass. Improvements on the Cowan Type G transveyors, which enable them to be used as trailers behind electric storage battery trucks, either singly or in trains. With this arrangement a train of ten trucks can be turned in a circle on a twenty foot roadway.

Riveter: Baird Pneumatic Tool Co., Kansas City, Mo. A riveter designed for riveting ash cans, which is mounted on a stand and provided with a foot-operated controlling valve, leaving the workman's hands free for holding and locating the work. A pressure of 35 tons is exerted on the dies with an air pressure of 100 pounds per square inch.

Staybolt Chuck: Tom Brown & Co., 800 Great Northern Bldg., Chicago, Ill. The "Perfection" reversible staybolt chuck manufactured by the Lovejoy Tool Works. This chuck grips either threaded or blank round staybolts, and thus eliminates the necessity for squaring the ends. It is made in three sizes, to fit bolts from ¾ to 1½ inches.

Friction Clutch: A. Mill Clutch Co., 2116-2120 Colerain Ave., Cincinnai, Ohio. A clutch known as the Mill duplex friction clutch, designed to facilitate smooth engagement or disengagement at high speeds. Friction contact is made first by an expansion ring and then by side plates. The friction members are enclosed in a dustproof case.

Counterbores and Spot-facers: Dayton Machine Products Co., Dayton, Ohio. "Duplex" interchangeable counterbores and spot-facers, consisting of four parts—holder, cutter, collet, and locking screw. Cutters from ⅝ to 3 inches in diameter can be furnished. Morse taper shanks Nos. 1 to 6 are standard, but straight-shank holders can also be supplied.

Furnace: Industrial Electric Furnace Co., 53 W. Jackson Blvd., Chicago, Ill. An electric melting and refining furnace operated directly on a 220-volt motor circuit without transformers. The builders claim that this furnace can be used by an operator having practically no electrical knowledge. It is built with capacities of from 300 pounds to 1½ tons per heat.

Platform Truck: Terminal Engineering Co., Inc., 17 W. 44th St., New York City. An industrial platform truck having a rated capacity of 5000 pounds, a rated speed of from ½ to 10 miles per hour light, and of ½ to 7 miles per hour under full load. The driving and elevating motors are 60-volt, series-wound. A motor is provided for each wheel, making the drive of the four-wheel type.

Trip for Power Press: Tom Brown & Co., 800 Great Northern Bldg., Chicago, Ill. The "Perfection" pneumatic trip for power presses made by the Lovejoy Tool Works. This device is attached to the side of the machine and can be operated by pulling a cord, thus permitting the workman to operate the trip when balancing a plate in the press of such size that the hand trip is beyond his reach.

Reamer-holder: Scully-Jones & Co., 647 Railway Exchange Bldg., Chicago, Ill. A floating reamer-holder, designed for holding reamers in turret lathes, and for similar work where it is important that the reamer be permitted to float freely in its axis of rotation. These holders are furnished with a shank to fit any size of turret lathe or with any size of taper shank to fit drilling machine or lathe spindles.

Babbitting Fixture: O. A. Bremer Co., 222 Division St., Burlington, Iowa. A babbitting fixture intended for garage repair work, which has a capacity for rebabbitting connecting-rods up to 12 inches in length and of any bore from ½ to 2½ inches. A special fixture is also made for rebabbitting Ford connecting-rods. It is claimed that very little scraping is required to obtain a perfect fit when these fixtures are employed.

Electric Motor: Hobart Bros. Co., Troy, Ohio. A line of electric motors ranging from 1 to 10 horsepower. The motors have ball bearings and are furnished with base tracks and pulleys. All motors have a speed of 1800 revolutions per minute. The alternating-current motors can be furnished in either two or three phase and practically any cycle and voltage, and the direct-current motors can be furnished in any voltage.

Press: Toledo Machine & Tool Co., Toledo, Ohio. A straight-column inclinable press known as the No. 54 "Special," having direct motor drive, with the motor so mounted that it is always in a vertical position and the pinion always in mesh. The bed is 23 by 24 inches; the opening in the bed 12 by 12 inches; the distance between housings 24 inches; and the stroke, 2 inches. The weight is 6500 pounds.

Engraving-cutter Grinding Machine: George Gorton Machine Co., Racine, Wis. A machine for grinding the cutters used on engraving machines of this company's manufacture. The abrasive wheel is driven direct by a motor incorporated in the machine. An indexing sleeve and graduated base enable the tool to be held in identically the same way as it is held in the engraving machine, or at any desired angle while grinding.

Rivet-cutting Tool: Keller Pneumatic Tool Co., Grand Haven, Mich. An air-operated tool designed for cutting off and backing out steel rivets, which is known as the Keller "Iron Mule rivet-buster." The length of the tool over all is 67 inches, and its operating weight is 82 pounds. Three men are needed to operate the tool to the best advantage. Rivet heads ⅞ and 1 inch in diameter can be cut off in from four to six blows.

Cutting Torch: Torchweld Equipment Co., Fulton and Carpenter Sts., Chicago, Ill. A Style 15 MC gas cutting torch, designed to use oxy-acetylene, oxy-hydrogen, or oxy-hydrocarbon gases, when equipped with special tips. The standard torch-head angle is 85 degrees but 70-, 50-, and 35-degree as well as straight heads can be furnished when desired. A special device is employed to blow out back-fires and eliminate the hazard of flash-backs.

Soldering Iron: Made by Peterson-Plummer Mfg. Co. and sold through Belfrey & Craighead, Tribune Bldg., Chicago, Ill. A light-weight soldering iron known as the "Ever-hot," having the gasoline reservoir contained in the handle. The pump unit is placed at the end of the handle, and is easily removed for refilling. The one-piece burner is arranged to preheat the gas, and its design permits the iron to be used in any position in extremely cold weather and high winds.

Grinding Machine: Wisconsin Electric Co., 2529 16th St., Racine, Wis. An electric grinding machine known as the "Dumore No. 3 Multi-speed," which is suitable for both production and tool-room work. A set of interchangeable spindles adapts the machine for both internal and external grinding operations. The ¼-horsepower universal motor is furnished for either alternating or direct current. Seven spindle speeds ranging from 3600 to 50,000 revolutions per minute are available.

Milling Machine: American Milling Machine Co., Cincinnati, Ohio. Improvements on the No. 1½ plain and universal milling machines of this company's manufacture, including a four-step cone pulley the largest diameter of which is 11 inches, and the smallest, 7⅝ inches; sixteen feeds ranging from 0.005 to 0.212 inch; and a two-speed countershaft giving 107 and 265 revolutions per minute. The columns of these machines are drilled and tapped for the swiveling vertical milling attachment made by this company.

Screwdriver for Portable Drill: Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. A screwdriver attachment made in three styles to fit the different types of portable motors of this company's manufacture. The No. 1 attachment is designed for the "Thor" turbine air drill, and has a capacity for handling No. 12 wood-screws 1¾ inches long. The No. 2 attachment is an extension type, for use on electric drills, while the No. 3 is of the short type and can be used on the No. 00 "Thor" electric drill.

Air-line Moisture Separator: Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. The "Thor" separator for separating moisture and dirt from compressed air. On entering the separator the air strikes the cylindrical walls tangentially, causing it to revolve rapidly, so that the centrifugal force throws the entrained moisture and dirt to the walls where they descend to the bottom of the tank, while the clean air passes on to the pipe line. The separator is built in two sizes having capacities of 150 and 400 cubic feet per minute.

Grinding Wheel Dresser: Commercial Welding & Machine Co., Worcester, Mass. Three styles of grinding wheel dressers using conical cutters. Two styles are made in 2- and 2½- inch sizes with a standard length of 6 inches, one being provided with a double ball bearing at the front end and a ball radial and thrust bearing at the rear, and the other with roller bearings and a ball thrust bearing. A third type has a spindle that runs in soft bushings, and is designed to carry a ⅞-inch conical cutter suitable for dressing small cup and cylinder wheels.

Portable Grinder: Roto Pneumatic Co., 4700 Train Ave., Cleveland, Ohio. A portable rotary pneumatic grinder having only three moving parts, consisting of the pistons, which are rigidly mounted on a straight shaft (thus constituting a single rotating member) and two self-sealing sliding valves. From 15 to 20 cubic feet of air per minute under a pressure of 80 pounds per square inch entering the machine through the control handle is required to operate the grinder. The machine weighs 40 pounds, and swings either a 6-inch or an 8-inch wheel.

Motor Starter: Cutler-Hammer Mfg. Co., 12th and St. Paul Aves., Milwaukee, Wis. The time-limit automatic starters of this company's manufacture have been redesigned to include both larger and smaller sizes. An air dashpot can now be supplied in place of the oil dashpot when desired. After once being set, the starter will cut out the resister in the required length of time, when controlled from any remote point by a single pole knife switch, a vacuum regulator float switch, or by a three-wire push-button control. The new starters are made in capacities of from ¼ to 10 horsepower at 115 volts, and up to 25 horsepower at 230 and 500 volts.

Hydraulic Presses: Southwark Foundry & Machine Co., 430 Washington Ave., Philadelphia, Pa. Three types of hydraulic presses. A 20-ton hydraulic broaching press having a clearance between the columns of 20 inches, a speed of from 15 to 20 working strokes per minute, and an accumulator designed to operate at a pressure of 1500 pounds per square inch. A 200-ton hydraulic bushing press, especially intended for use in railroad shops, and having a ram 12 inches in diameter operated at a hydraulic pressure of 3500 pounds per square inch. This press has a clear distance between columns of 32¾ inches, and an 8-inch slot is provided in the intermediate platen to accommodate piston-rods. A 200-ton hydraulic upsetting press adaptable to general upsetting work but especially suitable for upsetting the flanges on automobile crankshafts. This press has a vertical ram which carries a die that can be moved down to surround the heated work located on the anvil, and a horizontal ram which can then be run forward to upset the work.

* * *

FIGHTING TUBERCULOSIS IN THE INDUSTRIES

It is stated on the authority of the National Tuberculosis Association that out of every one hundred people employed in the average factory and manufacturing plant, two have tuberculosis in some form or other. It has been pointed out that the loss to the industries due to neglect in preventing the spread of this disease is very large. Just as the industries have taken steps to prevent accidents in their shops, not only from a humanitarian motive, but also as a means of increasing industrial efficiency, so the industries should take steps to control tuberculosis by careful medical supervision.

The prevention of tuberculosis in industry requires these steps: First, a medical examination of every applicant; second, periodic medical examination of all employes, and special examination of those who are found to be ailing in any respect; third, medical supervision and care for every employe that needs any attention; fourth, education of employes on the control of preventable diseases and their personal responsibility to the problem. If these things are done, any employer can aid in stopping waste in industry. That it pays to do this is evidenced, for example, by the work done by such concerns as the International Harvester Co., the National Cash Register Co., and many others. Tuberculosis can be reduced to a practical minimum in industry, and the saving in dollars and cents will pay the largest possible dividends on the money expended in this work. The National Tuberculosis Association, 381 Fourth Ave., New York City, and its allied agencies stand ready to help any employer in solving the problem of tuberculosis in industry.

E. P. BULLARD, JR., AWARDED FRANKLIN INSTITUTE MEDAL

The Howard N. Potts medal, which is awarded for distinguished work in science and mechanical arts by the Franklin Institute, was presented, October 20, to E. P. Bullard, Jr., president of the Bullard Machine Tool Co., Bridgeport, Conn., for his work in connection with the development of automatic machinery in the metal-cutting field. As is well known, the Bullard mult-au-matic is used with great success in the automobile and allied industries, where rapid production of duplicate parts made in great quantities becomes of first importance. The installation of more than 100 Bullard mult-au-matics at the Ford plant in Detroit was described in the December, 1919, number of MACHINERY, together with a review of the work done on the machines.

The mult-au-matic machine marked a new departure in the development of automatic machinery, and it is in recognition of the pioneer work in this field done by Mr. Bullard that the Franklin Institute has accorded to him a fitting tribute. In view of the important part that machine tools in general and automatic metal-working machinery in particular play in our whole industrial development, it is gratifying that a man in this field is receiving so well deserved a tribute.

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INDUSTRIAL COST ASSOCIATION

The Industrial Cost Association is an organization composed of industrial executives who use cost information and who control the cost policies of corporations, firms, and trade associations. The association is working toward the improvement of cost accounting in industry. The object is to standardize the governing principles and the terminology of costs as applied to industrial undertakings. A committee for uniformity of accounting will be appointed to assist committees of trade associations in standardizing cost methods. It is planned to organize sections in various localities where there are members of the association. M. F. Simmons of the General Electric Co., Schenectady, N. Y., is president, and A. A. Alles, Jr., Fawcus Machine Co., Pittsburg, Pa., is secretary of the association.

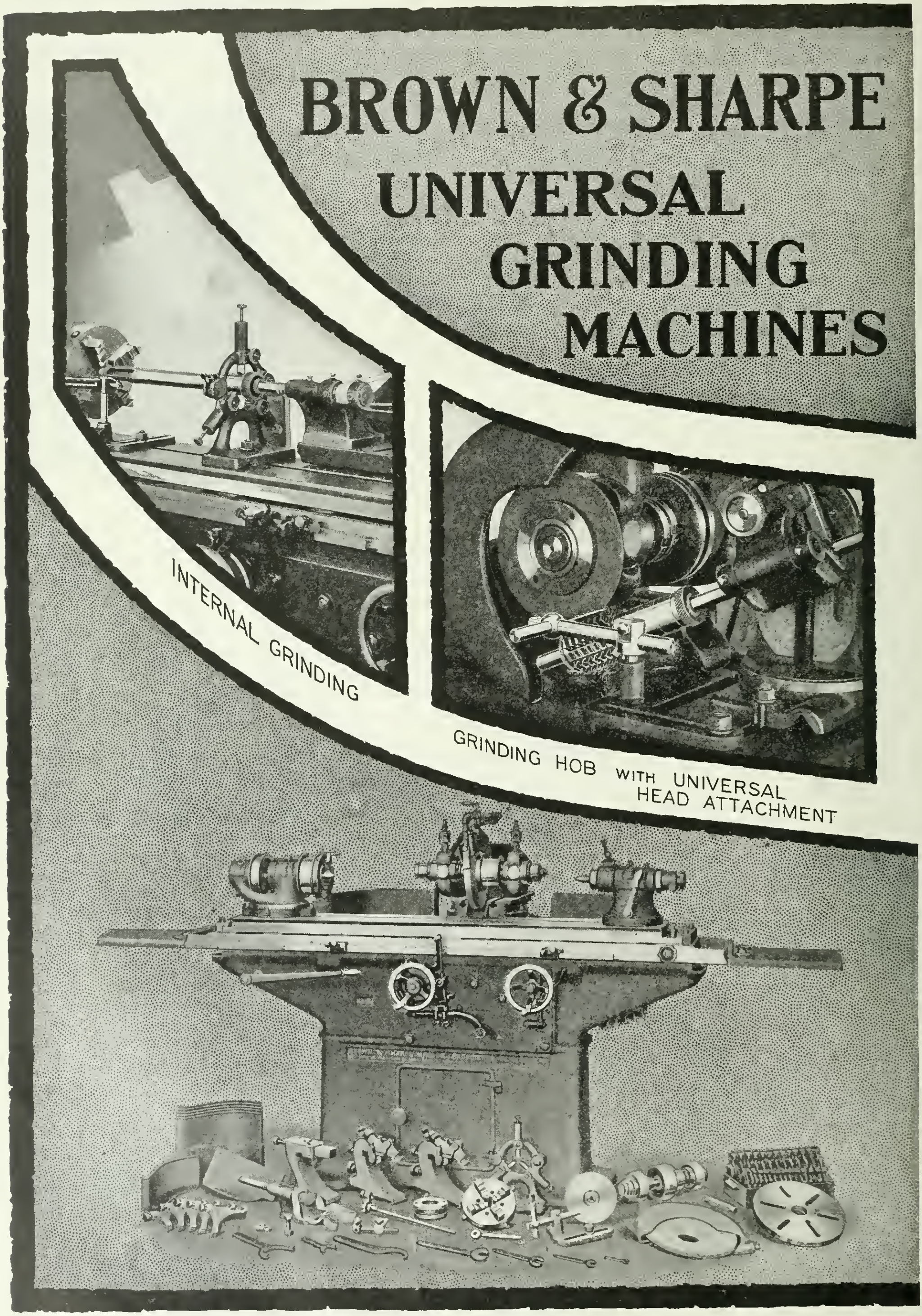
* * *

MANUFACTURER OF COLLAPSIBLE TAP

We have been informed that the collapsible tap described in the article on "Shop Practice in an Axle Plant," beginning on page 166 of the October number of MACHINERY and shown in the illustration Fig. 1, as well as the boring and reaming tools mentioned, were especially designed for the Timken-Detroit Axle Co. by the Murchey Machine & Tool Co., Detroit, Mich.

* * *

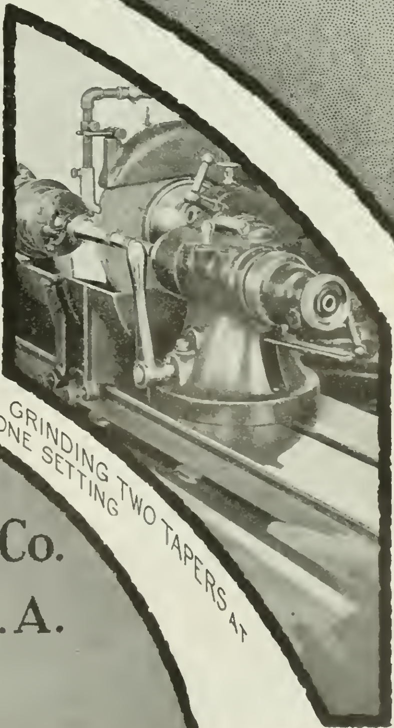
Statistics show that about 13 per cent more pig iron was produced in the first half of this year than in the corresponding period of 1919. The production this year was about 18,100,000 tons, whereas in 1919 it was 16,300,000 tons. The production of malleable pig iron showed an increase of 13 per cent.


BROWN & SHARPE
UNIVERSAL
GRINDING
MACHINES
INTERNAL GRINDING
GRINDING HOB WITH UNIVERSAL HEAD ATTACHMENT

BROWN & SHARPE Universal Grinding Machines are truly versatile. They are easily adapted to the most diverse set-ups in the wide range of work allotted to a Universal Grinding Machine.

The wide range—shown in four instances by the illustrations below, is adequately taken care of by Brown & Sharpe Universal Grinding Machines. Daily they turn out work in thousands of different shapes and dimensions with an accuracy and speed that meet requirements the world over.

ADAPTION TO DISC GRINDING



GRINDING TWO TAPERS AT ONE SETTING

Brown & Sharpe Mfg., Co.
Providence, R.I., U.S.A.

PERSONALS

C. C. Gray, formerly with the Farrar Advertising Co., has become manager of sales for Pannier Bros. Stamp Co., Pittsburg, Pa.

F. Rodger Imhoff, who has been located permanently in Detroit as field engineer for the Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., has been appointed sales manager.

G. J. Keller, formerly district manager of the Buffalo office of the Knox-Anderson Tool Co., has become sales manager for the Frontier Chuck & Tool Co., Inc., 30 Letchworth St., Buffalo, N. Y.

Edward Grossman, who was recently appointed sales manager of the T. P. Walls Tool & Supply Co., Inc., 25 Leonard St., New York City, has been made treasurer and manager of the company.

A. J. Baker, formerly chief engineer of the Cincinnati Milling Machine Co., who recently became research engineer of the Willys-Overland Co., Toledo, Ohio, sailed for England on October 16, for a three-months' trip.

Fred E. Kelly, for four years sales engineer for M. Jaeger, dealer in small tools, Engineers Bldg., Cleveland, Ohio, has entered the employ of the Cowles Tool Co., Cleveland, for whom he will act as sales representative.

W. B. Currier, Jr., has been appointed general manager of the Cleveland Planer Co., and of the Cleveland Machine Tool Co., Cleveland, Ohio, succeeding D. B. Clark who will now devote his entire time to the Clark-Mesker Co., of Cleveland.

J. G. Moohl, formerly chief engineer of the Cleveland Machine Tool Co., Cleveland, Ohio, has been appointed sales manager of that company, and also of the Cleveland Planer Co. He will have charge of the engineering and sales departments of both companies.

A. A. Loeffler has recently been appointed Detroit representative of the Doehler Die-Casting Co., Court, Ninth, and Huntington Sts., Brooklyn, N. Y., succeeding F. C. Seeger who will represent the company on the Pacific coast, with headquarters in San Francisco.

T. J. Davis, formerly representing the Union Twist Drill Co. of Athol, Mass., in Michigan, Illinois, Indiana, Wisconsin, and Minnesota, has become connected with the W. L. Romaine Machinery Co., Milwaukee, Wis., as manager of the tool and equipment department.

Brent A. Tozzer, formerly in charge of the Cleveland office of the Niles-Bement-Pond Co., has sailed from San Francisco for a one-year's business trip in the interest of the Niles-Bement-Pond Co., during which trip he will visit India, China, Japan, and other Far Eastern countries.

Edward Casey has joined the Duff Mfg. Co., Pittsburg, Pa., manufacturer of all types of lifting jacks, as sales representative of the forge department in the east, with offices at 50 Church St., New York City. Mr. Casey was formerly associated with Kraenter & Co., and the Bethlehem Steel Co.

R. G. Berrington, for fifteen years with the Cleveland Twist Drill Co. and prior to that with the Strong, Carlisle & Hammond Co. of Cleveland, is now Cleveland sales manager for the Reed-Prentice Co., Becker Milling Machine Co. and Whitcomb-Blaisdell Machine Tool Co., with office and stock warehouse at 408 Frankfort Ave., Cleveland.

George B. Hodges has been appointed manager of the industrial and production department of the McVicker Engineering Co., 716 Metropolitan Life Building, Minneapolis, Minn. Mr. Hodges has been identified with production and industrial work on tractors, plows, and power farming machinery for the last eighteen years.

W. E. Seymour, for six years works manager of Fairbanks, Morse & Co., Beloit, Wis., and recently vice-president and general manager of the A. O. Smith Corporation, Milwaukee, Wis., has organized the W. E. Seymour Mfg. Corporation in Milwaukee, to manufacture piston rings and motor parts. Mr. Seymour will serve as president of the company.

George B. Morris has opened offices at 803 Security Bldg., Los Angeles, Cal., specializing in the selling of hoisting and conveying machinery on the Pacific Coast. Mr. Morris has the exclusive representation in California for the Shepard Electric Crane & Hoist Co. of Montour Falls, N. Y., and is looking for other non-competing products in the material-moving lines.

H. M. Houston, who was recently connected with the Houston, Stanwood & Gamble Co., has taken up executive duties as an active member of the William K. Stamets Co., Pittsburg, Pa., manufacturer of machine tools. Mr. Houston has been in close touch with the Samets organization for a number of years, and is therefore somewhat familiar with his new duties.

Thomas J. Moore, for ten years resident sales manager of the Halcomb Steel Co., Philadelphia, Pa., has organized a new company known as the Rupp Moore Co., Inc., at 1418 Walnut St., Philadelphia. The company will do business in tool and alloy steel; crucible, electric, and open-hearth bars; and billets and forgings. Mr. Moore is president of the new company and Robert Rupp is secretary and treasurer.

E. W. Bernhard has been placed in charge of manufacturing in the plants of the L. H. Gilmer Co., manufacturer of solid woven belting and automotive products, the home offices of which are in Tacoma, Philadelphia, Pa. Mr. Bernhard was connected with the S. K. F. Industries Co., for seven years, serving as assistant general factory manager of the organizations under S. K. F. control. He will have charge of the two Gilmer plants in Philadelphia, and the plant in North Wales, Pa., and the mill at Millen, Ga.

R. A. Bull, formerly vice-president of the Duquesne Steel Foundry Co., Pittsburg, Pa., has been appointed consulting metallurgist for a number of prominent steel foundries which have been grouped for the purpose of developing and perfecting higher standards in the production of steel castings. Among this group of foundries are the following: Electric Steel Co., Chicago, Ill.; Fort Pitt Steel Castings Co., McKeesport, Pa.; Isaac G. Johnson Co., Spuyten Duyvel, N. Y.; Lebanon Steel Foundry Co., Philadelphia, Pa.; Michigan Steel Castings Co., Detroit, Mich.; and Sivyer Steel Castings Co., Milwaukee, Wis. Mr. Bull will devote his entire time to preliminary research work.

* * *

CHANGE IN DATE OF NATIONAL MACHINE TOOL BUILDERS' CONVENTION

Announcement has been made of a change in date of the National Machine Tool Builders' convention to be held in New York City. The convention will be held on November 11-12, instead of December 2-3 as previously announced.

COMING EVENTS

November 10-12—National fall convention of the Society of Industrial Engineers at the Carnegie Music Hall, Pittsburg, Pa. Business manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

November 11-12—Nineteenth annual convention of the National Machine Tool Builders' Association in New York City; headquarters, Hotel Astor. General Manager, Charles E. Hildreth, Worcester, Mass.

November 17-18—Twenty-fourth annual convention of the National Founders' Association, at the Hotel Astor, New York City.

November 18-20—Meeting of the Federated American Engineering Societies at the New Willard Hotel, Washington, D. C. Headquarters, Engineering Societies Bldg., 29 W. 39th St., New York City.

December 7-10—Annual meeting of the American Society of Mechanical Engineers at 29 W. 39th St., New York City.

January 11-13—Annual meeting of the Society of Automotive Engineers in New York City. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

The Effect of Addition Agents in Flotation. (Part II). By M. H. Thornberry and H. T. Mann. 68 pages, 6 by 9 inches. Published by the School of Mines and Metallurgy of the University of Missouri, Rolla, Mo.

Bituminous Coal Storage Practice. By H. H. Stoek, C. W. Hippard, and W. D. Langtry. 157 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 116 of the Engineering Experiment Station. Price, 90 cents.

Measurements on the Thermal Dilatation of Glass at High Temperatures. By C. G. Peters and C. H. Cragoe. 39 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 393 of the Bureau of Standards.

Blueprint Reading. By E. M. Wyatt. 86 pages, 6 by 9 inches Published by the Bruce Publishing Co , Milwaukee, Wis. Price, $1; by mail $1.10.

This book is the result of the author's experience in teaching blueprint reading in night schools for several years, and of several years' experience in teaching drafting. It is not intended for those who need an expert knowledge of mechanical drawing, but is prepared with the idea of giving an understanding of the fundamental principles of mechanical drawing, a knowledge of drafting conventions, practice in interpreting drawings, and some practice in shop sketching, by means of which the student can express his own ideas. A number of drawings have been included to give practice in reading, and at the end of each chapter is a list of questions intended to stimulate the study of the drawings. An idea of the range covered can be obtained from the following chapter heads: Kinds of Drawings; Theory of Orthographic Projection; Meaning of Various Kinds of Lines; Foreshortened Lines, Inclined Surfaces, Auxiliary Projections; Scale Drawing, Dimensions; Breaks, Representing Drawings as Broken; Sections; Bolts, Screw Threads, Machining or Finish; Rivets—Structural Steel; Architectural Conventions; Study of a Set of House Plans; Study of the Bench Grinder.

High Frequency Apparatus. By Thomas Stanley Curtis. 270 pages, 5 by 7½ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

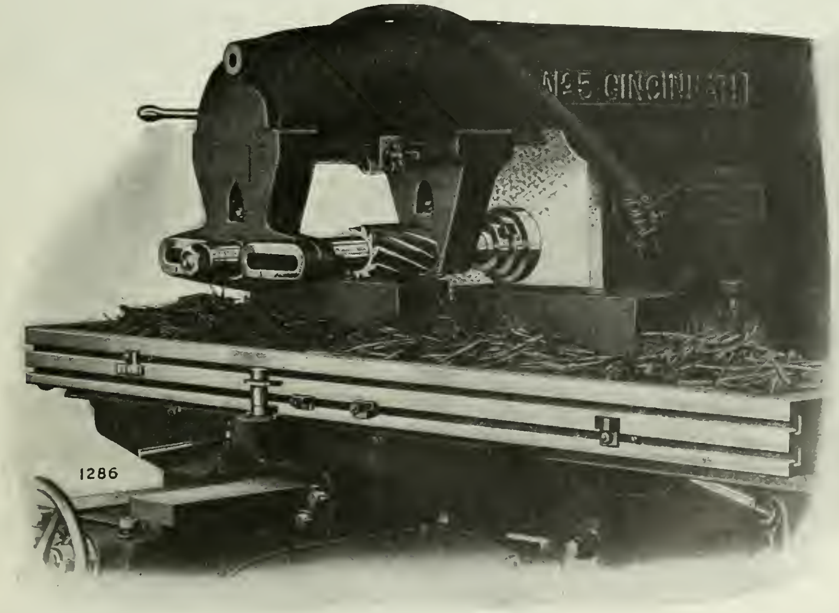
This is the second revised and enlarged edition of this work. The aim has been to make the treatment essentially practical and to avoid purely theoretical material as much as possible so as not to confuse the non-technical reader.

24 Cubic Inches of Steel Removed Without Braces on the No. 5 Cincinnati

THE CINCINNATI RECTANGULAR OVERARM

(PATENTED)

enables the new Nos. 4 and 5 machines to take cuts up to their normal rated capacity without the use of braces.



Material, machinery steel, cutter, 4½-in. diameter, Cincinnati design spiral mill, 2 in. arbor

Cut, ¼-in. deep, 5 in. wide Feed, 19 in. per minute

Removing 23¾ cubic inches of steel per minute—without the use of braces

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI OHIO, U. S. A.

The designs presented are the result of actual construction and experiment. The book is divided into six basic parts: The first two chapters explain what the high frequency current is, what it is used for, and how it is produced; the second section, comprising four chapters, describes in detail the principles of the transformer, condenser, spark gap, and oscillation transformer, and covers the main points in the design and construction of these devices as applied to the work in hand; the third section covers the construction of small high frequency outfits designed for experimental work in the home laboratory or in the classroom; the fourth section is devoted to electro-therapeutics and X-ray apparatus; the fifth section describes apparatus for the cultivation of plants and vegetables; and the sixth section is devoted to a discussion of apparatus of large size for use on the stage in spectacular productions. The closing chapter gives current prices of the parts and materials required for the construction of the apparatus described.

The Locomotive up to Date. By Charles McShane. 893 pages, 6 by 9 inches; 378 illustrations. Published by Griffin & Winters, New York Life Bldg., Chicago, Ill. Price, $5.

An entirely new edition of this book has been prepared covering the field of modern locomotive construction, repair, and operation. Everything in the former edition has been carefully checked with modern practice, and a great amount of new material is now presented for the first time. The book is fully illustrated to make the text as clear as possible. Special articles have been prepared by the American Locomotive Co., Baldwin Locomotive Works, and the Westinghouse Air Brake Co. The description of all new devices has been prepared by the inventors themselves. The subjects treated are as follows: Locomotive Valves; Valve Gears; Valve Setting; Air Brakes; Accidents to Locomotives; Blows and Pounds; Locomotive Power Reverse Gears; Boilers; the Locomotive Mechanical Stoker; Superheat; Feedwater Heating; Boiler Fittings; Locomotive Injectors; Locomotive Lubricators; Safety Pop Valves; Steam Gages, Water Gages, and Gage Cocks; Steam Engine Indicators; Metallic Packing; Compound Locomotives; Oil Burning Locomotives; Electric Locomotives; Compressed Air Locomotives; Gasoline Locomotives; Shoes and Wedges; General Shop Work; Machine Shop Practice. An index of twenty-two pages, with cross references, should enable the reader to find any information without trouble or loss of time.

The Modern Electroplater. By Kenneth M. Coggeshall. 276 pages, 5 by 7½ inches; 142 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

Electroplating and allied processes are discussed in this book from a practical rather than from a scientific point of view. An attempt has been made to describe the equipment and to explain the practical methods of modern electroplating in the simplest possible terms. No material has been included which does not bear directly upon the subject of electro-deposition; for example, only the essential fundamentals of magnetism, electricity, and chemistry have been considered. An elementary outline of electricity and chemistry in relation to plating is given, which is followed by a description of shop layout and equipment. Full instructions are included for the preparation and finishing of the work, and formulas and complete directions are given for making all kinds of plating solutions, many of which are said to have been trade secrets until published in this book. The material is divided into ten chapters headed as follows: The Advance of the Electroplating Industry; Elementary Chemistry and Electricity; the Location and Construction of the Plating Room; Electrical Equipment for the Plating Room; Electroplating Tank Equipment; Miscellaneous Plating Room Equipment; the Preparation of Work for Electroplating; Plating Solutions and the Electro-deposition of Metals; Polishing, Buffing, and Lacquering; Useful Reference Data.

American Lubricants. By L. B. Lockhart. 341 pages, 6 by 9 inches. Published by the Chemical Publishing Co., Easton, Pa. Price, $4.

This is the second edition of this book, and the material contained therein has been revised and enlarged. The purpose of the book is to aid the user and the buyer of lubricants in making an intelligent selection of oils and greases. The point of view throughout is that of the user rather than that of the refiner. An effort has been made to include such facts and figures in regard to lubricants as will best bridge the gap between the refiner or manufacturer and the consumer, and on the other hand, to exclude irrelevant matter so as not to obscure the main facts. The book is divided into thirty-seven chapters, and the following list of chapter headings will give an idea of its scope: Crude Petroleum; the Refining of Petroleum; the Refined Products; Friction and Lubrication; Lubrication of Internal Combustion Engines; Automobile Lubrication; the Lubrication of Electrical Machinery; the Lubrication of Steam Cylinders and Steam Engines; the Lubrication of Steam Railways; the Lubrication of Cotton Mills and Other Textile Mills; the Lubrication of Miscellaneous Plants and Machines; Physical Methods of Testing Lubricating Oils; Chemical Methods of Testing Lubricating Oils; Lubricating Greases; Methods for Testing and Analysis of Greases; Animal and Vegetable Oils; Methods of Testing Fatty Oils; Specifications for Fatty Oils; Specifications for Steam Cylinder Oils; Specifications for Turbine Oils; Specifications for Cylinder Oils for Internal Combustion Engines; Specifications for Transmission Oils and Crankcase Oils; Specifications for Compressor Oils; Specifications for Engine Oils, Paraffin Oils and Car Oils; Specifications for Printing Oils and Light Machine Oils; Specifications for Transformer Oil, Petroleum Residues, and Miscellaneous Oils; Standard Government Specifications for Lubricants; Specifications for Cutting Oils; Specifications for Greases and Graphite; Specifications for Boiler Compounds and Cotton Waste; Specifications for Fuel Oil; Specifications for Kerosenes; Specifications for Gasoline; Gasolines; Kerosene; and Tables.

NEW CATALOGUES AND CIRCULARS

Griscom-Russell Co., 90 West St., New York City. Bulletin 260, illustrating and describing Reilly feed-water heaters for power plants.

Casehardening Service Co., 2282 Scranton Road, Cleveland, Ohio. Circular advertising "Bohnite," a casehardening material for hardening gears and other steel parts.

Scientific Materials Co., Pittsburg, Pa. Circular advertising the F. & F. direct-reading optical pyrometer for measuring temperatures from 1500 to 4000 degrees F.

Electric Furnace Co., Alliance, Ohio. Bulletin 9-B, illustrating and describing Baily electric furnaces for melting non-ferrous metals and for annealing and heat-treating.

Gas Producer & Engineering Corporation of New Jersey, 15 Park Row, New York City. Bulletin 96, illustrating and describing the Galusha suction Type L stationary gas producer.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Leaflet 3461, illustrating and describing the Westinghouse automatic current regulator for electric arc furnaces with movable electrodes

Buffalo Forge Co., Buffalo, N. Y. Catalogue 460, of Buffalo standard pipe coil heaters, giving sizes, capacities, and other data of use in figuring the heater requirements for fan heating and ventilating work.

Weldon Tool Co., 321 Frankfort Ave., Cleveland, Ohio. Circular of Weldon double end-mills and holders, designed so that both ends of the tool can be used, in order to increase production and save time in sharpening.

Hobart Bros. Co., Troy, Ohio. Bulletin 66, advertising the HB thirty-two battery charging set. Bulletin 73, advertising the HB line of ball-bearing equipped battery chargers, lighting outfits, generators, and motors.

General Electric Co., Schenectady, N. Y. Bulletin 46209, illustrating and describing Thomson direct-current astatic watthour meters, Types CS and CS-3, for measuring direct-current installations of relatively large size.

Standard Pressed Steel Co., Philadelphia, Pa. Circular giving dimensions and prices of Hallowell interchangeable steel bench legs, for supporting benches and tables in machine shops and other manufacturing establishments.

Strauss & Buegeleisen, 16 Hanover Place, Brooklyn, N. Y. Circular advertising "Resistal" goggles which are made with non-shatterable lenses for protecting the eyes of workmen against metal chips, great heat, light, etc.

Wagner Electric Mfg. Co., St. Louis, Mo. Circular containing a reproduction of a letter relating to the performance of a Wagner electric motor that was under water for thirty-six hours and was able to start without cleaning or drying.

Canton Foundry & Machine Co., Canton, Ohio. Catalogue of Canton alligator shears, which are built in various styles and sizes, for cutting from 1 to 3 inches square, inclusive. These machines are made in high and low knife, belt and motor drive, stationary and portable types.

Oliver Instrument Co., Adrian, Mich. Folder advertising the Oliver sawing, filing, and lapping machine and showing a view of the machine engaged in cutting the relief on powder pocket cutters for high-explosive shells, on which operation an output of 100 cutters per day was maintained.

O. Zernickow, 15 Park Row, New York City. Circular advertising the O-Z hand tachometer-cutmeter, an instrument for recording speeds and feeds ranging between 60 and 12,000 revolutions per minute, and between 30 and 6000 feet per minute.

Cogsdill Mfg. Co., 1124 Grand River Ave., Detroit, Mich. Catalogue giving dimensions, list prices, and other data relating to the "CogsDrill" center drills, "Cogs-mill" gear-tooth rounding cutters, machine countersinks, and Morse taper shanks.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Bulletin entitled "Control of Motor-driven Steel Mill Machinery," containing a discussion of the problems involved and an outline of the Cutler-Hammer apparatus that has been used in solving these problems.

Sprague Electric Works of General Electric Co., 527-531 W. 34th St., New York City. Bulletin 48961, descriptive of Sprague electric Type W floor-controlled hoists, which are made in capacities of from one to six tons, for operation on direct and alternating current.

Charles F. Elmes Engineering Works, Morgan and Fulton Sts., Chicago, Ill. Sheets for loose-leaf catalogue, giving specifications for hydraulic presses for straightening, forming, bending, forcing, molding, and other uses. Specifications are also given for the company's line of hydraulic pumps.

Pawling & Harnischfeger Co., Milwaukee, Wis. Circular entitled "P & H in the Leather Tanning Industry," containing an article describing the use of the electric crane in the leather industry, illustrated with views showing the application of the Pawling & Harnischfeger cranes for handling this class of materials.

Golden Co., 405 Lexington Ave., New York City. Catalogue containing an article reprinted from The Engineer describing in detail the construction of the universal measuring machine made by the Societe Genevoise d'Instruments de Physique, of Geneva, Switzerland. The illustrations show the machine in use measuring different kinds of work.

Smalley-General Co., Inc., Bay City, Mich. Circular descriptive of the Smalley-General No. 1-0 thread milling machine, equipped with power traverse, which is designed for especially heavy work such as milling two- and three-pitch threads up to 5 or 6 inches long, as well as for milling lighter threads and smaller pitches at one revolution of the work.

Flather Mfg. Co., Nashua, N. H. Circular illustrating and describing Flather automatic gear-cutting machines for cutting spur gears, with a capacity for work of 30 and 40 inches in diameter and 10 inches face. These machines can also be supplied with bevel-gear and clutch-cutting attachments for milling miter, bevel, skew bevel, and face gears, and toothed clutches.

A. & F. Brown Co., 79 Barclay St., New York City. Catalogue 66, covering the line of power transmission machinery made by this company. Tables are given listing dimensions and prices of steel shafting, collars, couplings, clutch-shifting devices, pulleys, countershafts, pulley stands, hangers, journal boxes, pedestals, wall frames and brackets, sole plates, belt tighteners, etc.

Doyle-Wall Machine & Tool Co., 318-324 Pearl St., Syracuse, N. Y. Circular descriptive of a precision taper-measuring gage, which comprises a double sine bar and angle measuring gage. This gage is used for originating tapers and duplicating tapers already in use, and will give the correct taper per foot, as well as the measurement of any desired taper from 0 to 4 inches per foot.

Armstrong Cork Co., Pittsburg, Pa. Catalogue entitled "Nonpareil Insulating Brick," containing 72 pages treating of the insulation of high-temperature industrial equipment, such as boilers, furnaces, stills, hot blast stoves, ovens, kilns, etc. The book contains general information on the subject of heat insulation, and presents the results of heat transmission tests, and operating records with and without insulation.

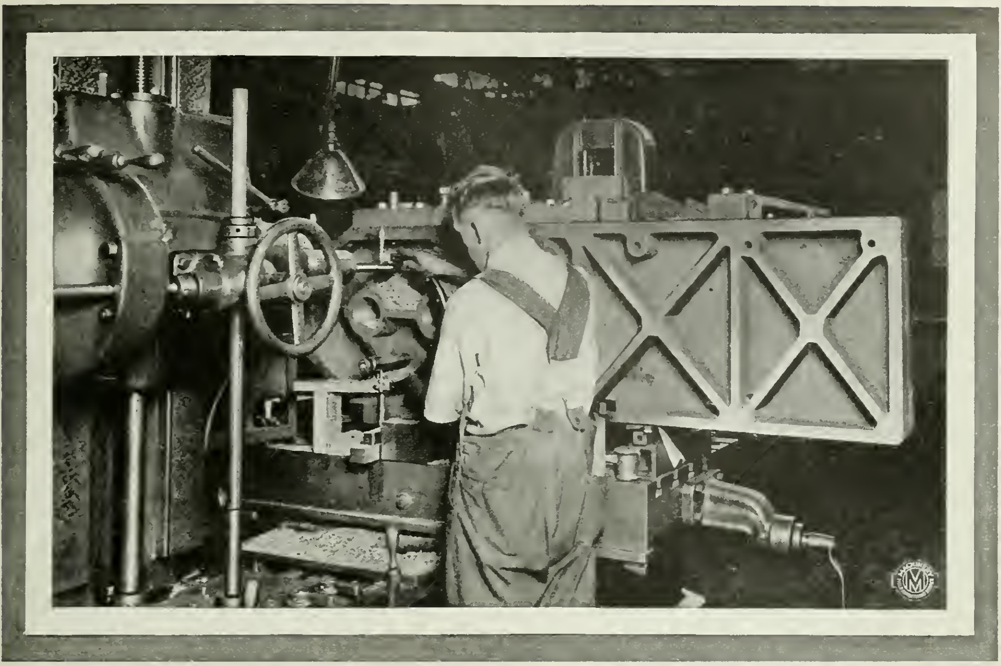
Bastian-Blessing Co., West Austin Ave. at La Salle St., Chicago, Ill. Catalogue 20, descriptive of "Rego" welding and cutting apparatus, giving prices and specifications for the various outfits, as well as details concerning the torches and regulators. Circular entitled "A New Principle in Welding and Cutting Apparatus," describing the features of construction of the "Rego" welding and cutting torches.

Acme Machine Tool Co., Cincinnati, Ohio. Catalogue entitled "Cincinnati Acme Efficiency," describing and illustrating different classes of machine work which can be done to advantage on Cincinnati Acme turret machinery, both on the flat turret and high type turret machines. The illustrations show work that has actually been done in a large number of plants, and figures are given concerning the rate of production obtained.

Oliver Machinery Co., Grand Rapids, Mich. Circular descriptive of the Metcalf grinding wheel dresser, which is made in three styles—Types A, B, and C—for hand dressing, dressing with tool-post, and for working in tight places, respectively. This dresser is designed primarily for fine wheels of 1 inch or less in thickness. The circular contains illustrations showing the Type A grinding wheel dresser in use on a band resaw sharpener; the Type C dressing wheel applied to a cutter grinder; and the Type C dressing wheel engaged in sharpening a cut-off saw.

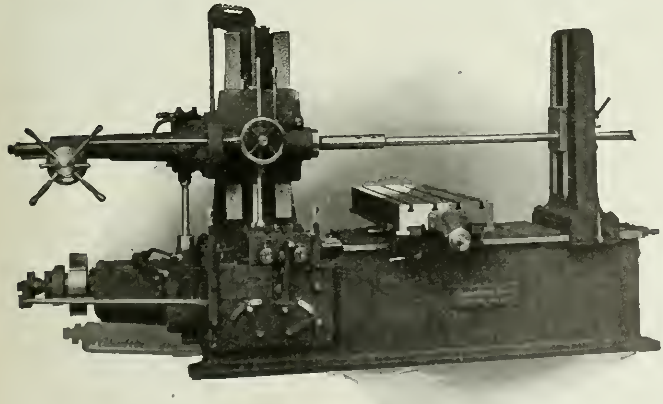
Fafnir Bearing Co., New Britain, Conn. Booklet 20, entitled "Fafnir Ball Bearings for Your Machines," describing the construction of this type of ball bearing, methods of mounting, lubrication, and types of closures. One section of the catalogue shows actual examples of the application of Fafnir ball bearings to drilling machines, lathes, automatic machines, grinding machines, portable tools, and electric motors. Reproductions of blueprints showing cross-sections illustrate the methods of mounting Fafnir ball bearings on different types of machines.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Catalogue 380, containing 96 pages covering the Link-Belt line of standardized monorail electric hoists, as well as overhead electric traveling cranes in capacities of from ½ to 3 tons, in-



TWO LUCAS "PRECISION" BORING, MILLING AND DRILLING MACHINES

In the "Kempsmith" Tool and Fixture Department



The far-famed accuracy of Kempsmith Millers has its source in the "Kempsmith" Toolroom, where accuracy is built into tools, jigs, fixtures, etc., and duplicated in the machines they are used to produce. Of the two Lucas "Precision" Boring, Milling and Drilling Machines in this department, the first is three years old and its services sold the other.

Wherever holes must check up within 0.001" center to center, wherever tolerances are only a matter of tenths of thousandths—as in the jig here shown being machined—one or the other of these heavy duty "Precision" machines is sure to be assigned, their "excellent workmanship and permanency of alignment" being the reason given for their popularity.

Lucas "Precision" Boring, Milling and Drilling Machines are made in three sizes with 3", 3¾" and 4½" spindles. Details or salesman on request.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U. S. A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

clusive. Tables of weights, clearance dimensions, and speeds are included. The book is illustrated with a large number of views showing this equipment in operation in foundries, machine shops, and factories of various kinds. Copies can be obtained from the main office of the company or from any branch office.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Booklet entitled "Multi-cuttings," descriptive of the LeBlond semi-automatic lathe for handling work which is centered, chucked, or held on arbors, up to 9 inches in diameter by 16 inches long. The machine is equipped with multiple tool-blocks for rapid production. The latter part of the catalogue contains a large number of views showing the range of possibilities of the multiple cutting tool principle. The operations illustrate special tool equipment laid out by the engineering department for a guaranteed production on certain jobs.

Cincinnati Planer Co., Cincinnati, Ohio. Catalogue illustrating the Cincinnati line of planers as well as the improved features which have recently been incorporated in these machines, among which are power rapid traverse to heads; forced lubrication to vees; herringbone gears; box arch; double-plate box table; enclosed top of bed; and safety stops for elevating device. The material relating to the new features is followed by descriptions and illustrations of the different types of drives; standard and medium types of machines; widened type of planers; open-side planers; and railroad type planers.

Flexible Steel Lacing Co., 4971 Lexington St., Chicago, Ill. Bulletin entitled "Short-cuts to Power Transmission—A Handbook for Belt Users," containing a variety of general information covering the entire process of selecting, ordering, and installing belting. Some of the subjects discussed are: Considerations in Belt Buying; Kinds of Belts; Belts and Their Uses; Technical Belting Problems; Care of Belts—Belt Dressings; Making Belt Joints; Belt Fasteners; Alligator Steel Belt Lacing; Leather Lacing; Belt Calculations; and Causes of Belt Troubles. Copies will be sent to readers of MACHINERY upon request.

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill. Catalogue B-20, giving data on the Armstrong tool-holders for turning, boring, threading, knurling, cutting off, planing, slotting, and drilling; the Armstrong system of construction embodies an inserted cutter held in a permanent supporting shank or holder, which is adapted to all classes of work from the lightest to the heaviest. Dimensions, capacity, weight, and prices are also given for drill vises, lathe dogs, clamps, drill sleeves and sockets, ratchet drills, and wrenches. Several new tools are introduced in this catalogue, among which are the spring threading tool shown on page 27 and three new sizes of the Armstrong knurling tool shown on page 31.

Walworth Mfg. Co., Boston, Mass. Export catalogue 35, 400 pages, 6 by 9 inches, bound in cloth. This book is printed in English, Spanish, Portuguese, and French, for distribution primarily in foreign countries. It is intended for use only in countries where the British standard thread is used, and will not be distributed in the United States; catalogue 78 has been prepared to cover the field in this country, and shows a full line of American thread fittings, valves, etc. Export catalogue 35 covers the complete line of pipe fittings, valves and tools made by the Walworth Mfg. Co., which includes malleable-iron fittings, standard-weight cast-iron flanged fittings, extra-heavy cast-iron flanged fittings, cast-steel fittings, power plant piping, pipe and tubes, "Kewanee" union specialties, brass gate valves, iron and steel gate valves, brass valves and cocks, iron valves and cocks, steam specialties, engine and boiler trimmings, pipe tools, drive well points, and ammonia valves and fittings. The arrangement is such that the data is given in the same sequence in each language on each page, and as considerable matter has to be included on one page with this arrangement, the book is printed on yellow paper to increase its legibility. Great care has been taken to guard against errors in translation, the material having been checked and rechecked several times. A complete index in the four languages is included.

TRADE NOTES

Colburn Machine Tool Co., announces the removal of its entire business from Franklin, Pa., to its new plant at 1038 Ivanhoe Road, Cleveland, Ohio.

Dale-Brewster Machinery Co., Inc., 56 Lafayette St., New York City, announces that the firm name has been changed to the Dale Machinery Co., Inc.

Churchill-Morgan-Crittsinger, Inc., Worcester, Mass., announces that it has made a 15 per cent reduction in the prices of its internal grinding machines.

Westinghouse Union Battery Co., Swissvale, Pa., announces that its factory, which is equipped for quantity production, is now in operation on the production of batteries.

National Tool Co., Cleveland, Ohio, has opened a new office at 988 Union Arcade Bldg., Pittsburg, Pa. R. T. Brown, will be in charge of the new office, and will be assisted by J. A. Powell.

Wagner Electric Mfg. Co., St. Louis, Mo., has removed its Salt Lake City office to 59 W. Broadway, and has opened a service station at the same address. L. Brandenburger will continue in charge as branch manager.

W. J. McKee, machine tool dealer at Detroit, Mich., has opened a large store and show-room at 99 Bates St. Mr. McKee handles a general line of tools and specializes on Hisey-Wolf portable tools and National lathes.

American Machine Products Co., 18th and Howard Sts., Detroit, Mich., manufacturer of "Stubby" reamers, milling cutters, drills, and other tools, has just completed a large addition to its plant that will nearly double the capacity.

Ackerman Bros. Co., Inc., of New York City, manufacturers' representative and jobber, announces that in order to centralize its business it has removed its office from 95 Liberty St. to its store at 301 W. 4th St., corner of Bank St.

Thompson Grinder Co. is now located in its new plant at W. Main St., Springfield, Ohio. The building is a one-story steel and concrete structure, and will be devoted entirely to the manufacture of the Thompson line of precision grinding machinery.

Skinner Chuck Co., Inc., New Britain, Conn., has recently adopted a trademark to identify its product, which represents an alligator in the form of a letter "S," superimposed on a solid black circular background with the words "Skinner Chucks" around the outside.

Bearings Co. of America, Lancaster, Pa., manufacturer of thrust ball bearings and "Star" ball retainers, has recently completed a new concrete and steel building, which will increase the capacity of the plant about 50 per cent. The company has also recently erected a new power plant.

Brinkman Engineering Co., 1001 E. 3rd St., Dayton, Ohio, has been organized by L. G. Brinkman, formerly superintendent of the Federal Tool & Machine Co., of Dayton. The company has erected a new factory and will design and manufacture tools, jigs, fixtures, dies and special machinery.

Weightman & Steigely, 21 N. La Salle St., Chicago, Ill., industrial engineers and architects, have been organized to take over the business formerly conducted under the name of Hugh E. Weightman, industrial engineer. The firm announces that it will be glad to receive catalogues on machines, tools, etc.

La Belle Iron Works, Steubenville, Ohio, has become a subsidiary company of the new Wheeling Steel Corporation. The officers are D. A. Burt, president; H. D. Westfall, vice-president in charge of sales; G. B. LeVan, vice-president in charge of operations; W. B. Higgins, secretary; and H. P. Beswick, treasurer.

Ward Tool & Forging Co., Latrobe, Pa., manufacturer of punches, dies, reamers, tools, and forgings has made arrangements to have John E. Love of John D. Scott, Inc., Detroit, Mich., represent the company in the state of Michigan and the northwestern part of Ohio. Mr. Love's offices are at 1156 Penobscot Bldg., Detroit.

Reed-Prentice Co., Becker Milling Machine Co., and **Whitcomb-Blaisdell Machine Tool Co.**, 53 Franklin St., Boston 9, Mass., has opened a branch office in Philadelphia under the management of G. S. Haven, who was formerly with the Whitcomb-Blaisdell Machine Tool Co. at Worcester. The new office is located at 514 Liberty Bldg.

Machine & Stamping Co., Ltd., 1209 King St., W., Toronto, Canada, manufacturer of automobile transmissions, differentials, screw machine parts, metal stampings, spark plugs, etc., announces that the firm name has been changed to **Russell Gear & Machine Co., Ltd.** The management will remain the same, the officers being T. A. Russell, president; Lloyd Harris, vice-president; and David Ayr, general manager.

J. H. Wilhelm, Inc., 42 W. 39th St., New York City, consulting engineers engaged in production control, factory organization, lay-out and research work, appraisals, inspection, systematizing, supervising, and planning machining operations, have published a folder showing examples of automatic machines which the company has installed for increasing production, parts that have been tooled for quantity production, die designs, etc.

Williams Machine Co., Poultney, Vt., has opened a machine shop to manufacture special machinery, dies, jigs, etc. Modern equipment including planers, lathes, grinders, radial drilling machines, presses, shears, splines, and milling machines has been installed, and the shop is now ready for operation. Robert H. Williams has had forty years' experience in this line of work, and Russell I. Williams has been connected with the Ruggles Machine Co., of Poultney, Vt., for the last sixteen years.

Kelly Reamer Co., Cleveland, Ohio, has recently moved into its new plant at 3705 W. 73rd St., which has been designed to meet the particular requirements of the company's business. Extra large vault space has been provided to accommodate both its own and its customers' drawings. Improved machinery and equipment is being installed for producing the Kelly floating adjustable reamer. The plant is located in the new manufacturing district at the southwest side of the city, convenient to the car lines.

Chapin & Baker Mfg. Co., Syracuse, N. Y., has outgrown its factory on Edison St., and has recently purchased a factory site in east Syracuse where a machine shop, 66 by 180 feet, will be erected. This will be followed by an office building, 40 by 98 feet, and later by a hardening plant, 40 by 60 feet. The officers of the concern are Frank E. Baker, president, and E. I. Chapin, treasurer and general manager. This concern is engaged in the production of small tools, reamers, end-mills, and in general tool manufacturing.

St. Louis Pump & Equipment Co., has been organized in St. Louis, Mo., to engage in the manufacture and installation of liquid handling equipment, especially as adapted to railroad and industrial uses. Executive offices have been opened in the International Life Building, and temporary factory space has been obtained in the western industrial section of the city. John C. Roberts, Jr. is president of the concern, and C. C. Fredericks of Fort Wayne, Ind., who has made surveys of oil handling facilities and equipment on railroads throughout the United States, is general manager.

Detroit Twist Drill Co., Detroit, Mich., has established a plant in Walkerville, Ontario, Canada, which will be known as the **Canadian-Detroit Twist Drill Co.** High-speed drills and reamers will be manufactured and a complete stock will be built up as soon as possible. The officers of the new company are as follows: President, Muir B. Snow; vice-president, Lewis H. Jones; treasurer, H. H. Sanger; secretary, P. C. Hill; manager, R. A. B. Goodman; and superintendent, George Johnston. Manufacturing operations have already begun and it is expected that the first drills will be completed by November 15.

Dwight P. Robinson & Co., Inc., 125 E. 46th St., New York City (with which Westinghouse, Church, Kerr & Co., Inc., have recently consolidated) have established a new branch office in Youngstown, Ohio, in the Home Savings & Loan Bldg., with O. I. Crippen in charge. The company recently moved its Cleveland office from the Leader News Bldg. to the Citizens Bldg., and H. P. Clawson, who was for several years a member of the Chicago staff, has been transferred to Cleveland to take charge of this office. The company now maintains branch offices in Pittsburg, Youngstown, Cleveland, Chicago, Dallas and Los Angeles, and Sao Paulo, Brazil.

Norton Co., Worcester, Mass., announces that an office has been opened for the grinding machine division of the company at 304 Penway Bldg., 241 N. Pennsylvania Ave., Indianapolis, Ind., under the direction of Walter F. Rogers, district representative. The establishment of this branch office will not affect the distribution of Norton grinding wheels, which will be handled as in the past by the Vonnegut Hardware Co. The company has also opened a branch office for the grinding machine division in Pittsburg at 230 Fifth Ave., under the direction of Paul R. Hawkins, district manager. The distribution of grinding wheels will be handled as previously by Somers, Fitler & Todd Co., 327 Water St.

Luster Machinery Co., 917 Arch St., Philadelphia, Pa., manufacturer of machine shop and railway equipment, has sold its entire business, consisting of all liabilities, stock on hand, and good-will, to **Fairbanks, Morse & Co.** The latter company will operate at the same address, as a separate branch, and will enlarge the machine tool business, in addition to handling its regular line of engines, motors, and pumps. E. J. Luster, president of the Luster Machinery Co., is now manager of the machine tool division of Fairbanks, Morse & Co., with headquarters at Philadelphia. The entire personnel of the Luster Machinery Co. will remain with Fairbanks, Morse & Co. W. D. Dunn is Philadelphia branch manager.

American Car & Foundry Co., 165 Broadway, New York City, is extending its plant at Buffalo, N. Y. The new plant will be used for building all-steel cars, and will have a capacity for turning out twenty to thirty cars per day. It will be equipped throughout with modern machinery and labor-saving devices. In addition to the new car-building plant, an up-to-date office building will be erected on property recently acquired on Babcock St. W. H. Sanford, for many years district manager of the Buffalo plant, has been appointed assistant vice-president, and will be placed in charge of sales. Mr. Sanford will be succeeded as Buffalo district manager by Andrew H. Gairns, who now holds a similar position in Chicago.

W. E. Seymour Mfg. Corporation, Milwaukee, Wis., has been incorporated with a capitalization of $200,000. The officers are as follows: W. E. Seymour, president; J. A. Lee, vice-president and general manager; M. L. Buckley, secretary; C. J. Gilbert, treasurer; and E. E. Hirschhaater, chief engineer. The company has been formed to manufacture a variety of motor parts, but for the present all its facilities will be devoted to the production of piston rings. A manufacturing plant has been purchased at Lisbon Ave. and Thirty-first St., and options on adjoining property have been taken as a provision for expansion when it becomes necessary. Machinery and equipment is arriving daily, and it is expected that actual production will begin the latter part of November or early in December. The temporary location of the offices is at 266 Plankinton Arcade, Milwaukee.

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MACHINERY

NUMBER 4

DECEMBER, 1920

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The Editor's Monthly Talk

MACHINERY'S specially conducted tour to the industrial centers and machine shops of the country is full of interest this month, the journey through the reading pages including visits to thirty-two different plants in thirty-two different cities and towns in the United States. The guides are the thirty-one authors of the seventy-four pages of shop and engineering articles in this number of MACHINERY—exclusive of the department of New Machinery and Tools, which covers all the developments of the month in the machine-tool building and accessories field.

Among the plants visited are some very well known throughout the world—The General Electric Co.'s plants at Schenectady, N. Y., and Lynn, Mass.; The Norton Co., Worcester, Mass.; The Putnam Machine Works plant at Fitchburg, Mass., of Manning, Maxwell & Moore, Inc.; The Clark Equipment Co., Buchanan, Mich.; The De Laval Separator Co., Poughkeepsie, N. Y.; and the Mueller Metals Co., Port Huron, Mich. The reader may sit in his easy chair at home and visit all these leading plants, because the editors of MACHINERY have done the traveling for him; in seeking and verifying the information published in this one number they covered over 5000 miles, visited dozens of shops in addition to those mentioned, and gathered information from scores of executives and engineers.

This is the method—and the only method—by which MACHINERY can keep its readers accurately posted on the latest developments and practices in the metal working field, giving the information required by practical men on shop practice, machine design, shop and drafting-room systems, engineering developments, and training methods. In addition, MACHINERY must review the conditions in the domestic and foreign machine tool trade; the latter subject, in this number, is dealt with in articles by special correspondents writing from England, Germany, and Spain. So much for this number.

In January MACHINERY a new and important series on shop practice begins. MACHINERY has published complete treatises on Modern Grinding Practice; Gage Design and Gage-making; Drilling Practice; Thread-cutting Methods; Electric and Oxy-acetylene Welding; Automatic Screw Machines; Production Milling; Tools, Chucks, and Fixtures; and Turret Lathe Practice. The new series will cover another large and important sub-division of machine shop work—Production Planing and Shaper and Slotter Work, presenting the most advanced practice to be found in American machine shops. In the preparation of these articles, dozens of shops were visited, and the completed treatise represents the combined experience of both manufacturers and users of planers. This series adds another link to the chain of shop practice articles which, when finished, will present a complete set of treatises on the operation of modern machine tools in progressive American shops.

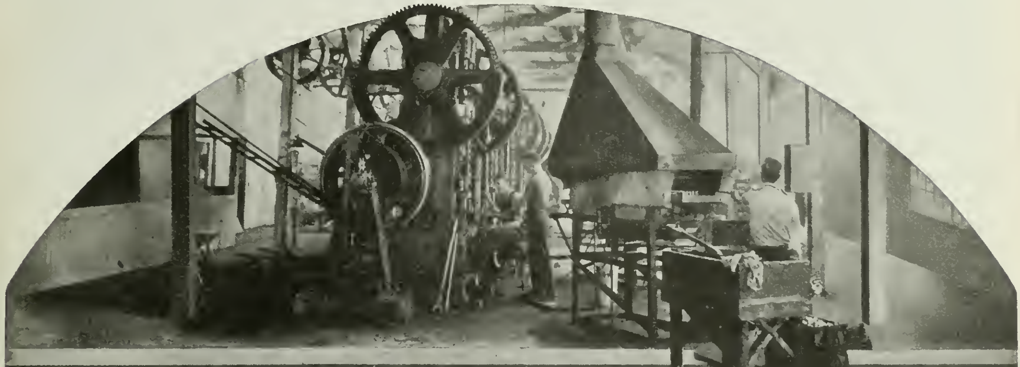
The hard and trying experience of the past four years has brought home to manufacturers with great force the vital importance of a better training of men for the mechanical industries. The importance of good methods of training inexperienced help—thoroughly as well as rapidly—is recognized by everyone. The problem has been solved with satisfactory results by the Norton Co., Worcester, Mass. In "Training Operators in a Machine Shop," John C. Spence, superintendent of the grinding machine division, describes in detail the methods used, reviews the results, and gives details in regard to the cost of such a training department—information which is of definite value to any manufacturer contemplating the organization of a training department. With the old type of apprenticeship system in existence only in a few plants, the effective method described ensures successful training of good operators and makes it possible to obtain skilled machinists without depending upon the limited supply available through apprenticeships. Mr. Spence's plan has much to commend it even when compared with the regular apprenticeship systems, and has proved its advantages over these systems in many ways.

It goes without saying that the work of the designing room and the drawing office—where the plans are made—is of equal importance to that of the shop—where the plans are executed. This brings us to a brief notice of an unusual series to begin in January MACHINERY: "Causes of Common Errors in Machine Design," by R. H. McMinn. The author has made a careful study of drafting and designing room errors and their underlying causes, and shows how to avoid them. The information he gives will not be found in any of the hitherto published literature on the subject of machine design and of manufacturing practice as affected by the design. The subject of errors in machine design is dealt with from many different viewpoints, on the assumption that anything adversely affecting operating results, manufacturing costs, the quality of the product, or the reputation of the manufacturer, is an error in designing, if it can be traced back to the work of the drafting room.

The subjects mentioned are only some of the more important to appear in January. Besides these, there will be articles dealing with some out-of-the-ordinary drawing operations on the power press; tractor engine shop practice; the use of sand-blasting apparatus; and an analytical and unusual treatise dealing with the work-speed in cylindrical grinding. No number of MACHINERY fails to show some interesting phase of automobile shop practice, and January will be no exception. As usual, MACHINERY will take its readers into more than a score of leading plants in the country and will show them the advanced practice and the improved methods that result in more production and greater accuracy.

These informal notes give the Editor an opportunity to tell about the articles in preparation and bring him, perhaps, a little closer to the readers. Very often they serve to point out the relative significance of some phase of practice, some new method, principle or development, thus lighting the mechanical highway a little in advance for those who, being busy about their own affairs, must depend upon the work of an engineering journal to discover and describe for them whatever is new that is worth while.

DECEMBER MACHINERY 1920



Making Brass Forgings

Methods Developed by the Mueller Metals Co., Port Huron, Mich., in an Original and New Art of Metal Working

By EDWARD K. HAMMOND

IN Great Britain and on the European continent, many parts which are made of brass, bronze, and other non-ferrous metals are forged to the desired form in dies. The British call this process "stamping," but although the work is done under a power press, such a term would prove misleading in this country, because we regard a stamping as a part cut from sheet metal by a die. In America, either the term "forging" or "die-pressed casting" is more generally used.

During the war, brass forgings or so-called "die-pressed castings" were made in large quantities to be subsequently machined into various fuse parts, but otherwise, the forging of brass in dies has not found wide application in the United States. However, the advantages of the process are so obvious that it is doubtless only a matter of time until many parts which are now cast in sand or machined from bar stock will be produced by this method.

An article entitled "The Production of Die-pressed Castings" was published in MACHINERY, January, 1916, which explained the making of various fuse parts and suggested other applications of the method in handling certain lines of commercial work. Such a general application of the process of forging brass is now being made by the Mueller Metals Co., in Port Huron, Mich. This firm's plant is equipped for the manufacture of various products from non-ferrous metals, including copper and brass rods and seamless tubing, screw machine products, sand molded castings, and die-castings, etc. One of the departments of the plant does contract work in the manufacture of brass, bronze, and copper forgings, and it is with the practice of this department that the present article is concerned.

> Several noteworthy advantages are secured by forging brass, bronze, or copper parts to the required shape, instead of turning the work from bar stock on an automatic screw machine or making it by some other familiar method of manufacture. Chief among these are the facts that it is possible to effect a substantial saving of high-priced metal; that parts can often be forged in a way that enables them to be utilized with little if any subsequent machine work, thus saving a heavy labor cost; and that the process of forging imparts greater density, freedom from porosity, and additional strength to the metal.

Extensive and valuable experience for the development of this branch of the business was obtained in the Mueller plant in Sarina, Ont., Canada, where the production of forgings for fuse parts had attained a daily output of 225,000 at the time that the armistice was signed. An idea of the range of commercial work which has already been successfully handled by the Mueller Metals Co. in Port Huron, will be gathered by reference to Figs. 1 and 2 which show, respectively, a collection of finished parts made from forgings, and a group of finished parts together with the untrimmed forgings and the blanks from which these pieces are produced. A careful study of these illustrations will prove instructive to men who are interested in the forging of brass and similar metals, as it will show the wide range of work that can be handled. Evidently, there can be considerable complications in the form of the work, including the presence of one or more holes, and where an extremely fine finish is required, it is important to note that the forging is brought to the desired form, merely leaving a sufficient quantity of metal for machining to provide for cleaning up the surface.

Grades of brass that can be successfully forged include yellow brass mixtures of about the following composition: Copper, 58 to 62 per cent; lead, 0 to 3 per cent; tin, 0 to 2.5 per cent; and zinc, 42 to 32.5 per cent. This brass usually contains from 1.5 to 2 per cent lead to make it soft enough to machine easily, and it is preferable to keep the tin content at a minimum.

Where strength is required and there is little subsequent machining to be done on a forging, either manganese

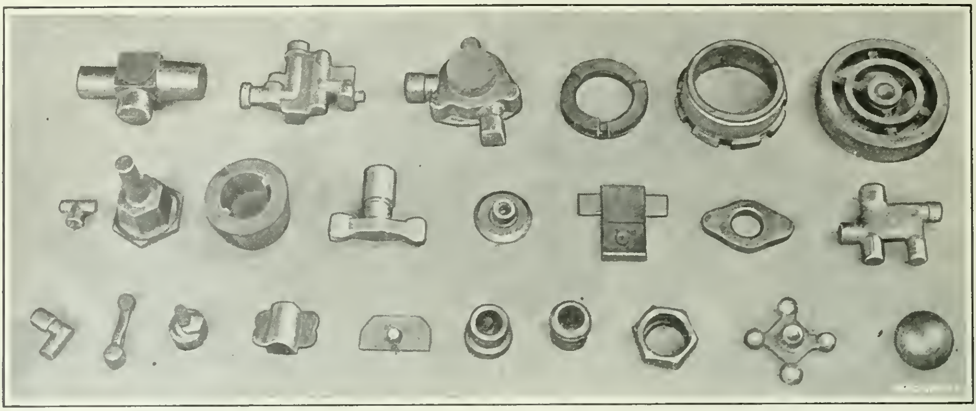


Fig. 1. Miscellaneous Collection of Forgings which gives an Idea of the Range of Work that can be produced

bronze or tobin bronze can be advantageously employed. The composition of an average manganese bronze is as follows: Aluminum, 0.5 per cent; copper, 58 per cent; iron, 1 per cent; lead, 0.2 per cent (not over); tin, 2 per cent; and zinc, 38.3 per cent. In manganese bronze, manganese is added as a deoxidizing agent, and it does not remain in the finished metal.

Tobin bronze of the kind used for making forgings has the following composition: Copper, 60 per cent; lead, none; tin, 2 per cent; and zinc, 38 per cent.

Another metal used for forgings is aluminum bronze having approximately the following composition: Aluminum, 10 per cent; and copper, 90 per cent.

Method of Procedure in Forging Brass

In making forgings of this type, the method of procedure is to squeeze a heated blank of metal between a pair of dies, which will cause the metal to flow sufficiently to completely fill the space between the upper and lower die members, which is of the same form as the forging that is to be produced. The metal blanks are usually made by cutting off pieces from extruded rods which have been sent directly to the forging shop without being submitted to the customary cold-drawing and strengthening operations after extrusion, as such work would simply add to the cost of the raw materials of the industry without giving any value in return. An article entitled "Extruding Brass and Copper Rods," published in Machinery for September, explained the method of making rods by the extrusion process, so that this part of the work does not require attention in the present article. It is desirable to provide for forging pieces to the desired shape without requiring the metal to flow further than is absolutely necessary; and with that idea in mind a practice is often made of extruding specially formed bars, the cross-section of which is a rough approximation of the finished form of the forgings that are to be made.

Examples of this kind are shown at *F* and *G* in Fig. 2, where it will be seen that the metal blank from which this forging is made has an outline somewhat similar to that of the finished forging. The extruded bars are sent to the forging shop, where they are set up on metal band-saw cutting-off machines, as shown in Fig. 3, each of these machines

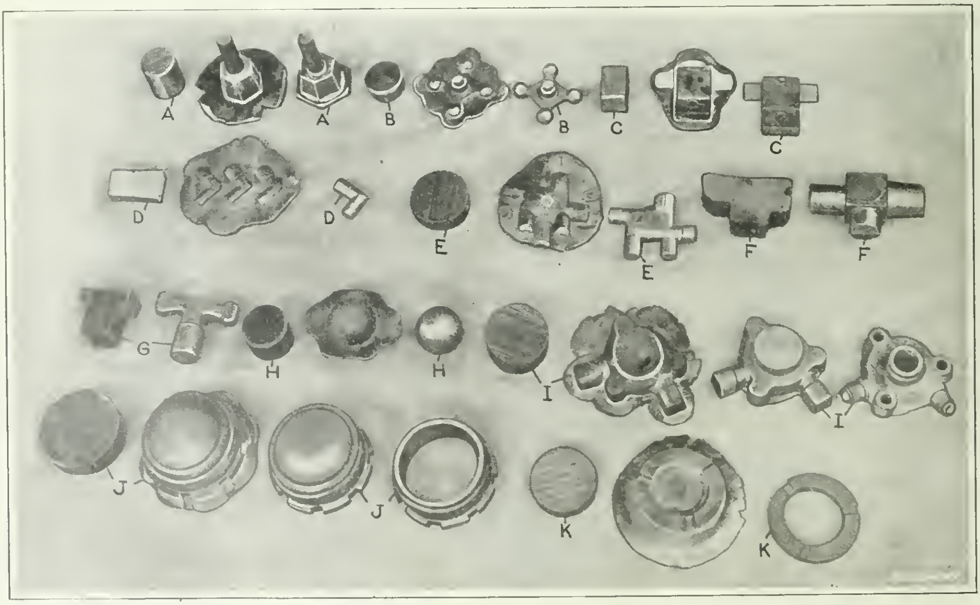


Fig. 2. Groups of Parts comprising the Metal Blank, the Forging as it leaves the Die, and the Finished Work after trimming off the Flash

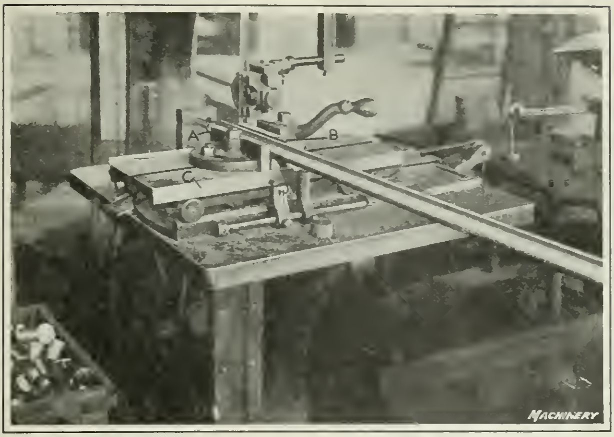


Fig. 3. Metal-cutting Band Saw equipped with End Stop, Quick-acting Vise and Traveling Table for rapidly cutting Bars into Forging Blanks

being equipped with an end stop *A* that locates the bar in the proper position to enable the saw to cut off a blank of the required length; and after the bar has been located and tightened in the quick-acting vise *B*, a longitudinal movement of the carriage *C* is utilized to provide for cutting off the blank. With an equipment of this kind, the operation can be conducted with great rapidity. If the blanks are not required to have their ends square, they can be more economically cut off in a shearing machine.

Heating the Blanks Preparatory to Forging

Oil-fired furnaces of the type shown in Fig. 4 are used to heat the blanks preparatory to forging them to shape, the practice being to raise the temperature to about 1250 to 1300 degrees F. Very accurate control of the heating is not essential, and it is the practice to judge the temperature of the work by its color, without resorting to the use of pyrometers. The furnaces in which the blanks are heated are open at both ends, and one attendant is kept constantly busy placing blanks in the front door of the furnace. It is the practice to arrange these blanks in groups, and the furnace attendant is provided with a poker *A* that has a cross-bar *B* of about the width of the furnace hearth, with which he can push forward successive groups of blanks. Formerly it was the practice to have a furnace hearth made of cast iron, but it was found that trouble was experienced through particles of iron or iron oxide becoming embedded in the work and preventing the production of perfect castings.

To overcome this objectionable feature, the furnace hearth *C* is now made of copper. Not only is it more durable, but the use of this material effectually overcomes the trouble caused by the non-ferrous forgings becoming contaminated with iron. These copper furnace hearths are capable of giving from 1200 to 1500 hours of service. The blanks are kept moving forward through the furnace, and by the time any one group has reached the farther end, the temperature has been sufficiently raised to provide for performing the forging operation. One furnace is provided for each power press in the shop, as shown in the heading illustration, and in addition to the furnace attendant, a press operator and a helper are needed. The helper's duty is to take the heated blanks out of the furnace, and place them in the die; and after the forging operation, he is also required to remove the finished forging.

Lubrication of the Forging Dies

As soon as the forging has been taken out of the die, the operator proceeds to lubricate the upper and lower dies shown in Fig. 5, with cylinder oil applied with a long-handled swab *A*. This oil is necessary to prevent the excessive pressure from causing the dies to wear with undue rapidity. The number of forgings that can be produced from a pair of dies varies according to the nature of the work, but the average will be from 15,000 to 18,000. In some cases, it is found that greater durability of the dies is accomplished by adding 1 per cent of powdered graphite to the cylinder oil to give it slightly more body to resist the pressure. Good forgings produced by this method can be held within an accuracy of ± 0.002 inch; and on average work from 6000 to 10,000 forgings can be obtained from one press in a ten-hour working day. In Fig. 5 the heated blank is shown at *B* ready to be placed in the die *C*, and a finished forging is shown at *D*.

Principles Governing Construction and Use of Forging Dies

It will be self-evident that the dies used for producing brass forgings will vary according to the nature of the work,

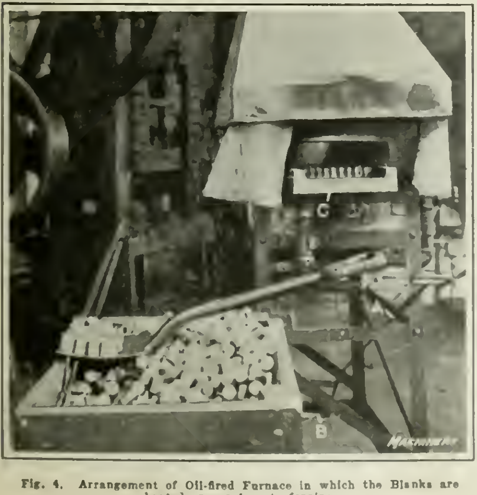


Fig. 4. Arrangement of Oil-fired Furnace in which the Blanks are heated preparatory to forging

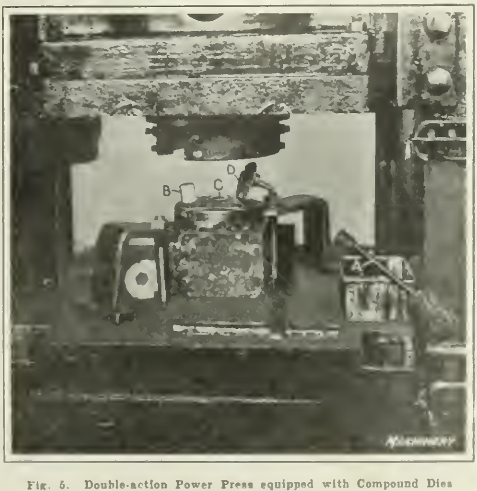


Fig. 5. Double-action Power Press equipped with Compound Dies for producing Forgings D

but there are certain fundamental principles which the experience of the Mueller Metals Co. has shown to be generally applicable in making dies. Among these, the following points may be mentioned:

Use of Double-action Press and Dies—Where the metal is required to flow through a considerable distance, it will usually be found advantageous to utilize a double-acting power press, and to have the die arranged in such a way that the first movement of the press ram results in closing the upper and lower die members to enclose the heated metal blank to be forged. Then the second stage of the ram's movement results in bringing down a plunger through the upper die member, to provide for applying pressure to the heated metal blank and causing it to flow out and completely fill the die.

Providing an Air Vent in the Dies—Where the impression in a die is of sufficient depth to cause an air pocket of considerable volume to be formed, provision must be made for allowing this air to escape; otherwise, difficulty might be experienced from the air retarding the flow of the metal to fill the die space. Several methods of accomplishing this result are employed, but the most satisfactory one is to use a No. 70 drill with which one or more holes are made, to allow the air to escape. The heated metal flows into these holes and solidifies, but the "needles" of brass so formed do not interfere with the removal of the finished forging, and when the next blank is introduced, the pressure of the metal will force the previously formed needles out of the holes, thus allowing the air to escape.

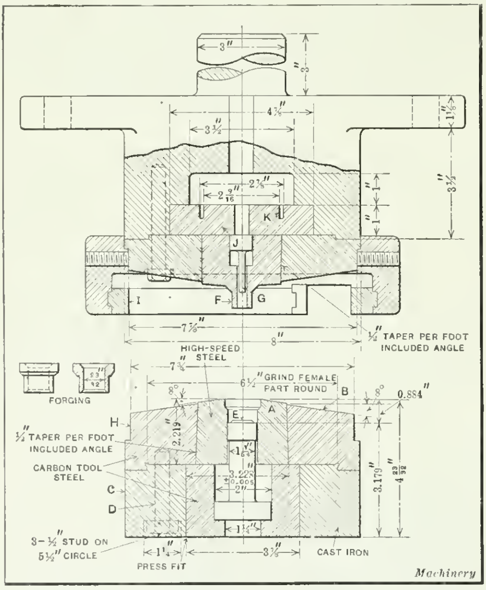


Fig. 6. Single-action Dies for forging Brass Union Seat Couplings

Standardization of Die Parts—Owing to the high temperatures at which the metal is forged in these dies, experience has shown it to be desirable to use a good grade of high-speed tool steel containing 18 per cent of tungsten for the die members in which the hot blank is pressed into a forging of the desired shape; but it would be too expensive to use steel of this kind to make the entire die, and so a practice is made of mounting high-speed steel inserts in holders made of carbon tool steel or of machine steel, according to the requirements of the work. The Mueller Metals Co. takes contracts from manufacturers for the production of brass forgings, and as the character of the work is constantly changing, it will be evident that there are a large number of dies to be made. With a view to simplifying both the work of designing and making these tools, the design of the dies has been standardized as far as possible. In this way it has also been found that standard die-holders can be utilized for carrying a variety of different high-speed steel inserts which must be especially formed for each particular job. This practice will be better understood by referring to the illustrations of single-action and of double-action dies shown in Figs. 6 and 8, and 7 and 9, respectively.

Description of Two Typical Forging Dies

Figs. 6 and 7 show, respectively, single-action and compound dies made for the production of brass forgings for one of the three parts of a pipe coupling, a side and cross-sectional view of one of the finished forgings being shown in each illustration. It will be noticed that in each case the lower die member is the same. Referring first to this part of the tool, it will be evident that the interior of the high-speed steel insert *A* is formed like the outside of the piece to be forged, and this insert is tapered on the outside so that it can be assembled into a carbon tool steel die-holder *B*. After insert *A* has been placed in the opening in block *B*, this block is secured to a cast-iron base *C* by means of bolts *D*. Carried in this die member, there is a stripper *E* that provides for raising the finished forging out of the die.

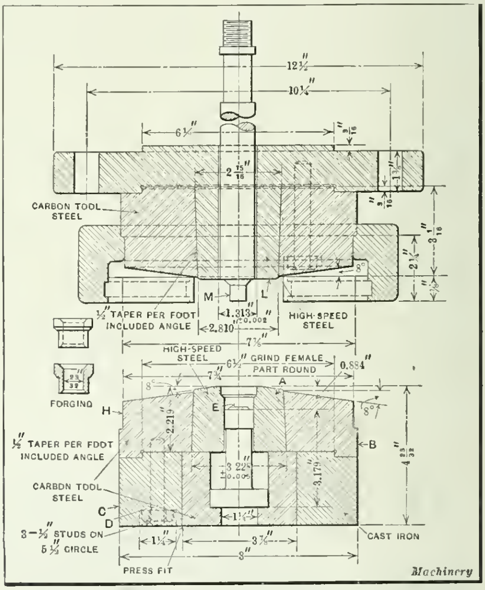


Fig. 7. Double-action Dies for forging Brass Union Seat Couplings

Bearing in mind that this forging operation is performed on a single-action press, it will be seen that the upper die member has a pilot *F* that forms the opening on the inside of the work, and there is a small stripper *G* to remove the finished forging from the pilot in case it tends to stick at this point. Between the pilot *F* and the horizontal face of the high-speed steel insert in the upper die, there is a beveled or filleted surface which provides for producing the required bevel between the top of the forging and the central hole.

Maintenance of Alignment of Upper and Lower Die Members

In making all kinds of forging dies, there are two points which require careful attention, namely, the provision for keeping the upper and lower die members in accurate alignment, and the furnishing of means in the die for protecting the crankshaft of the power press from damage in the event of the die becoming blocked. Both of these points are well taken care of in the dies shown in Figs. 6 and 7, and refer-

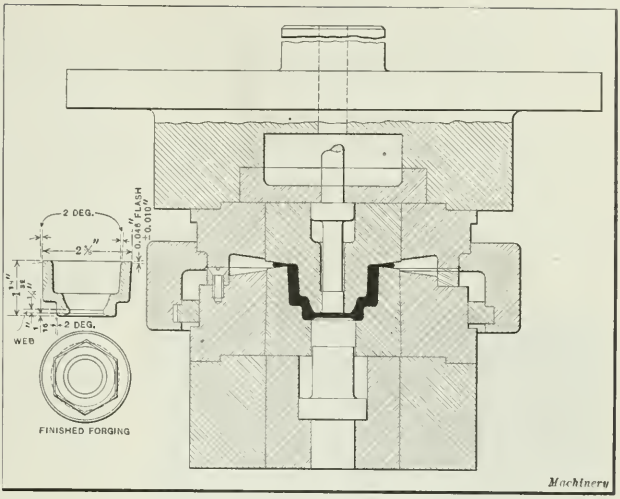


Fig. 8. Single-action Dies for forging Bronze Change-speed Lever Ball Sockets

ring to Fig. 6 it will be seen that to keep the dies in alignment, the outside surface *H* of the lower member is machined to form a pilot that enters into the tool-steel guide ring *I* on the upper member. This guide ring *I* engages pilot *H* on the lower member before the forging operation commences, thus assuring accurate alignment of the dies and a high degree of accuracy in the finished work.

Various methods are employed for protecting the crankshaft of the press from damage, but the arrangement here illustrated has been found as satisfactory as any. It will be seen that a cast-iron block *J* has been placed above the upper die in a pocket in the holder in which this die is supported. Cut in the upper side of block *J* there is an annular groove *K*, the function of which is to so reduce the shearing strength of block *J* that in the event of the die becoming jammed, block *J* will be sheared at the annular groove *K* before the stress on the crankshaft of the press approaches the elastic limit of the steel. It will be evident that above block *J* there is a pocket that provides clearance for the disk that may be sheared out of the block, so that the crankshaft of the press will be freed of its load by allowing the tool-steel die member *F* to rise in its holder. Before such a safety device for overcoming a difficulty of this nature was developed, it was not a rare occurrence for a crankshaft to be broken and cause a serious delay before a repair could be made.

Application of the Extrusion Principle in Forging Brass

Where forging operations are performed with compound dies and double-action presses, the process is more truly one of extrusion than of forging. Referring to the die shown in Fig. 7, it will be apparent that the lower member is of the same construction as that of the single-action die illustrated in Fig. 6, and the same provision is made for maintaining alignment of the upper and lower die members. In using a die of this type, the ram of the press makes its first downward movement and brings die member *L* down on top of the heated blank placed in the opening in the lower die, so that the metal is confined.

At the second stage of the movement of the power press ram, a plunger *M* carried by the upper die descends on the heated blank and applies sufficient pressure to cause the metal to flow and thoroughly fill the die opening. It will be apparent that an axial opening has to be forged in the work, and, as in the case of the single-action die, this is accomplished by means of a pilot on the upper die member. However, in the production of pieces of work of this kind, it is a general principle that the opening cannot be forged all of the way through the work without resorting to the use of a die, the construction of which would be too expensive in cases where only a limited number of parts are to be produced on an order.

The method of procedure followed in making a die for forgings with an opening through the middle is to depend upon the stripper to form a slight indentation in the under side of the forging and to have the pilot on the upper die produce practically the entire opening, leaving a thin web of metal, which closes the hole at the time the forging is removed from the first set of dies. By having this web of metal located slightly above the bottom of the forging, it can be sheared out without leaving a burr. In addition to this excess metal closing the opening, there will also be a flash of metal surrounding the forging at the point where the upper and lower dies come together; and two subsequent trimming operations must be performed on the work to remove the surplus metal at these two points.

Simple trimming dies are utilized for the purpose, which are set up on single-action power presses so that the pieces of work can be put in these dies without being previously heated, to first have the web of metal struck out of the central hole and then have the circumferential flash trimmed off. Fig. 10 illustrates a power press with a die for trimming forgings, one of the untrimmed pieces of work being shown at *A*, while a finished forging is shown at *B*, and the flash at *C*. After these two operations have been performed,

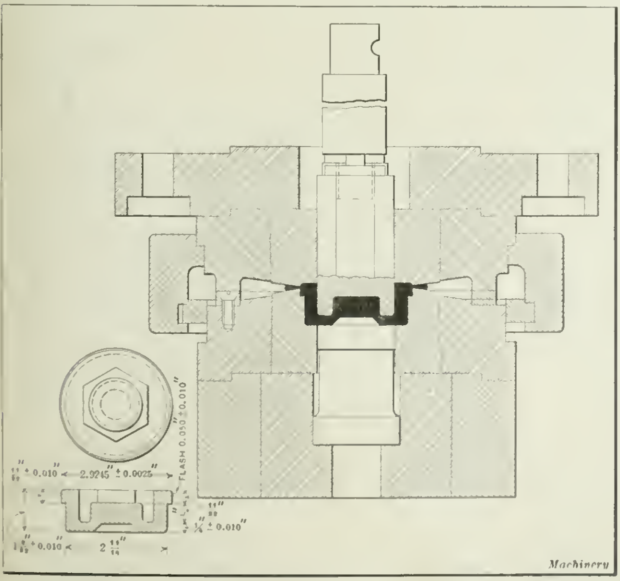


Fig. 9. Double-action Dies for forging Brass Motor Cylinder Valve Chamber Plug Inlets

the forgings are sent to a pickling bath where they are first dipped in a solution of 5 per cent nitric acid and then washed in clear water, after which they are ready either for shipment or for subsequent machine work which is done on the forgings before they leave the factory.

Other Examples of Die Construction

Figs. 8 and 9 show, respectively, two other examples of single-action and double-action forging dies, and in this case the work is shown in position between the upper and lower die members. The high-speed steel inserts are the only special parts of these tools, the remaining members being of standard types, so that after the contract for these particular forgings has been completed, other die inserts may be substituted to adapt the remainder of the tools for use on other work. From the preceding description of single-action and compound dies illustrated in Figs. 6 and 7, the reader will be able to understand the general arrangement of the two present tools without requiring a detailed description. However, it may be mentioned that the dies shown in Fig. 9 are used for forging motor cylinder valve chamber plug inlets from brass; the detailed views of one of these parts in the lower left-hand corner are of interest in that they show the limits within which the diameter and the height dimensions of the work must be held. The dies illustrated in Fig. 8 are used for forging bronze change-speed lever ball sockets, and it will be apparent from the detailed views of one of these parts shown at the left-hand side of the illustration that this is another case in which it is required to produce an opening extending right through the work. However, as previously explained, the formation of this opening cannot be completed during the forging operation. It will be noticed that a web of metal ⅛ inch in thickness is left at a distance of 1/16 inch from the bottom of the forging, this impression on the under side of the work being produced by the stripper in the lower die member. The web so produced will be removed by a subsequent operation with a trimming die.

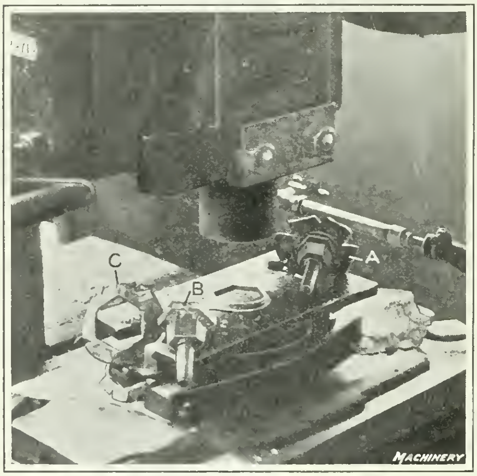


Fig. 10. Power Press equipped for trimming Forgings A to remove Flash C from Forging, as shown at B

Advantages of Non-ferrous Forgings

There are several advantageous features of aluminum, brass, bronze, and copper forgings. Important among these is the fact that owing to their greater strength, pieces made of other materials than iron and steel can be of smaller cross-sectional area when forgings are used, thus effecting an economy in the use of metal. The density of the metal is also greater, and hence there is less porosity. Consequently, brass and similar forgings can be successfully utilized in making connections and other parts for use on air lines where the high pressure might cause leakage through more porous connections. The same applies to the use of forgings in gasoline pipe lines, etc. Production costs are lower because of the saving of material, as compared with cases where similar parts are made by machining from bar stock on automatic screw machines. Also, there is a saving of labor, because the time required to do the work is far less than when all of the forming has to be done on a machine. In many cases, the finish produced by forging is found satisfactory, without any subsequent machine work.

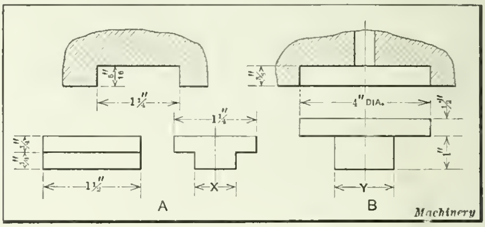
Mention has already been made of the fact that when necessary, the diameters of cylindrical forgings can be held within limits of ± 0.002 inch; but it is not feasible to attempt to hold other dimensions closer than 0.008 inch, owing to variations in the size of the blanks to be forged and the consequent spring of the press. In cutting the blanks off from bar stock, their volume is held as close as possible to the desired size by having a weighing scale provided near each of the cutting-off machines, so that at frequent intervals the operator can take a blank and weigh it to see that he is holding the weight within specified limits. The largest forgings which have been produced by this method up to the present time weigh approximately three pounds.

* * *

LOCATING KEYS AND PLUGS FOR FIXTURES

By W. OWEN

Keys and plugs of the type shown in the accompanying illustration enable milling, planing, and boring fixtures and the arbors of gear-hobbing machines, to be located on the machine tables without the heavy hammering which is frequently necessary. Such hammering nicks the slots of a table and in time causes the machine to become inaccurate. Two keys of the dimensions shown at *A* are employed for locating milling and planing fixtures. The dimensions given are standard for all machines, except dimension *X*, which must be made to suit the T-slot in the table of each particular machine. A slot of the size shown above the keys is milled across the base of the fixture to receive the keys, the fit between the keys and the slot being a sliding one. When the operator desires to mount a fixture on a machine table, he first places the keys in one of the table slots and then sets the fixture over them. This insures accurate location of the fixture.



Keys and Plugs of Standard Dimensions for locating Fixtures on Milling, Planing, Boring Machines, etc.

A plug for locating boring fixtures and gear-hobbing arbors on the tables of the respective machines, is shown at *B*, the dimensions given being standard for all cases, except dimension *Y* which must suit the hole of each particular table. The base of a fixture or arbor to be used in connection with such a plug is provided with a counterbored hole as shown in the illustration above the plug. The operator first places the plug in the hole in the table, and then sets the fixture or arbor over it, as in the previous case. The method of locating fixtures outlined in the foregoing not only gives accurate results but also saves a considerable amount of time, as it eliminates the filing of keys which have become abused while the fixtures and arbors are in the tool storage.

The Efficiency of Worm-gearing[1]

By W. S. ATKINSON

It is quite generally understood that the efficiency of worm-gearing is determined by the lead angle of the worm thread, by the degree of mechanical excellence attained in its manufacture, and by the kind of lubrication provided. A superficial examination of the subject discloses these facts, and experience and tests confirm them, but it is important to know the definite relation of these features to the efficiency. In the formulas which follow,

n = revolution per minute of worm;
l = lead in inches;
ϕ = lead angle;
μ = coefficient of friction;
d = pitch diameter of worm;
P = pressure, in pounds, transmitted axially by worm to wheel;
R = pressure, in pounds, normal to wheel tooth.

Consider a worm and wheel in which the worm is driving. When the worm makes one revolution, a point at its pitch diameter moves axially a distance equal to the lead, and a point on the pitch circle of the wheel also moves this distance. When the worm makes n revolutions per minute and there is a pressure of P pounds transmitted axially by the worm thread to the wheel tooth, the useful work transmitted, in foot-pounds per minute, is

$$\frac{Pnl}{12} \qquad (1)$$

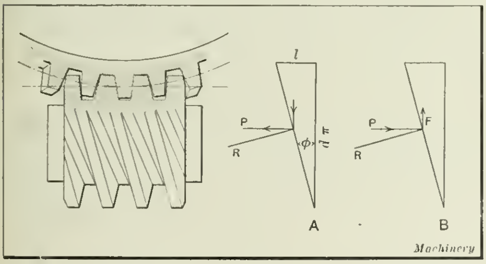


Diagram illustrating Conditions when Worm is the Driving Member and when Wheel is the Driving Member

The pressure normal to the wheel tooth is $R = P\cos\phi$ (see diagram A); the friction is $\mu R = \mu P\cos\phi$; and the work per minute against friction is

$$\mu P\cos\phi\,\frac{n\pi d}{12}\sec\phi = \frac{\mu P n\pi d}{12} \qquad (2)$$

The total impressed work then is

$$\frac{Pnl}{12} + \frac{\mu P n\pi d}{12} = \frac{Pn}{12}(l + \mu\pi d) \qquad (3)$$

The efficiency is the ratio of useful work, Formula (1), to impressed work, Formula (3), or

$$\frac{\dfrac{Pnl}{12}}{\dfrac{Pn}{12}(l + \mu\pi d)}$$

which reduces to

$$\text{Efficiency} = \frac{l}{l + \mu\pi d} \qquad (4)$$

Formula (4) is the expression for the efficiency of a worm and wheel with the worm driving. This expression can be further developed to show the efficiency as a function of the lead angle ϕ, and the coefficient of friction μ, by noting that

$$l = d\pi\tan\phi$$

which substituted in Formula (4) gives:

$$\text{Efficiency} = \frac{d\pi\tan\phi}{d\pi\tan\phi + \mu\pi d}$$

or

$$\text{Efficiency} = \frac{\tan\phi}{\tan\phi + \mu} \qquad (5)$$

From Equation (5) the accompanying table has been computed showing the efficiency for various lead angles, and coefficients of friction.

EFFICIENCY OF WORM-GEARING (THE WORM DRIVING)

Lead Angle, Degrees	Coefficient of Friction									
	0.10	0.08	0.06	0.04	0.02	0.01	0.008	0.006	0.004	0.002
5	0.466	0.522	0.594	0.683	0.813	0.897	0.915	0.935	0.956	0.977
10	0.638	0.688	0.703	0.815	0.898	0.946	0.956	0.967	0.977	0.988
15	0.728	0.770	0.814	0.870	0.930	0.964	0.971	0.978	0.985	0.992
20	0.784	0.819	0.858	0.900	0.947	0.973	0.978	0.983	0.989	0.994
25	0.823	0.853	0.886	0.921	0.958	0.979	0.983	0.987	0.991	0.995
30	0.852	0.878	0.905	0.935	0.966	0.983	0.986	0.989	0.993	0.996
35	0.875	0.897	0.921	0.945	0.972	0.985	0.988	0.991	0.994	0.997
40	0.893	0.913	0.933	0.954	0.976	0.988	0.990	0.992	0.995	0.997
45	0.909	0.926	0.943	0.961	0.980	0.990	0.992	0.994	0.996	0.998

Machinery

This table is instructive in showing the high efficiency attainable in worm-gearing when by careful machining and finishing and in the provision of adequate lubrication, the value of the coefficient of friction is kept low, and indicates the comparative difficulty of attaining the highest efficiency with low lead angles.

Efficiency and Torque when the Wheel is Driving

When the wheel is driving, the force is impressed at P and transmitted in the direction F, as shown by diagram B. The impressed force at F is $P\tan\phi$, and the work, in foot-pounds, in n revolutions of the worm is

$$P\tan\phi\,\frac{n\pi d}{12} \qquad (6)$$

The work per minute against friction is

$$\mu R\,\frac{n\pi d}{12}\sec\phi = \mu P\cos\phi\,\frac{n\pi d}{12}\sec\phi = \mu P\,\frac{n\pi d}{12} \qquad (7)$$

The useful work is

$$P\tan\phi\,\frac{n\pi d}{12} - \mu P\,\frac{n\pi d}{12} = \frac{Pn\pi d}{12}(\tan\phi - \mu) \qquad (8)$$

The efficiency is the ratio of the useful work, Formula (8), to impressed work, Formula (6),

$$\frac{\dfrac{Pn\pi d}{12}(\tan\phi - \mu)}{\dfrac{Pn\pi d}{12}\tan\phi}$$

Therefore

$$\text{Efficiency} = \frac{\tan\phi - \mu}{\tan\phi} \qquad (9)$$

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[1] Paper presented at the fourteenth semi-annual convention of the Elevator Manufacturers' Association of the United States, Toledo, Ohio, October 27, 1920

or

$$\text{Efficiency} = \frac{l - \mu\pi d}{l} \qquad (10)$$

The available pressure at the pitch line of the worm (torque T at pitch line) and tending to turn it is

$$T = \frac{\dfrac{Pn\pi d}{12}(\tan\phi - \mu)}{\dfrac{n\pi d}{12}}$$

$$= P(\tan\phi - \mu) \qquad (11)$$

$$= P\left(\frac{l}{\pi d} - \mu\right) \qquad (12)$$

It will be noted that when the value of μ approaches that of $\frac{l}{\pi d}$ or $\tan\phi$ a comparatively great pressure P at the pitch line of the wheel is required to produce a torque in the worm, and when μ equals $\frac{l}{\pi d}$ or $\tan\phi$ no amount of pressure P at the pitch line of the wheel will produce torque in the worm, and the gearing is then irreversible or self-locking.

* * *

PRODUCTION WORK ON THE VERTICAL TURRET LATHE

A production job for which the vertical turret lathe is especially suitable is illustrated and described in this article. This machine, manufactured by the Bullard Machine Tool Co., Bridgeport, Conn., is shown in Fig. 2 engaged in finishing the exterior surfaces of a cream separator bowl at the plant of the De Laval Separator Co., Poughkeepsie, N. Y. This bowl is a steel forging made from acid open-hearth steel, a detail view of which is shown in Fig. 1. This illustration indicates by the dotted outline the amount of metal removed in finishing the bowl to the outline shown in full lines. The hole *H* is first bored with a tool held in boring-bar *A*, Fig. 2, this operation being performed while a tool held in the square side-head *B* is engaged in roughing surface *A*, Fig. 1, of the bowl. The next operation is that of rough-facing surfaces *B* and *C*, using a combination tool-holder shown at *C*, Fig. 2, while at the same time a forming tool held in the side-head, rough-forms the radius at the top of the bowl. It will be observed that the machine is shown taking these two cuts. The angular surface *D* is next roughed out with a tool carried in the third side of the turret, the compound feed of the machine being employed for this purpose. The fourth operation is that of finishing this angular surface, using the same tool but employing an increased rate of table speed. A tool-holder similar to that used in roughing surfaces *B* and *C* is next employed to finish these surfaces, the tool-holder being shown at *D*, Fig. 2. While these surfaces are being finished, a forming tool held in the side-head is engaged in finishing the radius at the top of the bowl. The final operation performed is that of finish-turning surface *A*, during which the speed of the table is considerably increased.

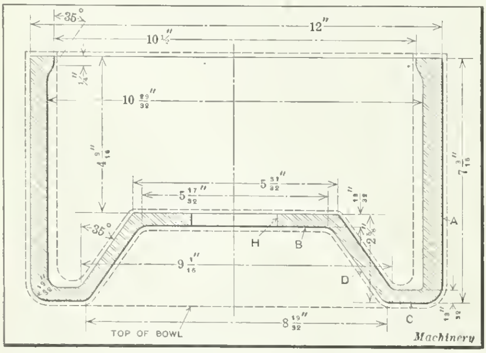


Fig. 1. Cream Separator Bowl finished on the Exterior on Machine shown in Fig. 2

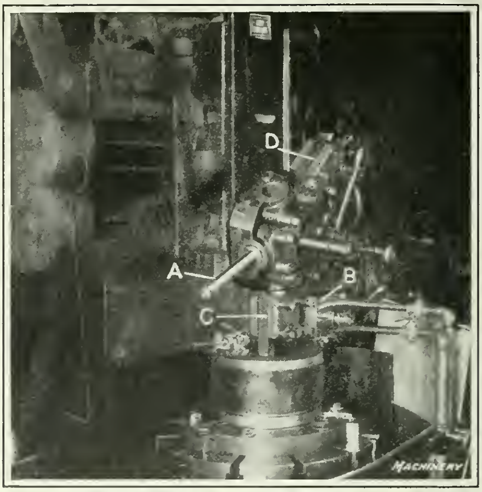


Fig. 2. Vertical Turret Lathe engaged in machining Cream Separator Bowl Forgings

The production time on this job is fifty-two minutes, floor to floor, and thirty-five shells may be finished between grindings of the tools. A feed of 0.007 inch per revolution of the table is employed for the tools; and the velocity of the table during the roughing operations is forty revolutions per minute, and for the finishing operations, 60 revolutions per minute, with the same rate of feed.

* * *

ENAMELS FOR SHEET IRON AND STEEL

The enameling of sheet iron and steel has been treated in detail in a recent publication of the United States Bureau of Standards, entitled "Enamels for Sheet Iron and Steel," by J. B. Shaw. As little material has been published on this subject in the past, the pamphlet is an interesting addition to technical literature. From the standpoint of mechanical equipment, the sheet-iron and steel enameling industry has probably been the most progressive of all the ceramic industries in the United States. The presses and machinery used for working this steel and forming the shapes are very ingenious, and are constantly being improved. In the preparation and application of the enamels, however, progress has been less rapid. Up to a few years ago very little of this work was carried on, but recently there has been a decided change in this respect.

The material contained in the treatise represents a compilation of data from various publications; from the notebook of the author; from the files of the Bureau of Standards; and from the experience of men engaged in the enameling industry in this country. Among the subjects dealt with in connection with the properties and preparation of steel for enameling are physical and chemical requirements; sandblasting; treatment preliminary to pickling; and methods of pickling. A chapter is devoted to the properties of the raw materials used in compounding enamels. The relations between chemical composition and physical properties of enamels are discussed fully, and the procedure used in the preparation, applying, and firing of enamels is described in detail. The calculation of enamel formulas is fully explained. The physical properties of enamels are dealt with, and their resistance to chemical action is discussed.

Follow-up System for the Drafting-room

A System for Recording the Status and Daily Progress of Work During the Process of Manufacture

By JOHN A. HONEGGER

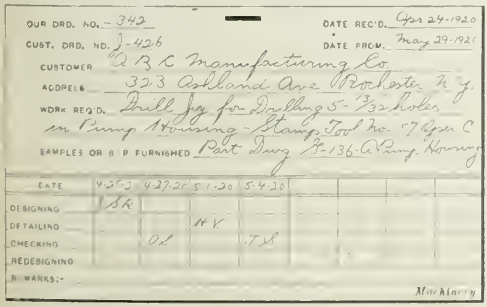
A FOLLOW-UP system bears the same relation to manufacturing as train dispatching does to the operation of a railroad. If a train dispatcher does not regulate the time between trains properly, or if the procedure of the trains throughout their runs is not followed, one of two things usually occurs: Either several trains run into each other, or they do not reach their respective destinations on time. The latter also holds good in manufacturing; without some method of recording the daily progress of each job, there is no assurance that orders will be delivered at the time promised. This is because the contractor cannot definitely state when the job will be completed if he does not know the standing of the various orders in the plant. From the foregoing it should be obvious that a proper follow-up system is just as important in building up a successful business as methods of routing orders through the various departments or inspecting the work when completed.

Developing a Follow-up System

In developing a follow-up system, consideration should be given to existing methods of handling work, to insure that the new system will not interfere with them or reduce their efficiency. The primary function of a follow-up system is to see that orders are kept progressing through the plant in such a manner that their delivery to the customer on time is insured. To this extent the system should have preference over every other part of the organization; otherwise the desired result will not be obtained. Numerous other factors must be considered before the system can be made operative; these, of course, vary according to the nature of the product manufactured.

When a system has been worked into definite shape, it should be carefully checked to find possible defects; the following points should be given careful consideration: (1) Can it be handled in a simple manner? The percentage of efficiency of any given action is rated upon the ease and accuracy with which it is accomplished; therefore, the less complicated a system, the more efficient it will be, provided it will produce the desired results. (2) Will it produce the desired results? This can be determined by applying it to situations that have occurred in the past. (3) What will it cost? (4) Is it fool-proof? (5) Will it interfere with any other system in use? (6) What advantage has it over the present system?

In regard to the third question, the greatest cost is obtained in working out the system; after that, printing charges mainly are involved. The answers to the fourth, fifth, and sixth questions can be determined by going over every detail of the system carefully and by making a practical application on a small scale. This practical application may also bring to light defects that otherwise might not be thought of. Taking the foregoing as a basis to work from, the firm by whom the writer is employed, devised a system for their engineering department, which has been in successful operation for over a year. This system, which is



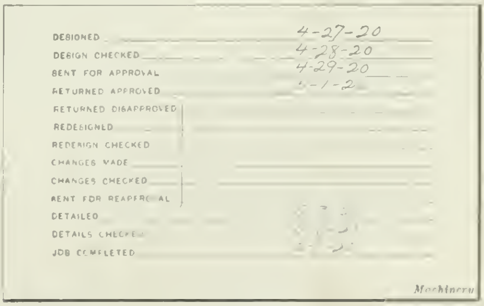
OUR ORD. NO. 342
DATE REC'D. Apr 24-1920
CUST. ORD. NO. J-426
DATE PROM. May 29-1920
CUSTOMER ABC Manufacturing Co.
ADDRESS 323 Ashland Ave Rochester N.Y.
WORK REQ'D. Drill Jig for Drilling 5-13/32 holes in Pump Housing - Stamp Tool No. 57 Ryser C
SAMPLES OR B P FURNISHED Part Dwg G-136-A Pump Housing

DATE	4-25-20	4-27-20	5-1-20	5-4-20			
DESIGNING	BK						
DETAILING			HV				
CHECKING		OL		TS			
REDESIGNING							

REMARKS:-

Machinery

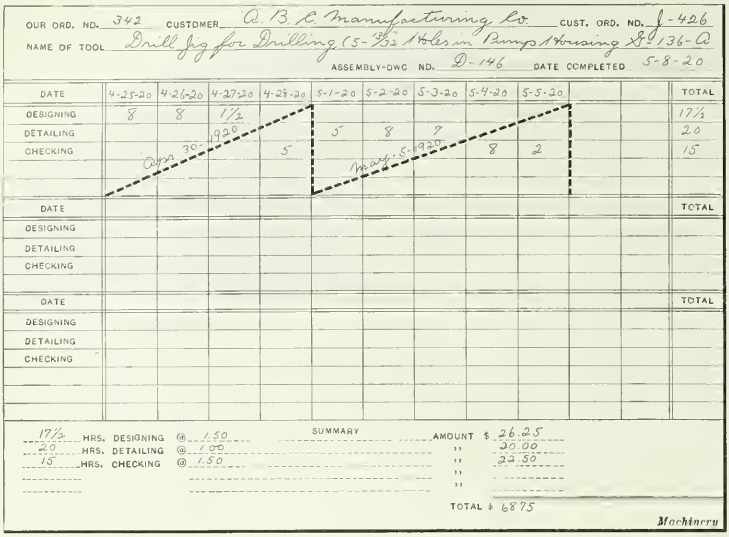
Fig. 1. Form which is filled out in Triplicate when an Order is received, and during its Progress through the Drafting-room



DESIGNED 4-27-20
DESIGN CHECKED 4-28-20
SENT FOR APPROVAL 4-29-20
RETURNED APPROVED 5-1-20
RETURNED DISAPPROVED
REDESIGNED
REDESIGN CHECKED
CHANGES MADE
CHANGES CHECKED
SENT FOR REAPPROVAL
DETAILED [illegible]
DETAILS CHECKED [illegible]
JOB COMPLETED [illegible]

Machinery

Fig. 2. Form stamped on the Back of the Triplicate Order Card to record Dates when Certain Work is completed



OUR ORD. NO. 342 CUSTOMER A. B. C. Manufacturing Co. CUST. ORD. NO. J-426
NAME OF TOOL Drill Jig for Drilling (5-13/32" Holes in Pump Housing G-136-A
ASSEMBLY-DWG NO. D-146 DATE COMPLETED 5-8-20

DATE	4-25-20	4-26-20	4-27-20	4-28-20	5-1-20	5-2-20	5-3-20	5-4-20	5-5-20			TOTAL
DESIGNING	8	8	1½									17½
DETAILING					5	8	7					20
CHECKING				5				8	2			15
DATE												TOTAL
DESIGNING												
DETAILING												
CHECKING												
DATE												TOTAL
DESIGNING												
DETAILING												
CHECKING												

Apr. 30 1920

May. 5 1920

SUMMARY

17½ HRS. DESIGNING @ 1.50 AMOUNT $ 26.25
20 HRS. DETAILING @ 1.00 " 20.00
15 HRS. CHECKING @ 1.50 " 22.50
TOTAL $ 6875

Machinery

Fig. 3. Card on which the Time consumed on a Job and the Costs involved are recorded and summarized

described in the following, can no doubt be modified to suit various other departments.

Follow-up System Used in an Engineering Department

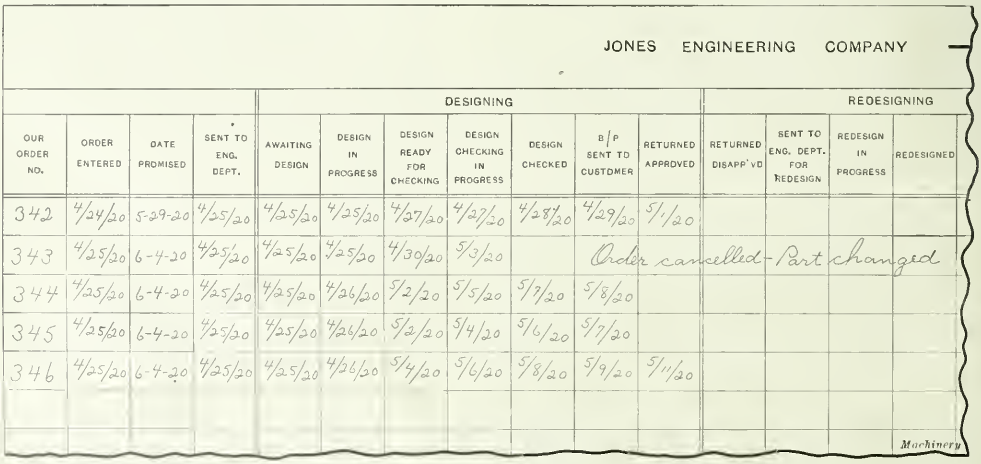
The firm mentioned contracts for manufacturing a variety of work such as tools, fixtures, gages, special machinery, etc., and normally employs about twenty draftsmen. The forms used in the follow-up system are shown in the accompanying illustrations, and in order to make their use fully understood, it will be assumed that an order has been received, and this order will be followed through the office and the engineering department until it has been completed.

Immediately after the order has been received, the hour and date of receipt are stamped on it in some conspicuous space, usually at the top. The order is then sent to the order department, where several forms are filled out. First the order is entered in a book having forms such as shown in Fig. 1. There are six forms to the page and they are made out in triplicate, the first two being on bond paper and the third on a heavy paper similar to bristol-board. It will be noted that the first item on the forms is "Our Order No." This is put on so that the job can be identified at all times by this number. The remaining items are arranged according to their relative importance.

When the forms have been filled out, the duplicate and triplicate are detached and fastened together. The original form is left in the order book as a record. The back of the triplicate card is then stamped with a rubber stamp, as shown in Fig. 2, which is filled out when the work designated is completed. When a draftsman begins working on a job his initials and the date on which he started work are placed on the front of the card by the routing clerk. When the draftsman finishes, his initials and the date of completion are placed on the back of the card. By this method, if any trouble arises in the future concerning a particular job, reference to the order card of that job will show what men have worked on it. The main purpose of the forms, however, is to inform the chief draftsman where every job in the drafting-room is.

The second form to be filled out is the time and cost card shown in Fig. 3, which is used to summarize the time spent on the job and the costs involved. The items at the top of this card are similar to those on the order forms. The dates at the heads of the columns are filled in as the order is worked upon. It sometimes happens that when a job is sent to the customer for approval, it is not returned for several days, and if the dates were printed in the spaces, it would mean that a number of columns would have to be left blank. As it is, one column after the other may be used. The blank spaces beneath "Checking" are provided for any miscellaneous charges, such as extra blueprints, etc. The customer is billed from this card, and when a bill has been made out, a red line is drawn diagonally from beneath the charges to the date on which the bill was made out, as shown by the heavy dotted lines. The date of billing is then written or stamped along the diagonal line.

The next form to be filled out is illustrated in Fig. 4 and



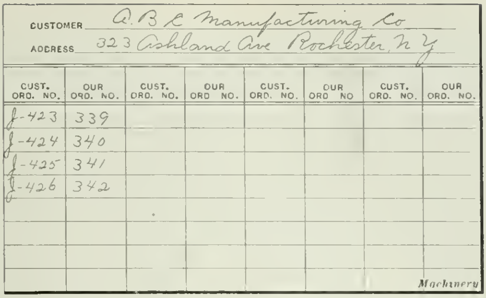
JONES ENGINEERING COMPANY

				DESIGNING							REDESIGNING			
OUR ORDER NO.	ORDER ENTERED	DATE PROMISED	SENT TO ENG. DEPT.	AWAITING DESIGN	DESIGN IN PROGRESS	DESIGN READY FOR CHECKING	DESIGN CHECKING IN PROGRESS	DESIGN CHECKED	B/P SENT TO CUSTOMER	RETURNED APPROVED	RETURNED DISAPP'VD	SENT TO ENG. DEPT. FOR REDESIGN	REDESIGN IN PROGRESS	REDESIGNED
342	4/24/20	5-29-20	4/25/20	4/25/20	4/25/20	4/27/20	4/27/20	4/28/20	4/29/20	5/1/20				
343	4/25/20	6-4-20	4/25/20	4/25/20	4/25/20	4/30/20	5/3/20		Order cancelled - Part changed					
344	4/25/20	6-4-20	4/25/20	4/25/20	4/26/20	5/2/20	5/5/20	5/7/20	5/8/20					
345	4/25/20	6-4-20	4/25/20	4/25/20	4/26/20	5/2/20	5/4/20	5/6/20	5/7/20					
346	4/25/20	6-4-20	4/25/20	4/25/20	4/26/20	5/4/20	5/6/20	5/8/20	5/9/20	5/11/20				

Machinery

Fig. 5. Progress Card which is used by the Routing Clerk of the Drafting-room to record the Status of Various Jobs

is known as the "key card." The majority of customers desiring information as to the standing of an order, refer to the work by their own order number, and this key card, by giving the corresponding shop order number, saves much confusion in replying to such queries. These cards are filed alphabetically according to the name of the manufacturer. The time and cost cards are filed under the shop order number, while the duplicate and triplicate order forms and all drawings and samples submitted by the customer are sent to the engineering department.


CUSTOMER A. B. C. Manufacturing Co
ADDRESS 323 Ashland Ave Rochester, N.Y.

CUST. ORD. NO.	OUR ORD. NO.	CUST. ORD. NO.	OUR ORD. NO.	CUST. ORD. NO.	OUR ORD. NO.	CUST. ORD. NO.	OUR ORD. NO.
J-423	339						
J-424	340						
J-425	341						
J-426	342						

Fig. 4. Key Card, giving the Customer's Order Number and the Corresponding Shop Order Number of the Manufacturer

Work of the Drafting-room Routing Clerk

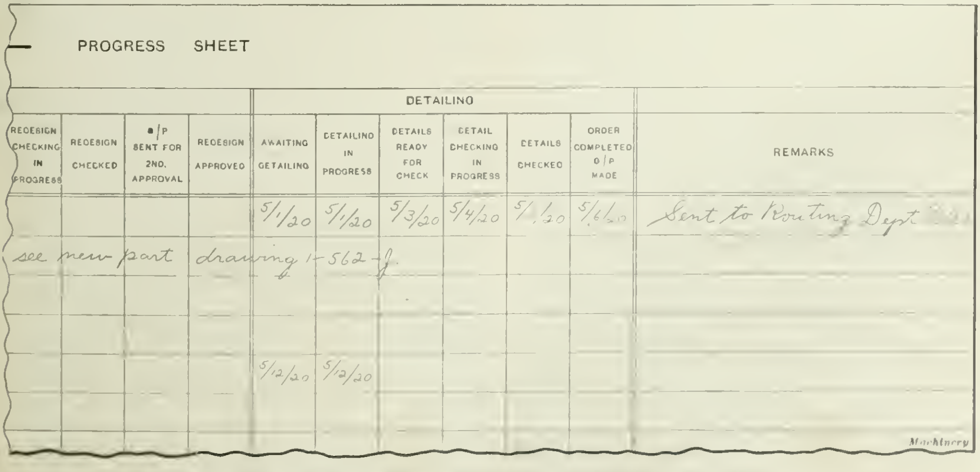
Upon receipt of the order forms, the chief draftsman gives them to the routing clerk who enters the orders on a progress sheet, as illustrated in Fig. 5. This sheet is divided into the following main headings: Designing, redesigning, and detailing, which are subdivided into other headings to indicate the various stages in the progress of the work. The latter items are a combination of those on the front and back of the triplicate order card. The routing clerk fills in the first five columns from the information given on the order forms, after which the order forms are filed in the progress file. This file has a subdivision for each item contained on the progress sheet such as "Awaiting Design," "Design in Progress," etc., except those referring to the return of the work sent to the customer for approval. The forms are filed according to the status of the order, irrespective of the name of the customer.

It may seem unnecessary to have a redesigning section, but often the operations to be performed on a part or the design of the parts is so changed that a redesign of the tool is necessary. A filing cabinet is provided for the disposal of the drawings after the tool has been designed and while they are in the drafting-room, but are not being worked with. This cabinet has eight drawers, marked to suit the following conditions: "Design Ready for Checking"; "Design Checked"; "To be Redesigned"; "Redesign Ready for Checking"; "Redesign Checked"; "Awaiting Detailing"; "Details Ready for Checking"; and "Drawings to be Blueprinted."

All work is given out by the routing clerk and returned to him when completed. The chief draftsman concerns himself only with the manner in which the work is executed by the men and goes from board to board, making suggestions or giving instructions. In this way he is more likely to catch errors while the drawings are being developed. When a draftsman completes a job, he reports to the routing clerk, who consults the order file and selects another job for him. For instance, if a designer desires a new job, the routing clerk looks over all orders waiting designing and selects one that indicates the earliest delivery date. Then he obtains from the drawing cabinet the drawings and operation sheets submitted by the customer. He next gives the duplicate order form and drawings, etc., to the designer, enters the date and the initials of the designer on the triplicate order card, and files it under "Design in Progress." He also enters the date on the progress sheet in the column "Design in Progress." The duplicate order form remains with the job until completed.

When the designer has completed the drawings for the tool, he fills out a time sheet as shown in Fig. 6; however, such a slip is filled out daily if the job lasts longer than one day. Then, with the time slip, order slip, part drawings, and the completed design, he again reports to the routing clerk who files the design in the drawer containing designs ready for checking, removes the triplicate order card, marks the date in the proper place on the back, and files it under "Design Ready for Checking." He also marks the date in the proper column on the progress sheet. The order cards are moved toward the back of the file in each instance while the drawings are moved from the top to the next lower drawer, until both the cards and drawings, respectively, arrive at the final section and drawer.

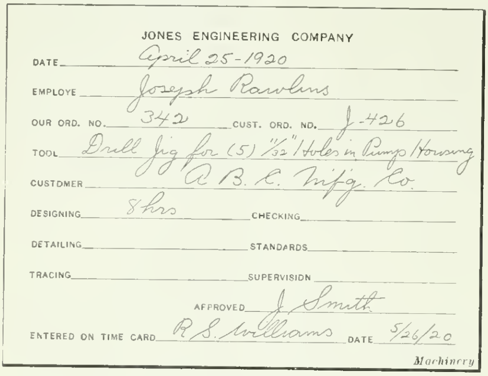
The main purpose of the progress sheet is to permit the routing clerk to tell at a glance the standing of all jobs on hand; without it, it would be necessary to go through the various sections of the order card file before this information could be obtained. With this system, for example, if the A. B. C. Mfg. Co. wished to know the progress of its order J-426, it would only be necessary to refer to the key


PROGRESS SHEET

				DETAILING						
REDESIGN CHECKING IN PROGRESS	REDESIGN CHECKED	B/P SENT FOR 2ND. APPROVAL	REDESIGN APPROVED	AWAITING DETAILING	DETAILING IN PROGRESS	DETAILS READY FOR CHECK	DETAIL CHECKING IN PROGRESS	DETAILS CHECKED	ORDER COMPLETED O/P MADE	REMARKS
				5/1/20	5/1/20	5/3/20	5/4/20	5/[illegible]/20	5/6/20	Sent to Routing Dept
see new part drawing 1-562-J.										
				5/12/20	5/12/20					

going through the Department so that the Chief Draftsman can tell at any Time what Progress is being made on a Job card in Fig. 4 to find the corresponding shop order number to be 342. By referring to this number on the progress sheet, the desired information can be obtained.

When a job has been completed, the date of completion is marked on the back of the order card, and it is then sent to the time and cost clerk, who marks the card illustrated in Fig. 3 to suit. The billing clerk is then notified that the order has been completed, and the customer is billed for the remaining hours, the total cost of the job being carried under the summary. The assembly drawing number is marked on this card as information which may be of value on future jobs. A record print of the assembly drawing is also kept for the same purpose. It has been found advantageous to file the order cards and record assembly drawings according to the shop order number, and the time and cost cards under such headings as "Drill Jig," "Reaming Fixture," "Boring Fixture," etc. The drawings are folded and filed in the same manner as correspondence. Estimating future orders of a similar nature is made an easy matter under this system because of the data on hand. Costs and deliveries can also be given customers with some assurance that the jobs will be finished on time and at the prices estimated.



JONES ENGINEERING COMPANY

DATE April 25-1920

EMPLOYE Joseph Rawlins

OUR ORD. NO. 342 CUST. ORD. NO. J-426

TOOL Drill Jig for (5) 11/32" Holes in Pump Housing

CUSTOMER A. B. C. Mfg. Co.

DESIGNING 8 hrs CHECKING

DETAILING STANDARDS

TRACING SUPERVISION

APPROVED J. Smith

ENTERED ON TIME CARD R. S. Williams DATE 5/26/20

Machinery

Fig. 6. Time Slip filled out daily by the Draftsmen and upon the Completion of a Job

* * *

ELECTROMAGNETIC PROCESS OF REMOVING INTERNAL STRAINS

An electromagnetic process and apparatus for removing internal strains from forgings, stampings, and castings has recently been patented by Lars G. Nilson, Hoboken, N. J. The object of the invention is to provide a means of quickly and cheaply removing internal strains from gears, shafts, tools, cylinders, and other metallic articles which must retain their exact shape and dimensions as closely as possible, even if subjected to rough usage. It is a well-known fact that internal strains are set up in metal articles during forging, drawing, hardening, and casting operations; in fact, almost any operation which is commonly employed in the production of machine parts produces internal strains in the parts, or modifies existing strains.

Parts containing such internal strains naturally tend slowly to eliminate the strains at ordinary temperatures. This process of elimination is necessarily accompanied by changes in the shape or form of the part. Therefore to produce parts that will permanently maintain their accuracy, it is necessary that the internal strains be removed. In the case of castings the strains may often be sufficiently reduced to meet the requirements by seasoning, which is simply a process of setting the rough-machined castings away until the internal stresses have been practically eliminated by natural processes. This method, however, is slow and like the annealing and tumbling processes used for eliminating internal strains, does not meet present-day requirements of large manufacturers.

Briefly, the new process consists of subjecting the article to be treated to a powerful interrupted magnetic field, preferably an alternating electromagnetic field under such conditions of flux, density, time, and temperature as to remove internal strains quickly without affecting the desired hardness, tensile strength, or other desired characteristics of the article being treated. In the accompanying diagram is shown the general plan of an electromagnetic equipment, in which provision has been made for controlling the temperature of the part under treatment. The coil *A* is wound over a horseshoe shaped core *B*, and a tank *C* is placed between what would ordinarily be the poles of the core, the part to be treated being immersed in the tank. The tank can be filled with water, oil, fused metal or salt, or other liquid having the temperature desired for the combined drawing and magnetizing treatment, or combined cooling and magnetizing treatment.

Circulation is provided by a pump *D*, and cooling or heating is accomplished when necessary by the use of coil *E*, which is connected to the tank by pipes *F* and *G*. By means of this arrangement, hardened articles of steel such as milling cutters can be put in the tank and subjected to the alternating magnetic field without objectionable rise in temperature, since the temperature can be controlled by the circulation of the liquid to give the desired draw or to keep the eddy currents from raising the temperature.

Many articles made of high-carbon steel are spoiled during quenching, due to internal strains, and they often crack or warp a long time after being finished, in some cases even while in the store-room. It is claimed that treating such articles preferably just before the final grinding, or simultaneously with the drawing or tempering operation, insures a finished article which will be practically free from internal strains and which will permanently retain its finished form. The commercial value of this process lies in the fact that it saves much time and labor now required in manufacturing such products as high-grade machine tools intended for accurate work. Various modifications of the process and apparatus here described are made to meet special requirements. More complete information regarding the process and its special applications may be obtained from patent No. 1,335,453.

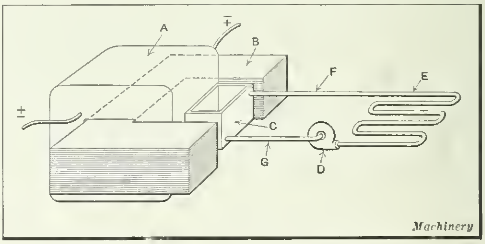


Diagram showing Arrangement of Electromagnetic Apparatus for removing Strains from Metal Products

* * *

ANNUAL MEETING OF THE TAYLOR SOCIETY

The annual meeting of the Taylor Society will be held in the Engineering Societies' Building, 29 W. 39th St., New York City, December 2, 3, and 4. Public sessions will be held Friday and Saturday forenoon, afternoon, and evening. The subjects dealt with will be "Scientific Management in the Sales Department"; "The Long Day in the Steel Industry—a Problem in the Engineering of Men"; "The Standardization of Products"; and "Risk as a Retarding Factor in Production." The discussions will bring out the point of view of the manufacturer, the merchandiser, the industrial engineer, organized labor, and the consumer, each represented by a well-known speaker.

Increasing Production by Training Workers

Purposes and Principles Underlying the Establishment of a Training Department in the Plant of the Norton Co., Worcester, Mass.

By JOHN C. SPENCE, Superintendent Grinding Machine Division, Norton Co., Worcester, Mass.

EVERYBODY talks about the necessity for increased production and calls attention to the fact that the cost of living can be reduced principally by this means; but few definite proposals have been made whereby production can actually be increased. It seems to be the opinion of most of those people who advocate increased production that the increase should come merely by the worker doing more of his own accord, and little attention has been given to the duties and responsibilities of the management of an industrial plant in aiding the worker to produce more. In the following article the writer intends to point out some of the conditions that retard production, in the machine building trade especially, and to outline some of the principles that must be observed in making it possible for the worker to produce more.

In dealing with this problem, the open shop only is considered, because only in the open shop can the management freely aid the workers in increasing their production by means of proper training for the work to be done. In the closed shop the management is restricted in its efforts to aid the men in properly performing their work. It has to consult outside men, entirely removed from the industry, as to the number of people that may be trained and the method in which they are to be taught. The length of the period of training is prescribed; and, generally speaking, the constructive thought and ability of the management is absolutely nullified by the restrictions placed upon its efforts by union regulations, with the result that an arbitrary limit is placed, not only upon the worker's productive capacity, but upon his earning ability as well.

In the open shop, the management has a free hand to train the workers so as to enable them to earn good wages in a short period of time, and is also at liberty to provide any means and facilities whereby the production can be increased and to adopt such rules and methods as will be equally advantageous to the employer and the employe.

Hiring Men from Other Plants versus Training Them Yourself

One of the practices in the management of industrial plants that has done much to decrease production, when the whole industry is considered as a unit, is that of hiring workers from other plants instead of obtaining untrained men and giving them the required training for the work to be done. Whenever a skilled worker is hired from another shop, there is merely a transfer from one shop to another, which does not in the least help the labor situation as a whole. The neighboring shop that loses its skilled men in this way is forced to adopt the same plan, and as likely as not will hire other workers from the first plant, so that there is ultimately merely an exchange of labor. Meanwhile, by these practices some of the workers who otherwise would have learned to stick to a worthwhile job have become rovers, because they find it easy to jump from job to job. This condition is a bad one for the men themselves as well as for the industry.

The only remedy in busy times is that of training unskilled help to perform whatever class of work is required. Those who have learned the fallacy of hiring men from their neighbors, and who years ago have adopted a plan of training their own help, know that intelligent, although inexperienced, men under proper conditions of training soon become better producers than the average men available in busy times who claim to have had previous experience in other shops.

To provide for proper training, it is necessary to have good teachers. Few people are good teachers. Out of twenty foremen it is seldom that more than one is a really good instructor. This means that in nineteen departments beginners do not have the opportunity to quickly become big earners both for themselves and for the company. It is therefore necessary to have a training department where all beginners pass through the initial training that one or more good teachers can give. This will insure uniform results. To provide such a department, it does not mean that it is necessary to purchase a great deal of new machinery and to incur great expense. As will be explained in a following article, the expense is nominal and will soon be more than balanced by the results obtained.

Scope and Advantages of the Training Department

A training department need not necessarily be confined to the instruction of inexperienced people. In busy times this, of course, would be its main object, but the true measure of the value of a training department is its work during a period of years representing a fair average of conditions. Almost any manager, superintendent, or foreman will admit that there is an advantage in setting up a training department when that scheme offers the only available means of obtaining more help; but, naturally, he wants to know what to do with the training department when the rush is over and help is more plentiful.

In order to answer this question, we must take into consideration the fact that in most plants there are several grades of work—some comparatively simple and others more involved. The machines doing the simpler work can be grouped together, and to these machines are routed the same class of work that they have been doing in the past, but they are used in a department by themselves as a starting point for beginners, who are then promoted from this job to something more complicated in the main shop. A training department properly conducted should be run as a production department from the outset, because there are several distinct advantages to be gained thereby; first, it avoids the fear which the apprentice frequently feels when he is shifted from the training department to a "real job"; and secondly, men already employed in the shop, who are willing workers but whose efficiency falls somewhat short of the desired degree, may be placed in the training department for a brief period until they have obtained suitable proficiency in their work. While in the training department, they will still be employed on productive work, and there is no need of considering their time lost or their work unproductive.

The Duty of the Management in Obtaining Increased Production

In the open shop where the management has the power to arrange the work in the best interest of production, the main reasons for low production rates are: (1) Lack of tools or materials; (2) physical inability to do justice to the job; (3) lack of training; (4) lack of full information, even though the worker is trained; and (5) willful restriction on the part of the worker. For all of these causes, even the one mentioned last, the management is responsible. Each of these questions will be taken up in turn in this and following articles, and proper and effective remedies will be outlined.

Lack of Tools or Materials

It is unnecessary to point out that the management alone is responsible for lack of tools or materials; yet production is restricted in many instances because the important duties of the management in this connection are neglected. Tools and materials are not ready for the worker when he is ready to start on a new job. In too many places the decision as to what constitutes an economical supply of material to work upon and proper means for doing the work is made by someone who is a good bookkeeper, but who does not understand the productive processes in the shop and who does not know that men will work faster when there is plenty of work in sight and when the methods are such as to require the least amount of physical exertion. This subject has been dealt with extensively in the past, and employers are gradually beginning to see the necessity for more systematic means for providing the workers with the proper tools and materials for keeping production going.

Physical Incapacity for the Job

There are many instances where the worker is physically unfit to do justice to the job that has been given to him. Every industry should subject the workers to a physical examination before they are put to work, in order to determine that their health and strength is such that they are suited for the work they are expected to do. Such a physical examination, followed by proper medical attention after the employe has gone to work, has two advantages: It will prevent a man who is physically unfit for a certain class of work from being engaged upon it; and it will reduce the lost time due to sickness and injury. This has been proved in many shops where the practice of subjecting employes to a physical examination and of maintaining a shop hospital has been followed. On this subject also a great deal has been written in the past, and details are available for those who wish to study the subject further.

Lack of Proper Training

The most important factor of all, in the writer's opinion, is the lack of proper training, and it is with this factor that this article mainly deals. Quantity production and interchangeable manufacture have changed the conditions of production. Operators, rather than skilled mechanics, are employed on the general manufacturing work. In the interchangeable manufacturing industries, men are hired to "run" machines. They need not be skilled machinists, and for that reason the old-time apprentice system gradually has been discontinued. Even foremen are often drawn from the ranks of the operators, and in most cases these men have not had the advantages of the broader views that go with an all-around training.

Efforts are being made in some shops to revive the apprentice system, in order to supply the needs for future all-around machinists. In the writer's opinion all-around men can be trained quicker and better in a special training shop than they can be by old-time apprenticeship methods. Complete details will be given in this and following articles of the organization and methods used by the training school that was started by the writer in December, 1915, at the plant of the Norton Co. for the purpose of giving absolutely "green" help a few weeks of intensive training in the elements of work on the various common machine tools—the lathe, drilling machine, milling machine, grinding machine, and shaper.

It is not claimed that you can produce an all-around machinist in a few weeks; but it is claimed that in this short time a man can be trained to operate a certain type of machine tool very much more quickly than he could be taught to operate this machine under the old-time apprenticeship system. If he is successively trained in one type of machine tool after the other, with intervals of work on the same types of machine tools in the regular shop departments, he will at the end of two years be as good an all-around machinist as the apprentice who has received a four-year's training by the old-time apprenticeship methods, where he is at the mercy of the teaching abilities of the foremen and his fellow-workers in the shop.

Reasons for a Training Department

The reasons that led to the establishment of the Norton Co.'s training department may be briefly stated as follows: Good teachers are rare, and when one has been found who meets the requirements, all the beginners should be given the advantage of being taught by him. The best workman is not always a good teacher, and it is a waste of executive or productive ability to have high-grade foremen or producers instruct beginners, when this often can be done by men who are not as important in the productive organization. A high-grade foreman is likely to be a poor teacher, just the same as a professor of higher mathematics probably would fail in attempting to teach beginners arithmetic, because his training and habits of thought have put him entirely out of sympathy with those so far behind him in mental capacity.

The training department further insures that all the beginners receive the same kind of training, and this training can be regulated to the needs of the whole shop organization. The training department also affords an opportunity for teaching questions of corporation policy. It is possible in this way to make the employe understand his relation to the shop, and to the industry as a whole, and to teach him certain economic facts that even foremen sometimes do not appreciate. One of these facts is that the money with which the men are paid on each pay-day comes out of their own labor, and if they curtail production, they also decrease the fund out of which their wages are to be paid. When wages become too high in proportion to production, industry must stop, because no business can continue to operate in face of a loss.

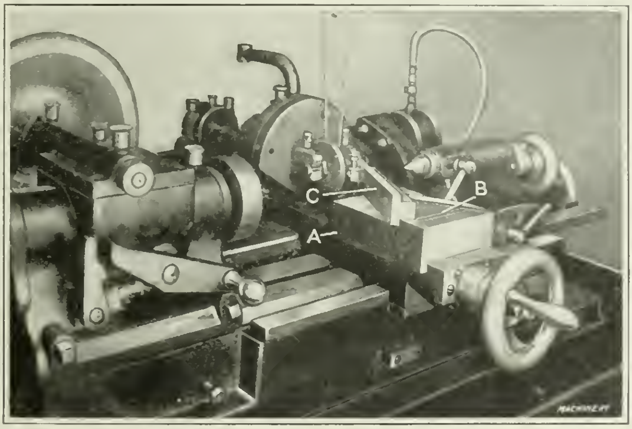
The workers can also be taught to understand that the expenses of a business comprise more than the payment of wages to the men at the machines. The product made must be sold, and the money for the sold product collected, before there is anything wherewith to pay wages. It would be well if the workers in the industries had a little more appreciation of the difficulties involved in gathering together fifty-two pay-rolls every year. The training department offers an opportunity for teaching this and for counteracting the many false but popular theories of economics that are propagated. It provides an opportunity to teach the truth about the relations of the worker to the industry, and of the industry to the community as a whole.

What Does a Training Department Accomplish?

While, as already stated, it is not claimed that machinists or even high-class operators are made by the training method in the short time that each worker averages in the training department—about six or eight weeks—it has been established that it is possible to obtain a higher grade of boy or man to start to work in the shop when he is assured that he will receive an intensive training from the first. It has further been established that better workers can be produced in eight weeks in the training department than the employment department can hire, except, of course, in the case of the few skilled men who may apply for work. It has further been found that the graduates of a training department, when put into the regular shop departments, make better workers than those who have been put into the shop without training.

Results Obtained by the Norton Training Department

The best proof that can be given of the value of a training department is to record the results that have been obtained by the Norton Co. during the last five years. Records of results are always better than mere arguments in favor of a certain procedure. During the war, 65 per cent of the men employed at the Norton Co. were in the first draft, but thanks to the training school, new workers were trained at such a rate that the company was able to continue with an ever increasing production in spite of the fact that the draft board was compelled to be drastic in its rulings. At the time the armistice was signed, over one-half the workers in the plant had less than four months' experience, and 15 per cent of the total number of workers were women. Nevertheless, with only twice the number of employes in 1917 and 1918, compared with the number of employes in 1912 and 1913, the Norton Co. produced and shipped three times as many machines, and furthermore it is claimed that in these machines the quality of the pre-war period was not only maintained but improved.



Device used for truing Formed Wheels used for grinding V-threads

It should not be understood that all this increase in production was obtained through the efforts of the training department. In part it must be attributed to other causes, such as the improvement in the manufacturing departments and the encouragement of piece-work. More effort was made to provide drawings and operation sheets that gave complete information as to how the work was to be done, and by a properly conducted piece-work system, the employes were encouraged to work to the full extent of their ability without fear that the piece rates would be cut. This phase of the subject will be dealt with in a subsequent article. The actual organization and methods used in the training school will be dealt with in an article in the January number of MACHINERY.

* * *

Owing to the unprecedented levels to which prices of railroad cross-ties have risen in this country, and to the increasing scarcity of the North American wood used for this purpose, the Pennsylvania Railroad has decided to investigate the adaptability for this purpose and the relative cost of the hard woods of Central and South America. Under normal conditions the Pennsylvania Railroad System uses from five million to six million cross-ties annually.

THREAD GRINDING WHEEL TRUING DEVICE

The accompanying illustration shows a bench lathe equipped with a thread milling attachment, which has been adapted for the performance of a thread grinding operation in the shops of the H. E. Harris Engineering Co., Bridgeport, Conn. A special belt is carried down from a large pulley on the overhead works to a small pulley on the grinding wheel arbor, in order to obtain the high cutting speed that is necessary for efficient grinding. Evidently, a wheel that is used for grinding threads must have its cutting face formed to correspond with the included angle of the thread to be ground, and this result is accomplished by means of a special wheel-truing device. It consists of a block *A* that drops over the lathe cross-slide and has a V-shaped templet *B* formed on its upper surface. The entire top of the block is carefully machined, and a sliding bar *C* is arranged with a shoulder that fits on either side of the V-shaped templet *B*. With a diamond mounted at the forward end of bar *C*, it is a simple matter to reciprocate this bar back and forth along the angular sides of templet *B* to provide for truing the inclined faces of the grinding wheel to the desired form. Evidently, bar *C* must be turned over to place it on the opposite side of templet *B*, and this brings the diamond into the proper position for truing the opposite side of the wheel to that on which it is engaged as shown in the illustration. It will be noticed that there are two flanges on bar *C* which engage opposite sides of templet *B*.

* * *

The retarding effect of the shortage of coal on the rehabilitation and development of the French industries may be best understood by observing the fact that during the first half of this year there were only 18,000,000 tons of coal available for consumption in France, as compared with a consumption of 27,000,000 tons in the same period of 1913. In other words, the available supply at present, when the need is much greater, is only two-thirds the amount required in 1913. Of the present supply England has furnished 40 per cent; French coal mines, 37 per cent; and German mines, 13 per cent; while 10 per cent came from German districts occupied by the French. In 1913, 65 per cent of the French coal consumption was furnished by France, 21 per cent by England, 7 per cent by Belgium, 6 per cent by Germany, and 1 per cent was imported from other countries.

* * *

A comparison of performance of the motive power of the *New Mexico* with that of other battleships shows marked economy in favor of the electric drive, according to figures given in the *Sibley Journal of Engineering*. At 12 knots speed, the consumption in tons of oil per day was 75 for the *New Mexico* as compared with 100 for the cruising turbines and 118 for the main turbines of the *Arizona*, and with 99 for the cruising turbines and 115 for the main turbines of the *Mississippi*. At 19 knots, the consumption of the *New Mexico* was 263 tons; of the *Mississippi* main turbines 305 tons, and of the *Idaho* main turbines, 310 tons per day.

Industrial Notes from Germany

From MACHINERY'S Special Correspondent

Berlin, November 3

THE exposition or fair held in Leipzig this fall did not result in any appreciable business for the machine tool builders. This was due to many causes, partly to the fact that the engineering exposition was held at a different time from the general fair, and partly to the present economic situation of the country in general. The main interest in the engineering exhibition centered around the exhibit of the Association of German Machine Tool Builders, where many new developments were introduced, making it worth while for both manufacturers and designers to study the exhibition. The fundamental idea of the new developments is economy—economy of materials, economy of power, and economy in cutting time and labor attendance.

For the first time the German Government appeared at an engineering exposition as a commercial exhibitor. Die Deutsche Werke—the successors to those huge manufacturing plants of the German Empire, which were occupied in the manufacture of small arms and ammunition for the Government—are now entirely occupied on peace work of various kinds. Die Deutsche Werke include large steel works, foundries, machine building plants, establishments for making precision tools and instruments, chemical factories, and shops for repairing locomotives and railway cars. This combination of factories, owned and operated by the German Government, exhibited at the engineering exposition large machines for railway shops and ship building plants, small tools, fittings, screws and bolts, castings, etc., and in addition machinery for numerous industries not in the metal-working field.

Machine Tools at the Leipzig Fair

At the Leipzig Fair, turret lathes were more in evidence than engine lathes, and automatic turret machines were quite prominent. Cone-driven and all-geared lathes were shown to an equal extent. Auerbach & Son of Radebeul-Dresden exhibited a lathe having a novel micrometer device for accurately setting the finishing cut for reducing work to a given diameter.

Among the grinding machines, a shaft grinding machine exhibited by Naxos Union of Frankfort-on-Main attracted attention. In this machine, slender shafts 13 feet long are ground within limits of 0.0001 inch. A bore-grinding machine was exhibited for grinding holes up to 7 inches in length. This machine is provided with an automatic disengaging feed, which is set to throw out the feed mechanism when the exact size of bore has been reached. Surface grinders were exhibited by Schönherr of Chemnitz-Furth, making use of grinding wheels arranged in segments. All the surface grinders shown were equipped with magnetic chucks. Shapers were shown in great numbers. The travel of the ram of the largest Wotan shaper is 32 inches, with a transverse movement of the table of 40 inches. Eight different speeds are provided for the shaper ram, the maximum speed being 120 feet per minute.

Reinecker of Chemnitz exhibited a new automatic bevel gear shaper for the making of spiral bevel gears, this shaper being said to be a further development of the Bilgram type of machine. A new gear-cutting machine was exhibited by Max Röber & Co. of Chemnitz. This machine works on the slotting machine principle. The tool has teeth similar to that of a gear, and is rotated slightly, in conjunction with the gear being cut, after each stroke. Wire nail machines were exhibited by Malmedie & Co., of Düsseldorf, having an output of 500 wire nails per minute. Measuring instruments for the automatic recording of operation time were shown by Theodor Horn of Leipzig. The Zeisswerke of Jena exhibited a device for measuring the pitch diameter of threads by means of wires, and a new microscope for metallurgical investigations in the shop; this microscope permits the observation of the structure of a piece of metal without special preparation of the surface. Other machines exhibited were an electric rivet heating machine by the Mollwerke of Chemnitz, in which the rivets are placed in resistance in the current and thereby brought up to the required heat, and a weighing scale to be used for counting the number of small duplicate parts in a lot. This latter scale was exhibited by Wilhelm Wagner of Dresden.

General Conditions in the German Industry

One of the leading machine tool builders in Germany reports that the foreign business has practically come to a standstill, which is partly due to the fact that English and French buyers have made an agreement not to buy German machines, but to equip their factories either with domestic machinery or tools of American make. The same firm states that the domestic business in Germany continues to be quiet as the result of the high prices that make the placing of orders impossible.

Another machine tool builder reports that the last year has shown a decreasing buying capacity in the domestic market as well as a falling off in foreign business. In the early part of the year, the company's plant was busy mainly on foreign orders, but the foreign countries have now ceased buying, and the selling price of German machines now exceeds the price of machines sold by foreign competitors in the world's markets.

It is reported that the Soviet Government of Russia has placed orders in Germany for locomotives and woodworking machinery. The latter order, it is stated, is so secured financially that the German company that has taken it can go ahead without risk. It is expected that more orders will be received from Russia in the near future. Reports from Holland indicate that prices for German machine tools are now higher than those of tools from competing countries, and that buyers in Holland are now obtaining their machine tool requirements from countries other than Germany. The German machine tool builders claim that their difficulties are due to the fact that they have been unable to offer their machines at a fixed predetermined price on account of the constantly increasing costs of production and the fluctuations in the value of the mark.

Standsrds Committee of the German Industry

The German industries have created a standards committee similar to that which has for many years been engaged in standardization work in Great Britain and also to the one which has recently been formed in the United States. This committee is composed of representatives of the government, of the engineering and technical schools and institutions, and ot the engineering and manufacturing societies. The object of the standards committee is to determine upon standards that are applicable either to the whole German industry or to some special trade or line of manufacture. The standards committee has already adopted 160 specific standards covering, among other things, standards for taper pins, reamers, threads, clamps, handles, wood-screws, parts of transmissions, ball-bearings, etc.

Plans for Importation of American Coal

Of the 470,000 coal miners in the Ruhr District, about 128,000 are engaged in mining coal for France, and it is stated that daily 77 trains, with 70 cars each, loaded with coal leave Germany. As a result, some of the largest iron and steel companies in Germany have had to cease operating their blast furnaces because of lack of coal, and the August Thyssen Metallurgical Works are said to be planning to import coal from America, in order to meet the urgent demands for fuel. Pig iron production has dropped from 19,300,000 tons before the war to 6,200,000 tons at the present time, and the outlook for the whole iron and steel industry is more serious than ever before. If the coal shortage becomes more acute, it will be necessary to cease the operation of a still greater number of blast furnaces and to shut down some of the steel plants completely. Should this come to pass, it will mean the breakdown of the whole economic life of Germany.

Investigation Work of the German Society of Engineers

In consequence of high wages and rising prices of raw materials, as well as the enormous taxes, German industry has been forced to seek means whereby these high costs may be compensated for by a reduction in the cost of production. For the solution of problems in this connection, the Society of German Engineers has engaged in far-reaching investigation work covering a number of different subjects, and is cooperating in this work with the leading societies of engineers and manufacturers in Germany.

The questions being discussed at the present time are as follows: The utilization of waste-heat from steam plants and from combustion engines and industrial furnaces; the development of cheaper methods for building houses; the scientific management of shop operations and the selection of an efficient working force; the development of the plan of interchangeable manufacture and the use of labor-saving machinery; standardization, and the elimination of unnecessary types of machines or classes of materials; and the specialization of each shop on a certain product that can be made by its equipment in the most economical manner.

Labor Conditions

The recent large strike in the industries of Wurtemberg ended with the complete defeat of the workmen and of the radical element. Terrorism in the shops has disappeared, and the workmen are now able to perform their work with greater efficiency. It is said that in the Bosch shops at Stuttgart and Feuerbach, the efficiency of the piece-workers has increased by 50 per cent as compared with the efficiency before the strike. The talking of politics during working hours, which was a habit acquired during the revolution, has become a thing of the past. The workmen have become convinced that they were deceived by the radicals. Owing to the depression in the industries, many of the plants have been unable to re-employ all the men that went on strike. The Daimler Works, for example, which employed 5000 men, are now operating with 3200 workmen, and state that conditions do not justify their employing even that number.

* * *

CONFERENCE ON EMPLOYMENT AND VOCATIONAL EDUCATION

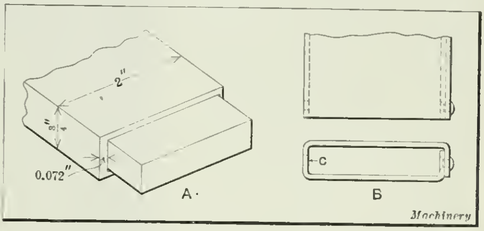
A conference on employment and vocational education was held under the auspices of the American Association of Engineers at the Congress Hotel, Chicago, Ill., November 12. Some of the subjects upon which addresses were presented were: "The Trend of Specialization"; "Placing the Graduate In His First Position"; "Fitting College Students for Success"; "Summer Employment for Men in Teaching Service"; "Employment Office Administration and Technique"; "Vocational Analysis and the Engineer"; etc. Four group meetings were also held, dealing specifically with employment management, employment bureaus, educational institutions, and general employment conditions.

INCREASING THE ENERGY OF A POWER PRESS FLYWHEEL

By DONALD A. HAMPSON

A certain manufacturer desired thousands of feet of special rectangular tubing of the dimensions shown at *A* in the illustration, which was to be so made that it would be possible to telescope a solid piece into the tubing without experiencing difficulty or excessive shake. Owing to the constant demand of the automobile industry for steel tubing material, it was impossible to find a manufacturer of this product who would contract to make the special tubing. Finally it was decided to produce the tubing on a power press by bending pieces of sheet steel to the desired shape, overlapping the two ends of each piece, and riveting them together as shown at *B*. The extra thickness and rivet heads along one edge were not objectionable, and as the tubes were to be used with one side up, the appearance was also satisfactory. Sheet steel of the proper gage and width was cut in lengths of from 5 to 14 inches as needed, preparatory to the bending operations.

Calculations were made to ascertain the approximate resistance of the stock to bending, and then the power press available for the work was tested to determine whether it was capable of performing the operation. It was found to be constructed amply strong, but it was lacking in power as set up. By referring to the formula which is given on page 288 of MACHINERY'S HANDBOOK, for finding the energy given out by flywheels during the power stroke, it was seen that if the velocity of the flywheel and its weight were increased, the desired power would be obtained. Substituting another pulley for the cone on the press increased the velocity 30 per cent. The weight and mean diameter of the flywheel were then increased by bolting a steel railroad car tire weighing 190 pounds to the flywheel through the medium of three small castings and strap clamps. Later service proved the calculations and their application to be correct, as the power delivered to the ram was sufficient for the job.



(A) Rectangular Seamless Steel Tubing. (B) Tubing as produced on Rebuilt Power Press

The tubes were formed in four operations, two operations being necessary to make the U-bend at *C* and one each for the right-angle bends at the opposite edge. A mandrel of proper dimensions was used in the last two operations to form the tubing to the required size. Cast-iron punches and dies were employed on the press. It was first thought that these would have to be provided with steel faces; however, the first few proofs struck by means of the cast-iron tools were so satisfactory that more were made, and finally the entire lot was produced without any appreciable change of size. Due to a lack of spot welding equipment, it was necessary to rivet the joint at several points on each section of tubing. The rivet holes were countersunk on the inside by using a drill ground to the included angle of the rivet heads. It was necessary to drill through the opposite edge first, and so a jig with upper and lower guide bushings was employed, while a stop was used to terminate the lowering of the drill when the proper depth had been reached. The tubing as finally made was as cheap as the seamless product that was originally desired would have been, and its appearance and utility just as satisfactory.

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THE FORGING OF BRASS

Older text-books on engineering materials generally state that brass can be cast and rolled, but can be forged only with difficulty or not at all. During recent years there have been noteworthy developments in the forging of brass and other non-ferrous metals by shaping them to the desired form in dies under pressure. This process has two distinct advantages: First, it saves expensive material and decreases the labor cost as compared with that of castings which must be machined; second, it produces a better quality of brass, because the forging process condenses the metal and imparts additional strength thereto.

The leading article in this number of MACHINERY, "Making Brass Forgings," will prove of particular interest to metal manufacturers and engineers, because it deals with new developments in a comparatively new process in the metal-working field. The war speeded up developments in the brass forging industry, as well as in many other directions in the engineering field. The process of forging brass was applied during the war to the making of fuse parts, and has been gradually developed for the production of a great variety of parts employed for industrial purposes. One plant alone was producing 225,000 brass forgings for munitions daily at the time the armistice was signed, and the experience then gained has been since successfully utilized in the industries that are now turning out products for peaceful purposes.

* * *

PROGRESS IN STANDARDIZATION

From the viewpoint of national industrial economy the efficient use of the means of production already available is as necessary as the origination of improved methods of production. Among the many factors making for increased economy, none is more important than the careful standardization of engineering products. Commendable advances in this direction have been made in the electric motor field, and within the last three years the American Gear Manufacturers' Association has been very active in collecting information and in obtaining the opinions of manufacturers and users of gearing as a basis for establishing standardized practice. Great savings can be effected by rigidly adhering to carefully worked out standards. The duplication and waste resulting from lack of uniformity in manufactured products and methods of production is obvious.

Standardization has been objected to by some on the ground that it has a tendency to interfere with further progress, and it is true that when a product or a method has become standardized more serious thought is given to proposed changes than if no generally recognized standard were in existence; but it is doubtful if any meritorious change has ever been long delayed in the engineering field because of standardization. It has prevented many innovations lacking real merit. American engineers have never considered a standard as not being subject to change; but when a change is made, it should be agreed upon by virtually the whole industry concerned, and should not be inaugurated by a single manufacturer who may not have the best interests of the industry in mind.

The gear manufacturers should be commended for the splendid work they have already accomplished, which shows not only the great need for standardization, but also the practicability of harmonizing conflicting opinions when a determined effort is made to do so. The progress of the present work of standardization in the gearing field indicates that within a few years there will be a recognized uniformity in gearing practice throughout the country; and considering the widespread ramifications of that industry, this is a truly remarkable accomplishment.

* * *

APPRENTICESHIPS AND INDUSTRIAL RELATIONS

Various methods have been proposed and inaugurated for improving industrial relations and for developing a more cooperative spirit between employer and employe. Some of these proposals are practical and have proved their value: others look good in theory but have given but indifferent results in practice. There is one method that has never failed, and which is now being adopted more and more in the metal-working industries—the apprenticeship method.

In general, apprenticeship systems are not looked upon as one of the means for improving industrial relations. Nevertheless, an intelligently conducted apprenticeship course does much to create a friendly feeling between employer and employe, not only for the present but for many years to come. The man who has been properly taught his trade becomes a skilled workman. A skilled workman is always at a premium and receives a higher wage than the man who has obtained his experience in a haphazard manner and who is, at best, an operator or helper. The intelligence of the skilled man has been more highly developed through the training he has received, and this, together with his better economic status, makes him less likely to fall a prey to the preachings of unsound economic doctrines.

To give young men an adequate incentive to strive for promotion, and to give them the means whereby they can improve their knowledge and skill in the mechanical trades, constitutes one of the best known means for producing satisfactory industrial relations. An apprentice who has been properly taught his trade realizes that the complete mastery of his work helps him to gain promotion and higher pay. He sees that in the long run it is skill, ability, and integrity that count, rather than affiliation with an association, the object of which is merely to secure equal pay for all men, irrespective of the great differences in their character, industry and working ability. During the apprentice period there is also an opportunity to teach the apprentice the truth that the slogan "Fair Pay" is only half of a complete statement. "Fair Pay for a Fair Day's Work," is the full statement, and where that is appreciated by employers and employes alike, there is no trouble about industrial relations.

National Machine Tool Builders' Convention

THE National Machine Tool Builders' convention, held in New York City November 11 and 12, was attended by an unusually large number of machine tool builders, as the present condition in the machine tool industry made it desirable for the manufacturers to come together to discuss problems common to them all. Great interest was evidenced in the meetings, which were attended by a larger number of members than any the association has previously held, and the same was also true of the committee meetings.

At the opening session, the president of the association, A. E. Newton, in his address referred to the present situation in the machine tool building field, and reviewed briefly the conditions now confronting the industry, especially in regard to prices. President Newton's analysis of the situation and his conclusion that machine tool prices should not be reduced at the present represented the general sentiment of the convention. The important point was emphasized that prices must be regulated with reference to production costs, which have increased proportionately more than selling prices. It was mentioned that increased overhead costs have been the result of decreased output, and more than offset any decline in the costs of raw materials likely soon to occur.

When considering this general question of prices, we believe that the basic nature of the machine tool industry and its importance to every manufacturer using metal-working tools should not be forgotten. In view of the fact that machine tools are used either directly or indirectly in the construction of every kind of mechanism, it is evident that developments in this field become a great national asset, but the development of the highly efficient machine tools now available represents an enormous outlay on the part of machine tool builders who are constantly making these costly improvements. The expense of this experimental and development work must necessarily be added to selling prices, and any reduction tending to arrest the progress of machine tool builders in constructing the most efficient tools possible, would be "penny wise and pound foolish" for the manufacturers who need, more than ever before, the best equipment that brains and money can produce. A few hundred dollars difference in the original cost of a highly efficient machine tool becomes insignificant when compared with the enormous gain resulting from the use of such a machine throughout the period of years representing its life.

A. H. Tuechter, Newly Elected President of the National Machine Tool Builders' Association

Among the other addresses at the convention was one by D. R. Weedon of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., on the subject of "Standardization," which related exclusively to the question of motor applications to machine tools. In this address the different types of motor drives suitable for various classes of machine tools were reviewed, and many points to be considered in the application of motors to machine tools were brought out. The fact was emphasized that standard designs covering the installation or application of drives, the style of control, and ratings, are practicable, and that considerable benefit can be derived by applying the same general types of electrical apparatus to the same general types of machine tools.

F. A. Foster of Peking, China, who at the present time is spending a few months in the United States, spoke on conditions in Chinese machine shops, and showed a number of interesting lantern slides illustrating the equipment and arrangement in Chinese shops. He also made special reference to the need for training schools in China and their value in introducing American machine tools in Chinese industries.

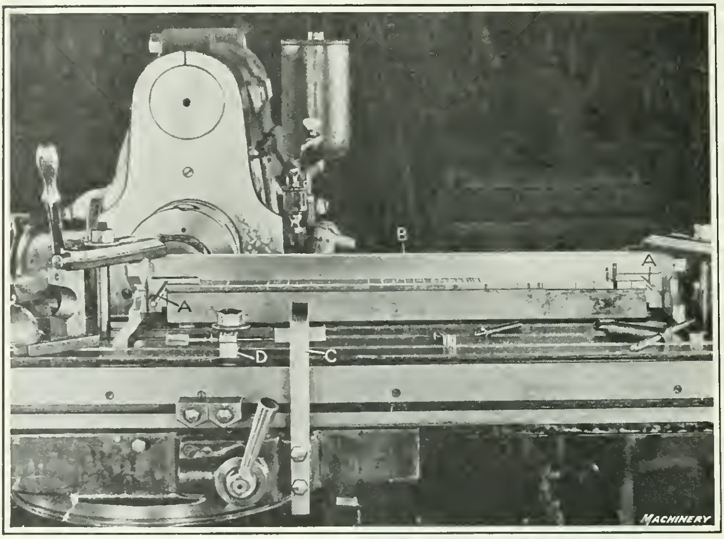
Financial conditions as affecting business were discussed in an address by Francis H. Sisson, vice-president of the Guaranty Trust Co. of New York City. In an unusually concise presentation Mr. Sisson dealt with the subject of the restriction of credits that has been necessarily exercised by the banks, and pointed out that although the banks at present have restricted credits, they have made loans to assist the industry in amounts greater than at any previous time in the history of American banking. He explained that the restrictions made were for the best interests of the entire industrial and commercial field, and that there necessarily had to be a period of liquidation after the period of expansion and inflation that the whole world has passed through industrially and commercially during and since the war. With regard to the future, Mr. Sisson spoke with optimism, but advised caution. He stated that normal business conditions could not be expected until price adjustments had brought prices to a level where there would be no further inflations of values, and where normal business on a permanent basis could be carried on. The foreign trade situation was also given attention, and it was pointed out that the foreign exchange could never be expected to return to normal until the production abroad reached a point where sufficient goods would be imported into this country to pay for exported goods.

An address by W. Randolph Montgomery that aroused a great deal of interest dealt with cancellations of orders. One of the important points brought out in this address was the difference in the laws covering contracts in different states. It was shown how a contract legal in one state may be entirely beyond the jurisdiction of the courts of another state. E. W. McCullough, manager of the Fabricated Production Department, U. S. Chamber of Commerce, gave an interesting account of the experience of the U. S. Chamber of Commerce in investigating the matter of cancellations.

The third session of the convention was devoted entirely to committee meetings. At the fourth session, officers for the coming year were elected as follows: President, A. H. Tuechter of the Cincinnati-Bickford Tool Co., Cincinnati, Ohio; first vice-president, E. J. Kearney, of the Kearney & Trecker Co., Milwaukee, Wis.; second vice-president, C. Wood Walter, of the Cincinnati Milling Machine Co., Cincinnati, Ohio; secretary, Carl F. Dietz, of the Norton Co., Worcester, Mass.; and treasurer, Winslow Blanchard of the Blanchard Machine Co., Cambridge, Mass. Charles E. Hildreth, of Worcester, Mass., remains general manager of the association.

LAYING OUT BUSHING HOLES IN SPECIAL DRILL JIG

In making a drill jig for drilling two 1/8-inch holes in tabular carriage stop racks for the Remington Typewriter Co., the Marvin & Casler Co., Canastota, N. Y., employs the following method for laying out the drill bushing holes. The operation is of special interest in that the spacing of the holes is greater than in most drill jigs, and in locating these holes an exceptionally long stack of Johansson gage-blocks was necessary. The accompanying illustration shows the job after the holes were bored, and gives an idea of the number of blocks that is required to check the distance between the two locating studs *A*. The distance between the drill bushings must check to 24.02 inches. In laying out the holes, the jig *B* is first strapped to the table of a No. 2 Cincinnati milling machine, and the right-hand hole located 1.56 inches from the end and aligned with the milling machine spindle, preparatory to boring, by means of a rotary center indicator. It is the locating of the second hole that makes this job especially interesting.



Set-up for checking Center Distance of Two Drill Bushing Holes in Drill Jig for Typewriter Part

With the table still in the position occupied during the drilling of the right-hand bushing hole, use is made of a Koch indicator carried on strap *C* and a micrometer spindle mounted in a parallel block *D*, for establishing an accurate registry point from which to locate the table to the right a distance of 12.01 inches, or one-half the total distance between the drill bushing holes. The reason for moving the table only one-half the distance at a time is that it was not thought that the accuracy in lead of the table feed-screw should be depended upon to obtain such a long and exact setting. The length of the jig is so great that nearly the entire length of this table screw is utilized in moving the table from one end to the other, and as there is likely to be a variation in lead caused by wear on the central portion of the screw, gage-blocks are employed to check the table movement obtained by using the graduated dial of the milling machine.

Then, with the micrometer block carrying the spindle secured on the milling machine table, and the end of the spindle in contact with the indicator point, both registering zero, a stack of gage-blocks is laid on the table, abutting against the left-hand side of the micrometer block. This stack of gage-blocks is such as to enable the micrometer spindle block to be relocated exactly 12.01 inches to the left of its original position. By this means, any cumulative error which exists in lead in the table feed-screw may be compensated for in obtaining this second setting of the table, by simply adjusting the micrometer spindle so that when it is in contact with the indicator point, zero registration will be obtained. This procedure of locating the micrometer block one-half the total spacing of the drill bushing centers is then repeated, so that the final setting should be as accurate as modern jig making methods are capable of producing. The second hole is then drilled and a locating stud driven in, so that the over-all distance between centers may be checked. For doing this, a parallel is placed as shown in the illustration so that gage-blocks may be supported between the locating studs.

By following this method of locating there can be no theoretical error, but if slight discrepancies occur between the spacing obtained and the over-all dimensions of the blocks, they can, of course, be easily rectified by reboring the last drilled hole, using an off-set boring head such as the milling machine shown in the illustration is equipped with. This is a Marvin & Casler product and contains a bushing graduated to thousandths of an inch, by means of which the tool may be offset any desired amount. The question may be raised as to why the table was not located in a single setting, using the complete stack of gage-blocks, rather than splitting them up and making extra work. The reason for this, however, will be at once apparent when it is realized that a stack of blocks 24 inches long would be composed of so many units that there would be a possibility of their bulging or springing slightly near the center. In the case of a shorter stack, of course, this would be less likely to take place, and consequently the likelihood of error would be proportionately reduced.

* * *

OIL-FIRED LOCOMOTIVES

Extensive tests have been made in France of the use of residuary oil as locomotive fuel, and as a result it is stated that the Paris-Lyons-Mediterranean Railway has decided to convert two hundred of its engines so that this kind of fuel can be employed. The main advantages which the tests showed to be secured are as follows: About 20 per cent more steam is raised as compared with coal fuel; space is economized; stoking is eliminated, as the oil flows automatically; and the fuel is easily taken in. These advantages would probably result in a material saving in running costs. An incidental benefit accruing from the use of oil is the fact that an oil fire gives off little smoke, and therefore the workshops and sheds can be kept cleaner. Similar tests have been made in Italy with much the same results, and British railway companies are said to be seriously considering the possibilities of oil firing. Among those taking an active interest is the London & Northwestern Railway Co., which recently completed a six months' test with one of its locomotives that had been converted for the purpose, and it is understood that the results were very satisfactory. These tests are of particular interest at the present time in view of the general shortage of coal and the difficulty of mining the required amount to meet the demand of the industries all over the world.

American Gear Manufacturers' Convention

THE convention of the American Gear Manufacturers' Association held at Lake Mohonk Mountain House, Lake Mohonk, Ulster Co., N. Y., October 27 to 29 was marked by the same active and progressive spirit that has characterized all the former conventions of the association. Practically the entire time of the meeting was devoted to reports on standardization of various types of gearing, and to discussion of these reports. Addresses were also made on the subject of standardization by P. G. Agnew, secretary of the American Engineering Standards Committee, and by Calvin W. Rice, secretary of the American Society of Mechanical Engineers. At one of the meetings Christopher Haigh, supervisor of costs of the General Electric Co., Schenectady, N. Y., spoke on "Machine-hour Rate Method of Distributing Manufacturing Expense." This paper is reproduced on page 370 of the present number of MACHINERY. C. L. Collens, president of the Reliance Electric & Engineering Co., Cleveland, Ohio, made an address on "Industry Organization," outlining the principles that should govern a successful association of manufacturing plants within a given industry that aims at reducing costs and increasing production by standardization.

The Significance of Standardization

The subject of Mr. Agnew's address was "Standardization from the Point of View of the American Engineering Standards Committee." The speaker pointed out that the first national engineering standardizing body was a British organization formed in 1902, which has been an important factor in the development of the British industries. During and since the war, national engineering standardizing bodies have been formed in Austria, Belgium, Canada, France, Germany, Holland, Sweden, Switzerland, and the United States, and similar bodies are now being formed in Italy and Japan. The organization in this country—the American Engineering Standards Committee, 29 W. 39th St., New York City—was organized in 1918, but has been engaged in active work for less than a year. The functions of this committee are to promote and coordinate standardization work on a national scale and to serve as an authoritative channel of cooperation in international standardization. As an illustration of work now under way, two or three examples were mentioned. At the request of the British Standards Committee, a standardization body representing American steel manufacturers, the American Society of Civil Engineers, the Society of Naval Architects and Marine Engineers, the United States Navy, and other bureaus and associations is now at work to secure an Anglo-American agreement on the cross-sectional shapes of structural steel. At present, there are in American practice two nearly independent series of sections, one for general structural purposes and one for ships; and it is proposed to simplify the matter greatly by reducing them to one systematic series. From Belgium has come a proposal for an international standard on zinc ores and zinc products. A comprehensive program of industrial safety codes is under way. In the past, there have been more than 100 organizations engaged in the formation of safety codes without any systematic cooperation. Hence duplication and confusion have been the result. In extreme cases there were devices manufactured conforming to regulations in one state, the use of which were prohibited by the regulations of another.

Objects of Standardization

In the course of his paper Mr. Agnew pointed out that standardization, if carried out on a sound engineering basis, enables buyer and seller to speak the same language; promotes fairness in competition, by putting bids on an easily comparable basis, both in domestic and foreign trade; lowers unit costs by making mass production possible; simplifies the carrying of stocks and makes deliveries quicker; eliminates indecision both in production and utilization; and decreases selling expenses, one of the serious problems of our economic system.

It was also pointed out that the standardization work in Germany has been carried on since the end of the war with great activity. In two years' time the German committees have published 160 standardization sheets and have 240 other standard sheets under consideration. The Swiss, German, Dutch, and Swedish standardization committees have split up their work into very small sections in order that a branch industry may quickly agree upon a standard for a certain kind of work even when the broad aspects of the standardization work in the trade cannot be completed at as early a date. It is better to get the standardization work under way in a small measure than to wait until the last word is spoken on every possible phase of the subject. The tendency in Great Britain during the eighteen years of standardization work has also been to split the work into smaller sections.

In his talk on standardization, Mr. Rice called attention to the pioneer work done by the American Society of Mechanical Engineers in standardization work, and pointed out how important this work is for the proper development of the industries. It was mentioned that the government of Great Britain has appropriated $5,000,000 for standardization work. In this country different conditions made it impossible or inadvisable for the government to appropriate for the purpose of standardization in the industries, but the manufacturers here must do the work themselves, and in so doing will greatly benefit the industries of the whole nation. Mr. Rice outlined the great variety of standardization work that has already been done by the American Society of Mechanical Engineers and pointed particularly to the Boiler Code as an example of what can be accomplished by concerted effort.

Report of Standardization Committee

B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., as chairman of the general standardization committee of the American Gear Manufacturers' Association, presented a report in which he reviewed the work done so far along the lines of standardization by the association. He pointed out that a standard for composition gearing had been adopted and that the report on gears and pinions for electric railway service had been accepted as recommended practice. A part of the report on bevel gearing has also been adopted as recommended practice by the association, as well as a report on limits for holes. Committees are now active on standardization work relating to spur gears, bevel gears, sprockets, herringbone gears, worm-gears, electric railway and mine gears and pinions, hardening and heat-treating, inspection, and keyways. In addition, the library committee has been active in compiling material bearing on the subject of gearing and gear-cutting practice.

Mr. Waterman also made a report on the work of the sectional committee of the American Engineering Standards Committee, the duties of which are to work in connection with the national committee for adopting American engineering standards. The object of the cooperation with the Engineering Standards Committee is to work in conjunction with that and other engineering bodies with the view to formulating engineering standards, and thereby avoid the duplication of standardization work and the promulgation of conflicting standards. The American Gear Manufacturers' Association has appointed a committee consisting of B. F. Waterman, J. B. Foote, H. J. Eberhardt, J. C. O'Brien, A. C. Gleason, and A. W. Copland. This committee will cooperate with a committee appointed by the American Society of Mechanical Engineers to consider gear standards of general interest with the idea of presenting them to the American Engineering Standards Committee for approval and ultimate adoption as American standards.

Report of the Spur Gear Committee

The spur gear committee, of which Frank E. Eberhardt of the Newark Gear Cutting Machine Co., Newark, N. J., is chairman, presented a report showing the progress of the work of the committee. This report also indicated the general tendency in practice, as determined from the answers received to a questionnaire sent out to the members of the association. The replies received indicated that the 14½-degree involute tooth is considered standard in the gearing field, unless otherwise specified. When a 20-degree pressure angle is used, the tooth dimensions employed vary. Some manufacturers employ the same dimensions as for the 14½-degree tooth, and some use the Fellows stub tooth. When using a stub tooth, the majority of the manufacturers appear to use the Fellows 20-degree stub tooth, while others use a number of special formulas.

An interesting question related to the width of the face with regard to the pitch. While the answers to this question showed some variation, the most general practice is simply to make the width of the face approximately equal to three times the circular pitch. With regard to the total thickness of the rim in relation to the diametral pitch, no uniform practice is in existence. The thickness varies with different manufacturers from 3.8 divided by the diametral pitch to 4.3 divided by the diametral pitch. The maximum thickness between the bottom of the teeth and the keyway in present practice also varies, and the proportion of the arms is not standardized. The diameter of the hubs with relation to the bore also shows some difference in practice, but the general usage is to make the diameter of the hub equal to twice the bore. The most generally used formula for the horsepower transmitted by spur gears is the Lewis formula, but there is some tendency to use the Lewis-Barth formula. As to many other questions relating to spur gearing, it was found that no generally accepted standard is followed by all makers, and the committee is endeavoring to formulate such standards and to present a complete report for adoption at some future meeting of the association. The idea is not to create any new standards, but to standardize existing usage whenever that is possible.

Standards for Worm-gearing

The committee on the standardization of worm-gearing of which J. C. O'Brien, of the Pittsburg Gear & Machine Co., Pittsburg, Pa., is chairman, brought in quite a complete report dealing with some of the important phases in worm-gearing, particularly with the nomenclature and symbols that ought to be used in worm-gearing formulas and calculations. Through the discussions at previous meetings, the committee had established the fact that the advisability of adopting the diametral pitch system for worm-gearing was questionable, as the only advantage of the diametral pitch system over the circular pitch system for worm-gearing would be the ease with which the pitch and throat diameter of the worm-wheels could be calculated. On the other hand, it was pointed out that there are several advantages in the use of the circular pitch system for worm-gearing, important among which are the ease by which the leads of worms may be obtained exactly by the use of simple gearing, while, when using the diametral pitch system, an approximate lead is generally employed, having a slight error. Makers of worm-gearing report that from 90 to 95 per cent of existing hobs are made in accordance with the circular pitch system. The committee stated that it thought the question of pitch systems for spur gears had been confused with that of worm-gears, and pointed out that because the diametral pitch system is better in the case of spur gears, it could not be assumed without further investigation to also be better for worm-gearing. Each case must be judged upon its merits.

With regard to the nomenclature and symbols to be used in designating parts and dimensions of worms and worm-gears, the committee reported that there were four systems of nomenclature and symbols possible, as follows:

1. A system in which the various quantities are written out and the formula stated in full.
2. A system in which the various quantities are abbreviated, as, for example, using the abbreviation "add." for addendum, "p. d." for pitch diameter, etc.
3. A system in which the various quantities are represented by single letter and sub-letter, as, for example, p_c for circular pitch.
4. A system in which the various quantities are represented by single letter symbols with primes instead of sub-letters, as, for example, d' for the pinion diameter, p' for circular pitch, etc.

As the fundamental object of symbolic representation is to make it possible to express rules and formulas in as condensed a form as possible and one in which the reader can easily remember the meaning of the various symbols, the committee recommended System (3), in which all quantities are denoted by single letters and sub-letters. Sub-letters may be so arranged that the reader, after becoming acquainted with the general scheme of nomenclature, will be able to understand the meaning of the symbols in the formulas without having to refer to a key to the symbols.

Report on Composition Gearing

In the report of the committee on composition gearing, of which John Christensen of the Cincinnati Gear Co., Cincinnati, Ohio, is chairman, an interesting historical sketch of the development of composition gearing was given. The history of composition gearing covers a period of from thirty-five to forty years. As cut gearing became more predominant, the noise produced by the higher pitch line velocities of metal gears demanded a silent factor in the transmission of power at a positive ratio. In the early stage, common fiber, hard rubber, leather, etc., were tried, but did not at that time fully meet the requirements of an ideal silent drive. However, the use of dried rawhide led to the development of the rawhide gear, and in recent years, hard fiber, fabroil and bakelite micarta have been used to advantage, all of which have proved very satisfactory elements in silent transmission. The rawhide pinion dates back to the seventies, and its origination is claimed by the Chicago Rawhide Mfg. Co., Chicago, Ill., a member of the association.

The story of the discovery of its use for this purpose is as follows: In the early history of the Chicago Rawhide Mfg. Co. the United States Government was being furnished, upon a small contract, with dry flint rawhides for chair seating purposes. At that time, the company had in its employ as Chicago city salesman, Captain D. R. McCutcheon, a veteran of the Mexican and Civil Wars, and a man of inventive and progressive mind. Captain McCutcheon, who was naturally looking for any possible outlet for the products of the company among the manufacturers of that city, one day encountered a customer to whom he had been selling rawhide belting and who was greatly annoyed by the racket of a metal gear and pinion in operation on one of his machines. Captain McCutcheon, realizing that hard flint rawhide was extremely strong of fiber and durable, conceived the idea of cementing together several layers of this rawhide, thus making a rawhide blank, from which a pinion was constructed and delivered to his customer. The experiment proved highly successful and the rawhide pinion gave good service. This, according to tradition, was the first rawhide pinion ever made.

Report of Keyway Committee

The committee on keyways, of which Henry J. Eberhardt of the Newark Gear Cutting Machine Co., Newark, N. J., is chairman, reported that average shop practice appears to agree fairly well with tables of keyways given in various handbooks. The committee recommended that for certain diameters of shafts, and in the absence of specifications to the contrary, the keyways should be of a width equal to one-quarter of the shaft diameter, and the depth should be equal to one-half the width, and measured at the side of the keyway. In order to avoid many and odd sizes of key stock, the committee submitted a table of diameters and corresponding sizes of keyways from 5/16 inch to 12 inches diameter of shaft. The report will be submitted at a later meeting of the association for acceptance, and when approved as an American Gear Manufacturers' Association standard will be published in detail.

Report by the Inspection Standardization Committee

E. J. Frost of the Frost Gear & Forge Co., Jackson, Mich., as chairman of the inspection standardization committee, made a complete report on the subject of standardization. This report related to the inspection of cylindrical holes, tapered holes, straight keyways, Woodruff keyways, tooth bearings, splined shafts, and dealt also with the design of test stands and fixtures for testing gears and tooth shapes.

Reports were also presented by A. C. Gleason of the Gleason Works, Rochester, N. Y., for the bevel and spiral bevel gear committee; by C. R. Weiss of the Link-Belt Co., Philadelphia, Pa., for the sprocket committee; by R. L. Dodge of the New Process Gear Corporation, Syracuse, N. Y., for the hardening and heating committee; and by A. F. Cook of the Fawcus Machine Co., Pittsburg, Pa., for the herringbone gear committee. The committee on electric railway and mine gears and pinions, of which W. H. Phillips of the R. D. Nuttall Co., Pittsburg, Pa., is chairman, also presented a report. The commercial side of the association's activities was represented by the report on Uniform Cost Accounting presented by J. H. Dunn of the R. D. Nuttall Co.

Resolution on Industrial Relations

The association adopted a resolution endorsing the principles laid down by the Philadelphia Chamber of Commerce on industrial relations. These principles are as follows:

1. Employment relations should recognize and conform to those principles of individual liberty, freedom of contract, and equality of opportunity that form the basis of our national institutions.

2. The right of open shop operation, that is, the right of the individual to enter and pursue any lawful trade or calling and to contract with others as employer or employe upon terms mutually acceptable as an essential part of the personal liberty of the individual.

3. While either employers or workers in the furtherance of legitimate self-interest have the right to combine for collective action or dealing, such combination has no right to compel others by intimidation or coercion to accept its direction or control.

4. Collective agreements between employers and employes, voluntarily entered into and not against the public interest, should be observed and performed by the parties with the same faith and credit as applies to any valid contract.

5. The power of industrial combinations, whether of employers or workers, is accompanied by corresponding responsibility. Where there is a lack of full legal responsibility on the part of such combinations for breach of agreement or violation of the rights of others, it is essential that they be held by the community to a higher degree of moral responsibility for their conduct.

6. Combinations to establish a monopoly of the product or of labor and to bar the competition or take away the opportunity of livelihood of those outside the combination are against good morals and the public interest.

7. The right of an industrial group to use its economic power for the benefit of its members is limited by its obligation to respect the rights of others. The use of the sympathetic strike or lockout or of the boycott involves an attack upon innocent third parties and the public, and is indefensible and intolerable.

8. The fact that disorder or violation of personal rights grows out of or is connected with an industrial controversy does not affect or lessen the primary duty of the public authorities to maintain law and order in the community and to afford the individual full protection for life and property.

9. The public interest requires that the highest degree of efficiency and productivity in industry consistent with the health and welfare of the workers should be maintained. There should be no intentional restriction of output by either employer or employe in order to cause an artificial scarcity of the product or of labor. In order that the worker may develop his full earning capacity and command his maximum wage, it is the duty of the management to assist him to secure employment suited to his abilities, to furnish him incentive and opportunity for improvement, to provide proper safeguards for his health and safety, and to aid him to increase the value of his productive effort.

10. The paramount interest of the public in the operation of the agencies of transportation and other branches of public utility service must be asserted and maintained against any attempt to bring about an interruption in the service of any public utility in the furtherance of any private purpose or interest.

11. Public employes should be accorded fair and generous treatment, and adequate means to protect their interests should be established; but the combination of such employes to interfere with or prevent the administration of any branch of the public service is a violation of their duty to the public and the state, and cannot be justified by any possible consideration.

The American Gear Manufacturers' Association now has ninety-two member companies, the five following companies having entered into the association since the April meeting: Machine & Stamping Co., Toronto, Canada; Detroit Bevel Gear Co., Detroit, Mich.; Whitney Mfg. Co., Hartford, Conn.; Diamond Chain & Mfg. Co., Indianapolis, Ind.; and Diamond State Fiber Co., Bridgeport, Pa.

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NATIONAL RESEARCH COUNCIL

The National Research Council is a cooperative organization of the scientific men of America. Its members include not only scientific and technical men, but also business men interested in engineering and industry. It is established under the auspices of the National Academy of Sciences, and its membership is largely composed of representatives of forty or more scientific and technical societies. The council was originally organized in 1916 to coordinate the research facilities of the country for work on war problems, and following the war it was reorganized as a permanent body. Its essential purpose is the promotion of scientific research and of the application and dissemination of scientific knowledge.

The field of activity of the council includes the appointing of committees to consider specific scientific subjects or problems, the establishing of laboratories or institutes for research work, the publication of scientific papers, and the dissemination of scientific news and information through the press. The council has recently established the Research Information Service as a general clearing-house and information bureau for scientific and industrial research. Information is supplied concerning research problems, progress, laboratories, equipment, methods, publications, personnel, funds, etc. A site for a new building in Washington, which is to serve as a home for the National Academy of Sciences and the National Research Council, has recently been obtained. The permanent secretary of the council is Vernon Kellogg, 1701 Massachusetts Ave., Washington, D. C.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, November 15

THE unsettled industrial situation and the consequent stagnation of prospective business has led to an uncertain feeling in the machine tool trade, and a slackness is feared. While the majority of firms is at present fully employed on an accumulation of orders on hand, others are stated to be working to stock. A cancellation of orders has in some cases been experienced, and new business is not forthcoming. Thus, when the present accumulation of work is disposed of short time will become general, unless there is in the meantime a revival of trade confidence, with accompanying new contracts. For the present, as a precautionary measure, some firms, which, as mentioned, are working to stock, are adopting the expedient of short time to take effect immediately, and in a few cases employes are being discharged altogether.

In Scotland, shipyards, which usually absorb a good deal of local machine tool production, do not regard the future prospects as any inducement to installing new machinery. The position in the local yards is that although they have plenty of work on hand at the moment, no new orders are being placed owing to the high cost of production, so that when existing contracts have been completed there is not much to look forward to.

Export trade is also very quiet, and in several cases overseas buyers have cancelled their orders in view of long delivery and reservations regarding prices. On the other hand the Board of Trade returns show that exports of machine tools continue to increase both in value and tonnage. It is interesting to note that imports of machine tools into the United Kingdom continue to be more or less equal in tonnage quantity to our export trade in 1913, although, of course, the corresponding values are disproportionate. Exports are practically double imports, and exceed 2500 tons per month. At the same time the value of imports is nearly equal to that of exports.

The Olympia Exhibition

The great machine tool exhibition held during the first three weeks of September was marred as regards results by the coincidence of the threatened coal strike, and the uncertainty of the general situation. Although definite orders were few, the tone of inquiry was good and gave the promise of an influx of orders all around when a more settled state of affairs is reached.

High-speed Hydraulic Presses

Great developments have taken place in this country during the last few years in high-speed hydraulic presses for forging. Davey Bros., Ltd., Sheffield, are the pioneers in this work, and in their high-speed hydraulic presses the rapidity of movement of the steam hammer is combined with the continuous pressure effect of hydraulic power. The development and use of such presses is sure to modify largely the technique of heavy forging, since it is only reasonable to assume that greater homogeneity throughout the work is obtainable. As an indication of the speed of working, 100 strokes per minute can be made by a 500-ton forging press, and even at this speed the press head responds accurately to the control lever, both as to speed and change of direction.

Standardization

During the last few months the British Engineering Standards Association has authorized important new standards. Included in these are the British standards for milling cutters and reamers. The standards have been drawn up with the full cognizance of the trade and came into force on July 12. Owing to the large numbers of milling cutters and reamers imported into this country, it was necessary to obtain information of dimensions accepted in other countries, and these have been taken into account as far as possible.

Power Transmission by Fluid Waves

A new method of power transmission which utilizes waves produced in fluids has been developed during the last few years and is now being applied by W. H. Dorman & Co., Ltd., Stafford, for driving rock drills, riveting hammers and machines, coal-cutting machinery, ore conveyors, etc. The fluid in which the waves are produced is usually water, and is contained in a pipe connecting the apparatus generating the wave motions to the machine that applies them to work.

Although apparently similar to hydraulic transmission of power, the underlying principle of wave transmission is absolutely distinct. In hydraulics, a continuous flow of liquid or motion of a liquid column as a whole invariably occurs, whereas in wave transmission there is no direct or continuous flow, the liquid merely pulsating backward and forward. Owing to the degree of water compressibility being very small as compared with many materials in use, the idea that water was incompressible came to be accepted. However, in wave transmission, advantage is taken of the elasticity of water and other fluids to transmit energy.

The action occurring in wave transmission can be illustrated by a simple analogy: In the ordinary speaking tube, the pulsations set up in the contained air by the vibration of the speaker's vocal cords travel in the form of sound waves to the far end where their energy is utilized in reproducing the vibrations in the ear of the listener. The column of air in the tube does not flow through it, the particles merely being subjected to small movements to and fro as the sound waves pass along. Similarly, in transmitting power by means of the waves of a fluid, the pressure impulses set up by the generator travel through the column of fluid contained in the pipe connecting the generator to the machine being driven.

The generator contains one or more chambers filled with the power-transmitting fluid and connected directly to the wave-transmitting pipes. A plunger is reciprocated into each of the chambers by means of a crankshaft driven by a motor or belt. As these plungers are reciprocated, the water in the chambers and connecting pipes is pulsated to and fro, the waves traveling at the rate of approximately 4800 feet per second, and causing plungers on the machines being driven to have similar movements. Thus, reciprocating movements are, of course, essential in the types of machines mentioned. When it is desired to rotate the tool, as in the case of rock drills, for instance, energy derived from the waves may also be employed for this purpose.

The fluid used in this system of transmission may be fed into the generator and pipe by means of gravity, but when this is impossible or undesirable, a simple pump is fitted to the generator. The feed of the fluid into the generator is regulated by a valve actuated by the pressures in the fluid chambers. A special type of flexible piping having ball and socket joints is used between the generator and the machine being driven, it being claimed that this piping is absolutely leakproof and has no tendency to stretch or straighten when submitted to high internal pressures.

Machining Cream Separator Bowls

Methods Employed by the De Laval Separator Co., Poughkeepsie, N.Y.—First of Two Articles

By FRED R. DANIELS

THE cream separator bowl which houses the mechanism by means of which cream is separated from milk consists of two main parts, the bowl shell shown at *A*, Fig. 1, and a tubular shaft *B* which forms the bottom of the shell of the bowl and provides a passageway through which the milk flows into the bowl. In order to make the various machining operations more easily understood, a brief description of the principles upon which the separating mechanism operates is given.

Within the housing formed by the shell and the tubular shaft, a series of tin cones is arranged, the cone angle coinciding with the 40-degree angle on the lower end of the tubular shaft, so that a seat is provided for this stack of tin cones. The arrangement may be clearly seen in Fig. 2 which shows a section of the assembled bowl, and the arrangement of the stack of cones. The top cone *K* is different from the others in the series in that it is provided with an extension in the form of a neck which will be apparent from the illustration. This neck contains the cream outlet *B*, located near the top. A steel part known as a distributor, shown at the left in this illustration, fits over the tubular shaft and seats on surface *C*, Fig. 1, of this forging. The position of this distributor, with reference to three tangential slots *U* in the tubular shaft, is such as to align the slots with passages on the inside of the distributor. The remaining cones of the set have their central hole stamped out to fit over the outside of the distributor.

This entire unit, when in operation, revolves at a velocity of from 6000 to 9000 revolutions per minute, depending upon the size of the separator, and is driven by a vertical spindle which extends up into a bronze bearing in the tubular shaft and engages a driving dog, which is a press fit in the tubular shaft. The location of this dog is such as to form a bottom for the chamber in the tubular shaft, slightly higher than the lower end of the three slots in the shaft. The relation of the driving dog to the slot may be seen in Fig. 10. Thus it will be understood that by delivering the milk into the hollow shaft, with the machine rotating at this high velocity, the milk will be forced out of the three tangential slots in the tubular shaft and into the passageway in the distributor, from which it will be delivered through the hole *H*, Fig. 2, into contact with the cones where the process of separation takes place. Each cone has three holes so located that when assembled over the distributor they will align with each other and with the delivery hole *H* in that member. Referring again to the assembly view, it will be seen that a space is provided between each of the cones sufficient to allow the passage of milk as it is forced from the distributor through the aligning holes of the cones. The principle of operation of the separating mechanism will be understood from the following description.

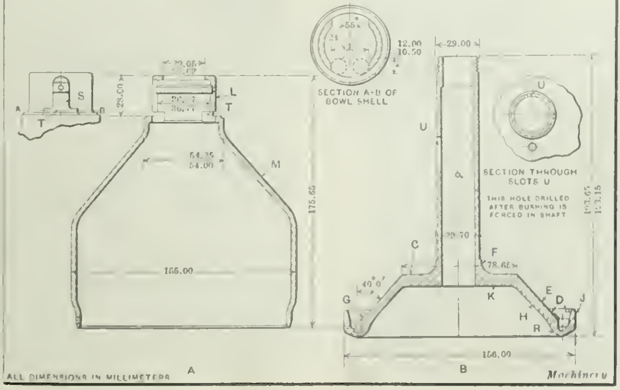


Fig. 1. Sectional Views of the Bowl Shell and Tubular Shaft of a Cream Separator

Principle of Operation

The operation of the cream separator is based on the principle of centrifugal force, the heavier material—skimmed milk—being precipitated against the walls of the shell, and the lighter material—the cream—working its way up on the upper side of each cone. After a sufficient amount of cream has accumulated, the continuous supply of milk being delivered to the machines will cause the cream to pass upward through the passageways on the outside of the distributor shown at *G*, Fig. 2. This cream fills the spaces between the neck of the top cone and the tubular shaft, whence it is delivered through the outlet in the top cone, which is located in a projection that fits in slot *S* of the bowl (see Fig. 1). The skimmed milk at the same time is being delivered through outlets *T* from the space between the outside of the top cone and the inside of the shell. In following out the various machining operations on these two parts, the purpose of such details as the tangential slots in the tubular shafts and the slot in the neck of the bowl through which cream is delivered will now be understood.

Forging and Roughing Operations on the Tubular Shaft

The tubular shaft is forged from mild steel bar stock, 2½ inches in diameter, from which it is sheared to the approximate length in a Covington shear. After heating in an oil-burning furnace, one end of the sheared bar is reduced in diameter in a Bradley helve hammer. The general appearance of the work after this operation is indicated at *A*, Fig. 3. This illustration is a view looking into the end

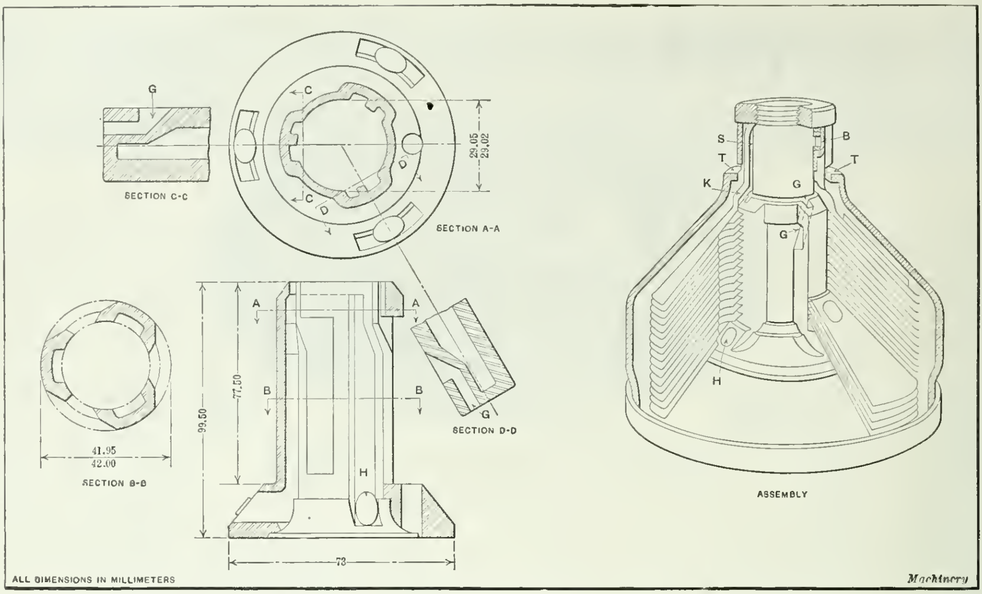


Fig. 2. Sectional View of the Cream Distributor and a Sectional View of the Assembled Bowl Unit showing the Relation of Cones to the Passages in the Distributor

of an Acme bolt-header, and shows the forging tools quite plainly. The die employed is of duplex construction, two operations being necessary to upset the end of the hot bar and forge the large end to the shape shown at *B*.

Before describing the machining operations on this forging, it should be stated that at the De Laval plant all work is performed to the metric system of measurement, so that it will be understood that what few dimensions appear on the drawings are given in millimeters and not in inches. The first operation in the machine shop is performed on a Jones & Lamson flat turret lathe and is illustrated in Fig. 4. This operation consists of roughing out the under surfaces of the forging, using in the first station a heavy two-bladed boring head which can just be seen at *A*, to hog out the angular surface; in the second station, a center drill; in the third and fourth stations, drills for drilling the small and large diameters of the hole in the tubular shaft (see Fig. 1). The hole is then rough-reamed with the floating reamer *B* carried in the fifth station on the turret, and the final work performed on this machine consists of beveling the inner and outer edges of the base, using a tool-holder which carries both tools necessary for the performance of this operation. This tool-holder is located on the opposite side of the turret, and consequently the position of the tools cannot be seen. The time required to perform this first roughing-out operation is nine minutes.

Reaming Large Hole in Tubular Shaft and Machining Slot in Periphery

The large hole is next finish-reamed on a small bench machine, after which a Whitney hand milling machine is employed to machine a slot in the periphery of the work. The sole purpose of this slot is to provide a means of driving the forging in the subsequent machining operations. In the fourth operation, use is made of this driving dog slot in connection with a pilot center in the machine spindle, to locate the work in the chuck of a Brown & Sharpe hand screw machine. This operation consists of facing and countersinking the top of the shaft and reaming the small hole.

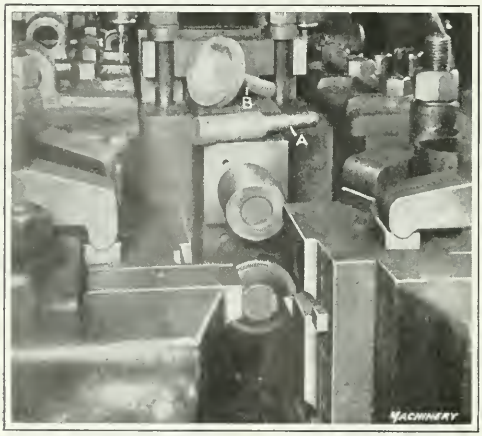


Fig. 3. Tubular Shafts forged to Shape in Two Operstions on a Bolt-header

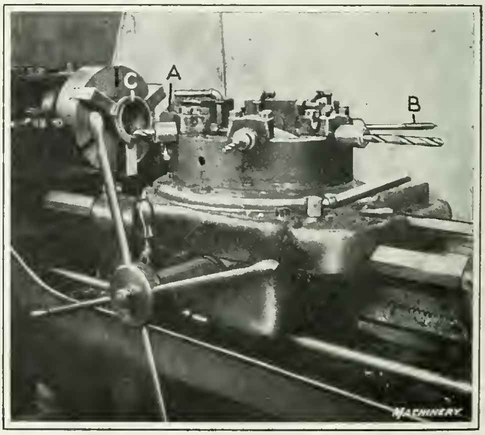


Fig. 4. Flat Turret Lathe equipped for roughing out the Bottom of the Forging

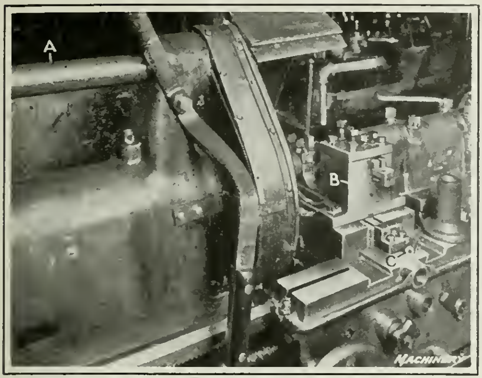


Fig. 5. Lathe equipped with Special Direct Drive Heavily Constructed Head for Use in rough-forming the Surfaces which furnish the Seat for the Bowl Shell

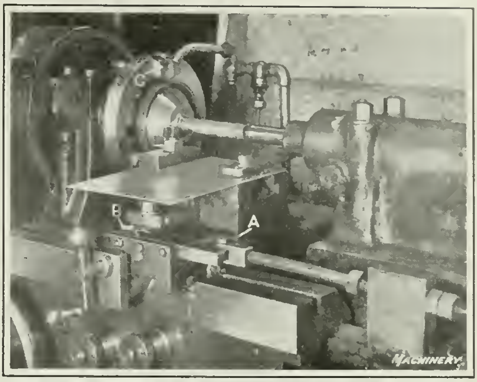


Fig. 6. Geared-head Lathe equipped for rough-turning Angular Surface of Forging. In this Operation a Special Taper-turning Attachment is employed

The production rate is sixty-six pieces per hour. In the fifth operation, the bottom surface *C*, Fig. 4, is ground to form a bearing for subsequent operations, the work being held to within a limit of 0.05 millimeter, or about 0.002 inch. The work is performed on a Brown & Sharpe disk grinder; it is held between centers, a center bushing being used in the top end of the shaft for the tailstock center, and the dog slot on the opposite end. The production time for this operation is fifty five pieces per hour.

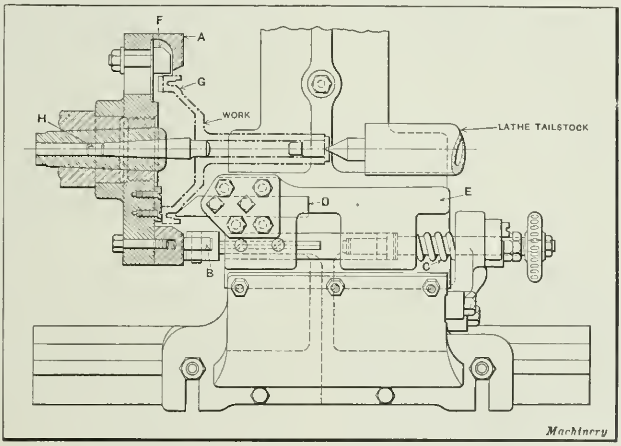


Fig. 7. Assembly View of the Special Attachment employed in turning Calks on Forgings

In the sixth operation, which consists of rough-turning surfaces *D*, Fig. 1, difficulty was experienced at first in obtaining equipment which was rugged enough to take the heavy cut required. The equipment for this work now consists of a Lodge & Shipley 20-inch lathe having a special direct gear drive to the faceplate, operated by a Johnson clutch and carried in a ruggedly constructed special headstock. This machine is illustrated in Fig. 5, and although the driving end of the machine is not shown, it will be evident that the power is transmitted to the faceplate pinion carried on the driving shaft *A*, for the purpose of driving the faceplate. A proportionately heavy toolpost *B* is used, in which the tool is adjustably mounted. In this operation a plug center *C* and the previously machined dog slot are used to mount the work in the machine. A production of seventy-eight pieces per hour is obtained.

After being rough-turned on a 16-inch Prentice geared-head lathe, the shafts are next ready to be rough-turned on the angular surface *E*. Fig. 1. This operation is performed on a Lodge & Shipley lathe equipped with a special taper-turning attachment. The cam-slide of this device is operated by the cross-slide screw, and is attached to the lathe saddle so that the tool may be adjusted to agree

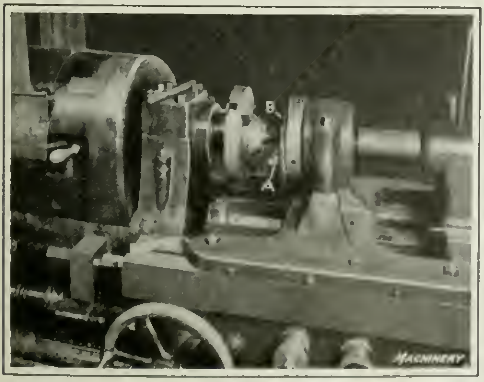


Fig. 8. Lathe equipped for finish-turning the Surfaces machined in the Lathe shown in Fig. 5

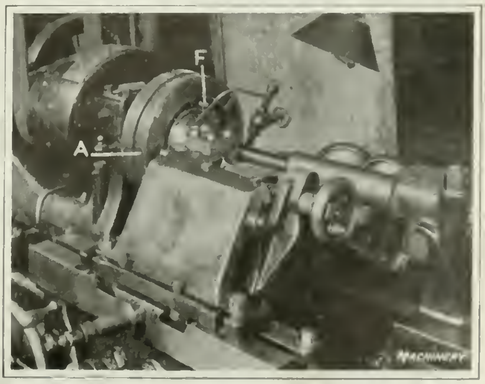


Fig. 9. Lathe employed in turning Calks on Outer Angular Surface of Forgings with Special Attachment

with the diameter of the work to be turned and traversed by means of the regular feed-screw. The set-up is illustrated in Fig. 6, which clearly shows the cam-slide *A* and the slot *B* in which the roller operates to feed the tool in an angular direction. This illustration also shows the use of the faceplate dog *C* which engages the dog slot on the outside of the work. Production time on this job is forty-five shafts per hour.

Finishing Operations on the Tubular Shaft

In the ninth operation, which is the first finishing operation on the forging, a 20-inch geared-head Lodge & Shipley lathe is used, which is illustrated in Fig. 8. This operation consists of finish-turning the surfaces *D*, Fig. 1, employing a special formed tool which may be seen at *A* in Fig. 8. An oil-tube *B*, formed to the shape of a ring and perforated with holes, is used to deliver the lubricant into the inaccessible surfaces which are finished in this operation. The production time is twelve tubular shafts per hour. The next two operations consist of finish-turning the radius *F*, Fig. 1, at the bottom of the shaft, and facing and forming the radius at the top end of the shaft. In the latter operation a Pratt & Whitney No. 2½ hand screw machine is used, the work being produced at the rate of 104 pieces per hour. The twelfth operation consists of grinding the thread end of the shaft 0.01 millimeter smaller than the main diameter. This operation is performed on a Brown & Sharpe No. 11 plain grinder, at the rate of seventy pieces per hour.

Turning Calks on Angular Surface of Forgings

One of the most interesting operations on the tubular shaft is known as the "calking" job. These calks, of which there are six equally spaced on the angular surface of the shaft, are indicated at *G*, Figs. 1 and 11, and the operation of relieving the space between these is performed on a Lodge & Shipley lathe especially equipped for this purpose.

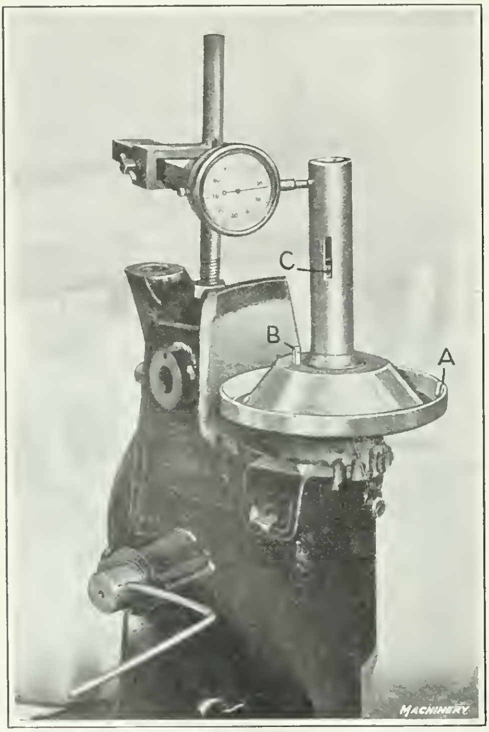


Fig. 10. Testing Concentricity of the End of the Shaft

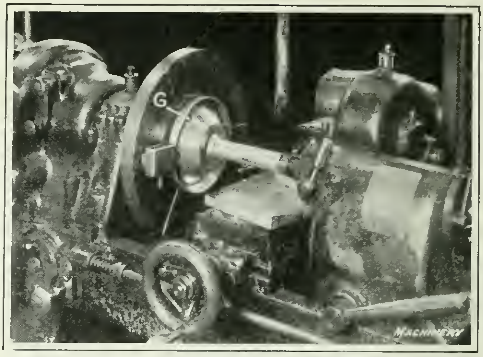


Fig. 11. Thread Milling Machine employed in milling the Thread on the End of the Shaft

This operation is illustrated in Fig. 9, and the special equipment employed in connection with the lathe is shown in detail in Fig. 7, from which it will be apparent that a special cam-ring *A* is fastened to the faceplate, this cam-ring containing six raised portions or lugs, located radially, against which roller *B* operates. The tension of the coil spring *C* may be regulated as desired by means of the handwheel carried at the end of the roller shaft. The tool-holder which carries the tool *D* is attached to slide *E;* thus as the roller rises and falls over the lugs on the cam-ring, the tool is intermittently lifted from the surface which it is engaged in turning, so that at the completion of the cut the calks are formed on this angular surface.

The entire attachment is secured to the lathe carriage, and the work is located by means of the dog slot in which driving dog *F* (see also Fig. 9) engages, and is supported at the outer end by the tailstock center and a center plug, as shown in Fig. 7. The use of a pilot center *H* in the lathe spindle assures that these calks will be located concentrically with the center line of the tube shaft. In the description of the construction of the cream separator, it will be remembered that spacing pieces are employed to separate the several cones from each other so as to provide space through which the milk is forced. The purpose of the calks on the tubular shaft is to provide a similar space between it and the lowest cone. The rate of production on this job is forty-seven pieces per hour.

Milling, Slotting, Forming, Turning and Grinding Operations on Tubular Shaft

The four following operations on the tube shaft, 14 to 17 inclusive, consist of two milling operations on a Whitney hand-operated machine to produce the tangential and radial sides of the three milk slots; and two die slotting operations to square the curved surfaces of these slots. The die slotting operations are performed on a Garvin die slotter equipped with an indexing head for rotating the work to bring each slot in the proper relation with the tool.

In the eighteenth operation, a forming tool is used to finish the angular surface *H*, Fig. 1, and the radius *R* at the bottom of the forging; this tool also forms the radius at the intersection of surfaces *H* and *K*. A second tool is provided for finishing the remainder of surface *K*. This work is performed on a Jones & Lamson flat turret lathe at the rate of thirty-one pieces per hour. The nineteenth operation consists of milling a pin slot (the location of which may be seen at *A*, Fig. 10) which is used to locate the bowl within the flange of the shaft by means of a correspondingly located pin on the bowl. The work is performed on a Whitney hand miller, being held in a clamp on the table of the machine in which it is located by the dog slot. This is the last function of the dog slot in the machining of the bowl, for in the following operation the outside diameter of the rim is rough-turned, thereby removing the driving dog slot. This operation is performed on a Prentice 16-inch geared-head lathe; in this case, the work is driven from the recently machined pin slot, and is located from the surfaces *D*, Fig. 1, in which suitable clamps engage, which are operated by an air-operated draw-in chuck. The production time on this operation is eighty-three pieces per hour. The work is next recentered, and the rim *J* is ground on a No. 11 Brown & Sharpe plain grinding machine. In the twenty-third and twenty-fourth operations the shaft is rough- and finish-ground, the finished surface being held to within limits of 0.02 millimeter. These operations are performed on a Brown & Sharpe grinder at the rate of about 100 per hour.

The twenty-fifth operation is that of drilling the hole for locating pin *B*, Fig. 10. The purpose of this pin is to position the distributor accurately in relation to the slots in the shaft. The hole is accurately located by means of a jig which fits over the spindle and which has a single tooth that engages the pin slot. After a series of bench operations has been performed on the parts, they are sent to the tinning department, and after being tinned, the bronze bearing bushing for the driving spindle is assembled in the shaft.

The final operations on the work are not unusual (although of considerable importance to the operation of the separator) and need not be enumerated. Fig. 11 shows the last operation prior to the final inspection of the shafts, in which a Pratt & Whitney thread milling machine is shown set up for milling the threads on the end of the shaft. This illustration shows the method of locating the work on the faceplate by means of a driving dog engaging the pin slot. The production time on the thread-milling operation is twenty-four pieces per hour. Fig. 10 shows the apparatus employed to inspect the running truth of the end of the tubular shaft by means of an Ames indicator, the work being mounted on a spindle which engages the driving dog *C* within the spindle. This arrangement is identical with the construction of the cream separator.

* * *

PROPERTIES OF DURALUMIN

In an article recently published in *Technische Berichte*, the physical properties of duralumin, which is used in the construction of aircraft, are dealt with. This alloy is made in various compositions, the amount of the different elements contained varying between the following percentages: Aluminum, 95.5 to 93.2 per cent; magnesium, 0.5 per cent; copper, 3.5 to 5.5 per cent; and manganese, 0.5 to 0.8 per per cent. Lead, tin, and zinc have an unfavorable influence upon the permanence of aluminum alloys, and so are not found in duralumin. The specific gravity of the latter varies from 2.75 to 2.84, according to the composition and hardness. The melting point is about 1202 degrees F. Duralumin has a strength of from 50,000 to 57,000 pounds per square inch and an elongation of 10 to 15 per cent in two inches. The modulus of elasticity is from 8,500,000 to 10,000,000 pounds per square inch. It is very brittle, especially in thicknesses above 0.04 inch, and consequently is sensitive to alternate bendings to and fro.

Working the Alloy

Duralumin can be rolled into plates and shapes, the elongation decreasing as the hardness of rolling increases. Tube blanks, however, can be made only by pressing and not by the oblique rolling method. The alloy can be tempered by heating and sudden cooling. For this purpose, plates, tubes, and shapes are heated to between 896 and 950 degrees F., quenched, and then aged. The original strength is very nearly restored after the quenching, but the tensile strength continues to grow with the ageing from 50,000 to 70,000 pounds per square inch. The elongation does not decrease, but remains at least the same and usually increases slightly. In practice, the greatest strength is reached after about five days of ageing. When heated to over 986 degrees F., duralumin becomes unusable; consequently the treating is carried on in a bath of nitrates, the temperature of which can be carefully regulated and watched. During the ageing of the metal, work should not be done on it which would change the section, as in that case the strength would not increase further. After the completion of ageing, the material can be rerolled to obtain smooth surfaces. Because the material may warp in tempering, it is not good practice to temper riveted parts; such parts should be tempered before they are riveted.

Modulus of Elasticity and Ductility

Duralumin is made in various compositions having different properties to suit the purpose for which it is intended. The modulus of elasticity of a hard composition known as "681a" was found to be 10,000,000 pounds per square inch. Making allowances for the possible effect of vibration on the modulus of elasticity, it appears better to use not more than 9,250,000 pounds per square inch in computations. In judging the suitability of a material for use in stressed parts, not only the tensile strength but also the ductility is of great importance. This can be determined by bending strips backward and forward through 180 degrees over a definite radius, usually 0.20 to 0.40 inch, the number of bends possible before a fracture being taken as a measure. Although the strength values of steel plates used in several experiments were less than those of the duralumin plates, the steel plates could be bent much oftener, since they possessed greater ductility. The number of bends for both metals decreased with increased thicknesses. The difference was least for plates under 0.02 inch in thickness. For thicker plates of duralumin, the number of bends decreased very rapidly; a plate 0.08 inch thick broke over a 90-degree bend, and a plate 0.16 inch thick broke over a 45-degree bend. This property makes duralumin unsuitable for highly stressed parts which must also withstand vibrations.

Influence of Heat and Cold on Duralumin

Heat has an important influence on the strength of duralumin, the results of tests indicating that the strength decreases 10 per cent for an increase in temperature of 212 degrees F. and about 20 per cent for an increase of 302 degrees F. The loss in strength increases with the increase of temperature. On first heating the increase in elongation is hardly appreciable, and between 302 and 392 degrees F., it decreases. At 482 degrees F., the elongation becomes the same as at the room temperature. Upon further heating the elongation increases with a rising temperature. Consequently, wherever duralumin is exposed to heat, the possible decrease of strength must always be considered. Opposed to this, the influence of cooling on the strength properties is less unfavorable. The strength and elongation increase somewhat with a decrease in temperature.

Experiments on the influence of weathering on the strength of duralumin, which have been carried on by the Durener-Metallwerke for three years, have shown that there is no observable decrease in the strength. Experiments have also been made to determine the electrolytic effect from junctions of duralumin with iron or steel. These were made by riveting duralumin bars to iron plates and then placing them in artificial sea-water. The result was only an insignificant destruction of the iron and a reduction in the weight of the bars of about 0.23 per cent, so there is no objection to using duralumin and iron junctions in aircraft.

* * *

According to W. B. Colver of the Federal Trade Commission, in charge of operation of the Webb-Pomerene law, forty-four associations comprising about 1000 concerns located in forty-three states have been formed in the two years' operation of the law. During this period not a single complaint has been made by a foreign customer against any of the associations.

Service Factor in Interchangeable Manufacturing

Importance of Considering, during the Development, Designing and Manufacturing Periods, the Service which a Machine or Device Must Render

By EARLE BUCKINGHAM, Engineer, Pratt & Whitney Co., Hartford, Conn.

THE ultimate test of any manufactured article is the test of service. The component parts may be absolutely interchangeable, the manufacturing processes may be developed to produce large quantities economically, and the inspection may be as rigid as possible; yet if the required service is not rendered, all of this work is useless.

Consideration of Service in Preparing Functional and Manufacturing Designs

If a commodity is to give satisfaction, this service must be built into it at every stage of its development and manufacture. The first conception of a new mechanism develops from the realization of some service to be performed. The functional design of this mechanism is solely the development of some mechanical means of performing this service; this thought is paramount and every other consideration is subordinate to it. It is only after this result has been obtained that any great thought is given to the matter of producing the mechanism commercially.

> **In the final analysis, no manufactured machine or device is ever purchased for itself alone, but is acquired for the purpose of securing the service which it is supposed to render. Thus, for example, the purchase of a reamer is the purchase of reamed holes of a desired quality or standard. Consequently it follows that the reamer which produces the most reamed holes of the required accuracy at the least ultimate cost is the best reamer and is finally recognized as such. Its first cost may be higher than others, yet if it produces more holes during its life, or produces them more quickly or with less power, the average cost of the reamed holes may be much less than those produced with a cheaper tool. In like manner, the purchase of a machine tool represents the purchase of machined surfaces; the purchase of a typewriter, typed letters; the purchase of a sewing machine, sewn seams; of an automobile, transportation, etc.**

The primary purpose of the manufacturing design is to develop the functional design into one which can be economically manufactured; yet, at the same time, the greatest care must be exercised to maintain all the serviceable qualities of the original design. The factor of economical manufacture must never be the controlling one when economy is secured at the expense of service rendered. The customer is purchasing this service, and any action which may rob him of some part of it, is unjustifiable. The development of the correct manufacturing design is a long process. There are no laboratory tests which will show all the requirements and results of service. The largest part of this information must necessarily come from the study of the results obtained from the commodity when in actual service.

A large amount of this information can be readily secured if proper attention is given to every complaint from customers. Too often, information from such sources is treated as an annoyance to be smoothed over rather than as a definite problem to be solved or as a matter which is of far more value and importance to the producer than to the customer. In general, a complaint from a customer results from one of three causes: First, some faults in design, workmanship, or material may exist in the mechanism which prevent it from giving the service which is due the customer. If this is the case, prompt steps should be taken to correct the trouble at its source. Obviously this matter is of more importance to the producer than to the user if he hopes to remain long in business. Second, the customer may not thoroughly understand the handling and care which the mechanism requires. In such cases it is of the greatest importance to the manufacturer that the customer obtains the needed information, or else the reputation of his product will inevitably suffer.

The third complaint is usually due to the customer's attempt to perform work for which the product was not intended or which is beyond its capacity. It is essential that the manufacturer know the limitations of his product. Furthermore, information derived from complaints of this sort often lead to modifications of the product which greatly increase its field of usefulness. Complaints of all sorts should be carefully checked and acted on accordingly. Several manufacturing concerns have a man or division in their engineering department that investigates all complaints from customers, using the information so gained in the improvement of their product. Only by such knowledge of actual results obtained under many conditions can the maximum service be built into a product.

Keeping Specifications up to Date

The specifications should include all information which is needed to produce a commodity capable of giving the desired service. In whatever form they are kept, they should be constantly revised to keep abreast of the needs of service. For example, if the material specified for a certain part proves too weak in actual use, it must be altered. Thus, the part may require a stronger material, a different kind of heat-treatment, or a strengthened design. Often it may be found that the original requirements of many surfaces or parts are not the correct ones. All of this information, if kept in such form that it is always available, will be found invaluable in the development of future products; products which will contain from the start a higher quality of service than any of the preceding ones.

Planning Production to Obtain Requisite Service

Every part of the manufacturing equipment provided should be selected or designed with the object of producing parts capable of rendering the required service. The design of the commodity itself, if properly recorded on the drawings, will emphasize these points; yet a careful check should be made to insure that no vital factor has been overlooked.

The constant care which must be exercised in every stage of the actual production determines in a large measure the character of the service delivered. No operation is too unimportant to be neglected. This care, however, must be taken by each individual workman. To obtain the necessary cooperation, every effort must constantly be made to develop in each workman the spirit of true craftsmanship. A craftsman, in the opinion of the writer, is a man who takes pride in the work and skill of his hands and brain; who feels that each result of his labor is a monument to himself; and whose enthusiasm and consciousness of power prevent him from doing any work but his very best. No man can do justice to his own capabilities unless he is interested in and proud of the results of his labor. The manufacturer must realize that he should have a vital interest in the proper training of each one of his workmen, and should use every means in his power to foster true craftsmanship in all branches of his establishment. No part of any work is too elementary to justify such an attitude.

Inspecting Parts to Insure Service

Every inspector must keep in mind at all times the requirements of service which the parts under inspection must render. This service is the sole purpose for which the parts are made. If they will render it, the parts are correct; if not, they are incorrect. In a well-balanced organization, the inspection is not carried on to discover the faults which others have committed, but rather to protect the customer and the firm's good name as well, by guarding against the possibility of faulty work going out despite all precautions taken in the productive departments. Yet, even with the most rigid inspection, some flaws remain hidden and are not discovered until the commodity is in the hands of the customer. With an honest inspection, such occurrences will be the exception, but without proper safeguards, these occurrences are apt to be the rule, and the customer will soon learn it, to the disadvantage of the manufacturer.

The majority of mechanical products are tested on work of the type they are built to perform before they are shipped. Needless to say, no attempt should be made to favor the commodity in such tests. Every effort should be made to detect any faults, and each fault detected should be permanently corrected. The interest of the manufacturer in the commodity should not cease when it reaches the customer. It is of more interest to the manufacturer than to the purchaser to see that his product is employed on the work it can best perform, and to see that it performs its maximum service. By so following up his product, he not only makes a satisfied customer but also creates new markets for his product. Furthermore, as noted previously, the information gained by observing his mechanisms in service under many varying conditions, will be invaluable to him in developing and improving his product, as well as often pointing the way to the development of new products.

Manufacturers in a number of different lines have established well-organized service departments with a view to insuring that the machines or devices that they build will give the highest possible service and satisfaction to their customers. Such service departments are well known in the automobile and typewriter fields, but similar departments, somewhat different in their nature, on account of the varying conditions under which the product is used, are also found in the machine tool field, where some manufacturers have highly organized service departments for determining the best conditions under which the customer's work may be performed. Through such service departments it has often been found possible to increase greatly the output of the machines built.

COMPLETION OF THE SERIES ON INTERCHANGEABLE MANUFACTURE

The article beginning on the preceding page is the last one in the series of articles dealing with the principles of interchangeable manufacture that began in the July, 1919, number of MACHINERY, and of which one article has appeared each month until it is now completed with the present article "Service Factor in Interchangeable Manufacturing."

In this series, the author, Major Earle Buckingham, has discussed the various phases involved in interchangeable manufacturing practice. The first article dealt with the principles of the subject, followed by articles on the "Terms Used in Interchangeable Manufacturing"; "Machine Design in Interchangeable Manufacturing Practice"; "Purpose of Models"; "Practice in Making Component Drawings"; "Economical Procedure in Interchangeable Manufacturing Practice"; "Equipment Required and Gages of Different Types Employed"; "Inspection and Testing in Interchangeable Manufacture"; "Manufacturing for Selective Assembly"; and "Small-quantity Production Methods."

It is the first time in technical literature that this subject has been dealt with as completely as it has been by Mr. Buckingham. His unusual training and experience make him particularly qualified to write such a series of articles; since his education at the United States Naval Academy at Annapolis, he spent fourteen years with various manufacturing concerns engaged in interchangeable manufacturing on a large scale. Among these firms may be mentioned the American Graphophone Co., Bridgeport, Conn.; the Winchester Repeating Arms Co., New Haven, Conn.; the Veeder Mfg. Co.; the Royal Typewriter Co., and the Pratt & Whitney Co., Hartford, Conn.; and in addition, his experience has covered munitions work with the Canadian Car & Foundry Co., and the Eddystone Munitions Co. In July, 1917, Mr. Buckingham took charge of the gage section of the inspection division of the Ordnance Department, being commissioned as captain. He was later transferred to the engineering division, where he was engaged both in the cannon section and the gage section. In October, 1918, he was promoted to major, and after his discharge from the service in January, 1919, came to the Pratt & Whitney Co., where he has had ample opportunity to make use of his varied experience in interchangeable manufacturing methods.

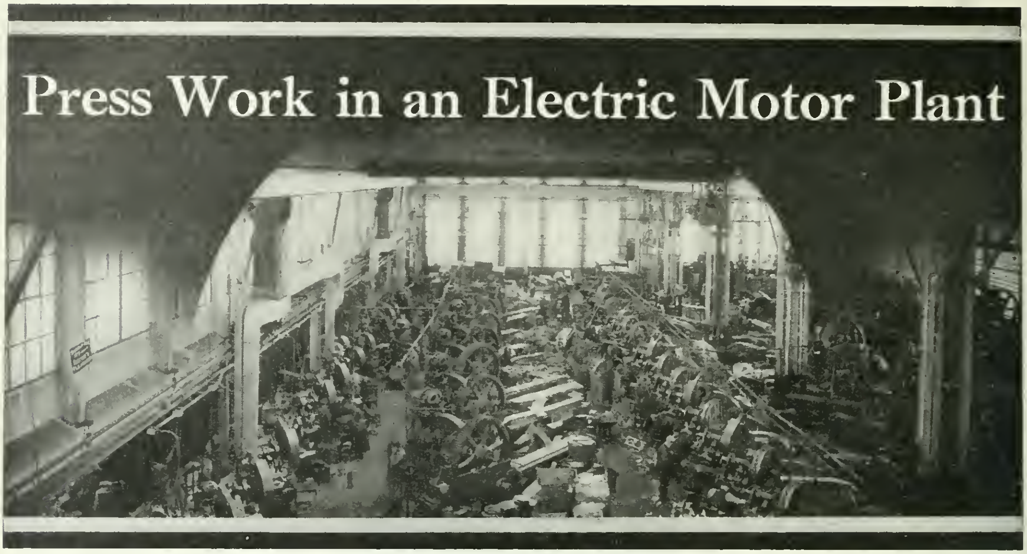
MAJOR EARLE BUCKINGHAM

Author of the Series of Articles on Interchangeable Manufacture Concluded in the Present Number

Mr. Buckingham is an associate member of the American Society of Mechanical Engineers, and a member of the Society of Automotive Engineers. He served as a representative of the latter society on the visit which the National Screw Thread Commission paid last summer to England and France in order to confer with the leaders in engineering there on the subject of standardization of screw threads. He is also a representative of the American Society of Mechanical Engineers on the Sectional Committee on Plain Limit Gages of the American Engineering Standards Committee, and a representative of the Society of Automotive Engineers on the Sectional Committee on Screw Threads of the American Engineering Standards Committee.

It is planned to make Major Buckingham's treatise on interchangeable manufacture available in book form within the near future, as doubtless mechanical men engaged in interchangeable manufacturing will want to be able to use this treatise for permanent reference.

Press Work in an Electric Motor Plant



Second of Two Articles Describing Methods Used in the Power Press Department of the General Electric Co., Lynn, Mass.

IN the preceding installment of this article, published in the November number of MACHINERY, a description was given of the design and operation of various compound blanking and perforating dies of the sub-press type. The present, and concluding, installment describes the power press equipment used in the production of street railway motor gear-cases; two types of dies used in making turbine-motor stampings; an automatic feeding mechanism and stop for power presses; and the indexing mechanism and work-holding devices used on notching presses when producing electric motor stampings.

Manufacturing Gear-cases for Railway Motors

The making of gear-cases for electric railway motors involves a special drawing operation which is performed on a Ferracute double-action press. The stock from which these gear-cases is made is 9/64 inch thick, and the shells are drawn to a depth of 10 inches, the width and length being 4½ and 23 inches, respectively. The shell before and after being trimmed is shown in Fig. 16, and a plan view of the assembled gear-case is shown in Fig. 17. The blanks from which the shells are made are first roughly sheared to the desired polygonal shape, after which they are drawn in one operation.

The operation of trimming the sides is shown in Fig. 18. The shells are laid flat on the side and slid under the shearing punch which is provided with a spring-actuated guide plate for the shear blade. The upper and lower members of the shear are held in alignment by means of square pillars, similar to the construction of sub-presses. A suitable stop and hand-operated eccentric are used to locate the work properly and to hold it in the desired position. The eccentric handle may be seen in the illustration. After the two sides have been trimmed parallel, they are taken to the press shown in Fig. 19, where the ends of the shell are trimmed. This machine is built by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., and is equipped with a special swiveling fixture for securing the work during the operation. This fixture holds the work in a vertical position during the trimming process, the shells being strapped in a suitable cradle.

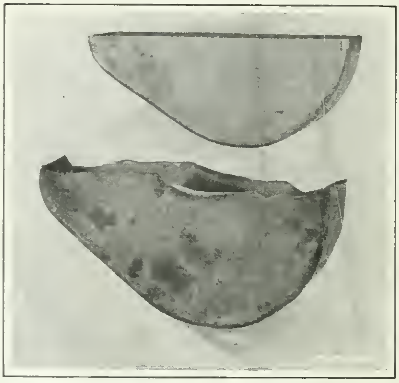


Fig. 16. Steel Shell (before and after trimming) from which the Gear Guard shown in Fig. 17 is made

When loading the shells, the fixture is swung to the left and swiveled so as to bring the shells into a horizontal position for convenience in loading. The fixture is then swung into the vertical position and locked in line with the shear by means of pin *A*, after which the work is advanced under the blade by an operating lever *B*. The stanchion of the fixture rides in a slide in the cast-iron support *C*, so that as the operating lever is manipulated, the sliding stanchion is brought up against stop *D*, thus enabling the ends to be trimmed in the same plane as the trimmed slides. A handle *E* located at the top of the fixture serves to raise the work by means of an eccentric, sufficiently to obtain the proper vertical relationship between the end of the shell and the shear blade. The opposite end of the work is brought into position to be trimmed, by simply sliding the fixture away from the machine, swiveling the cradle 180 degrees, and returning the sliding stanchion to the stop.

After the holes for the axle and motor pinion-shaft and the oil-hole in the top half of the gear-case have been punched out, a flange *A*, Fig. 17, is spot-welded to each half of the gear-case. In manufacturing this flange, the blank is trimmed on the corners to the desired shape, and a central strip is cut out on a combination blanking and piercing die, as indicated at *B*. The stock is also cut out at *C* and bent at right angles as indicated by the dotted line. By bending the stock in this manner, the ends assume a U-shape, and the stock between the

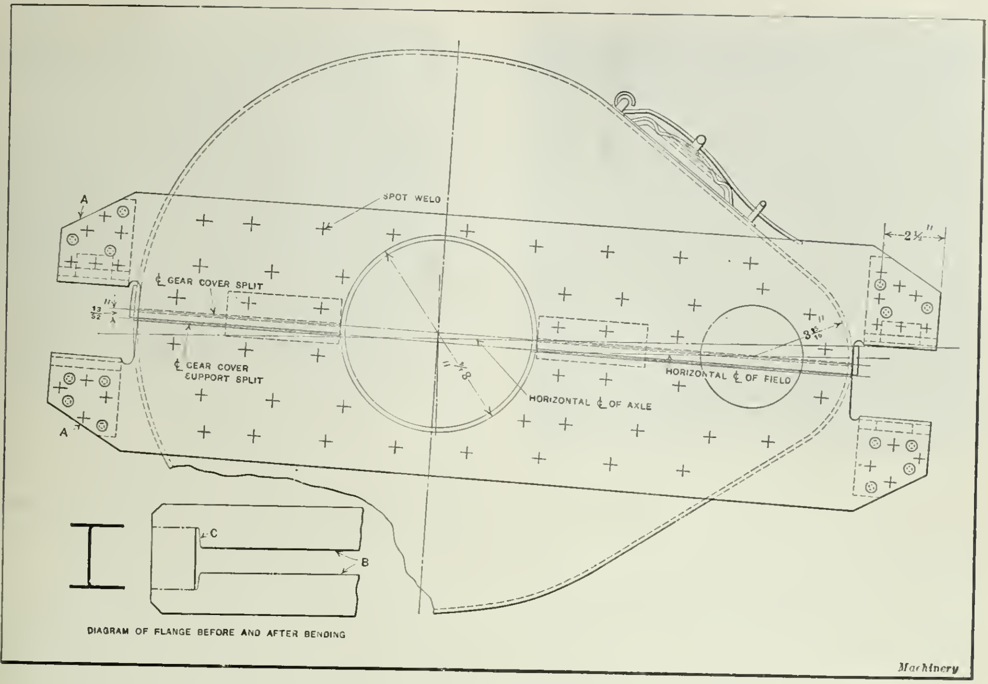


Fig. 17. Sheet-steel Gear Cover for Electric Railway Motors, and Development of the Flange before forming

ends forms the flat flanges on each side of the shell. This shape is indicated in the diagram.

Methods and Equipment Used in Producing Turbine-motor Stampings

There are two types of machines and two kinds of equipment employed in the General Electric Co.'s shops in producing turbine-motor stampings, both of which will be mentioned in this article. The laminations are stamped out in sections which are so arranged when assembled that the joints of adjacent laminations are offset in relation to each other. Fig. 20 shows a No. 95 Bliss press equipped with a sub-press for blanking out these stampings from strip stock. A stop is provided so that as the stock is passed through the dies, sufficient space is left between each stamping to enable another to be stamped out when the stock is reversed. This fact is evident by the appearance of the scrap which the operator is holding in one hand.

The compound blanking die used on this press is shown in section in Fig. 21. A three-pillar type of sub-press is used in this case, since the shape of the stamping adapts itself more readily to the use of three pillars than to an even number. The stock from which these stampings are made is 0.025 inch thick, and the shape is shown in both Figs. 20 and 22. Referring to Fig. 21, the upper holder *A* carries die *C* and one stripper *G*, movement of which is provided for by allowing a space between it and the templet *H*. The stripper is attached to the upper holder by a number of screws, the nuts of which fit in recesses in the holder to permit movement of the stripper. These screws and their nuts are prevented from turning by the same locking means used in other dies of this general construction. The lower holder *B* contains punch *D* and a stripper, also indicated by *G*, which is attached in the same way as the stripper in the upper holder. Pin *F* is carried on an extension arm at the

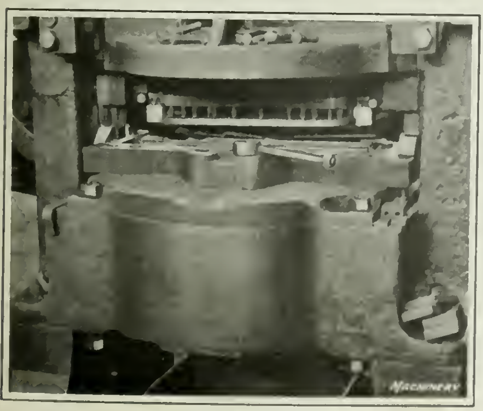


Fig. 18. Press equipped with a Two-pillar Shearing Die for trimming Gear Guard Shells

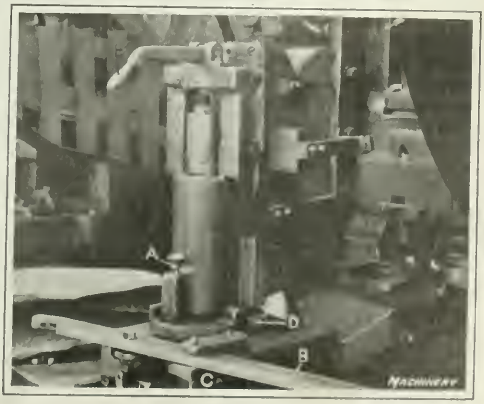


Fig. 19. Fixture used in locating the Shells during Operation of trimming the Ends

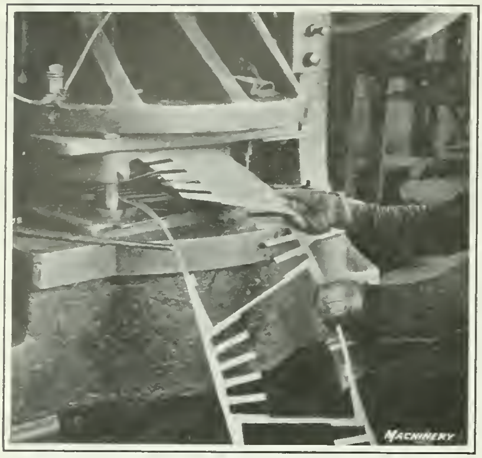


Fig. 20. Power Press equipped with the Dies shown in Fig. 21

rear of the sub-press, and locates the spacing of the stampings. The stock is located sidewise by means of two guide pins shown at *E*.

When these stampings are made by first blanking and then by punching the slots on a notching press as a separate operation, the method of holding the work for slotting is shown in Fig. 22. This illustration also furnishes an idea of the size of the rotor as well as the special mechanism employed to index the machine during the notching operations. The performance of the work by this method is, of course, somewhat slower than that previously described, but this machine may be operated by one man, whereas the feeding of strip stock requires a man at the front and one at the rear of the machine. This is a Ferracute press, and the fixture in which the stampings are placed holds eight parts, which have dovetailed sections stamped on the outer edge so that they may be located and held in position by corresponding lugs in the fixture. The operator stands at the right of the machine, and with one hand removes a finished stamping while with the other he loads a fresh one into position. As the fixture constantly revolves, the work is brought under a flat shoe *A*, which holds the work down by spring tension until the fixture has revolved sufficiently to bring the advancing edge under the head of the press. As the notches are stamped out and the finished work passes beneath a flat spring *B*, the fixture is indexed notch by notch by means of the mechanism shown at the left-hand side of the illustration.

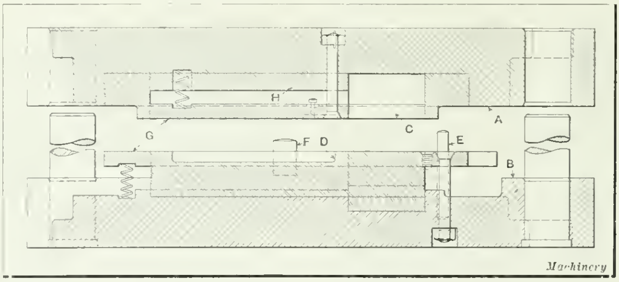


Fig. 21. Design of Sub-press Dies in which Stampings for Large Motors are made

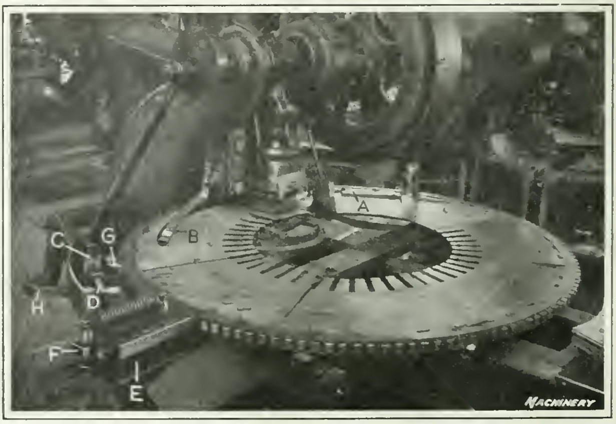


Fig. 22. Notching Press equipped with Automatic Indexing Mechanism, for punching out Slots in Large Motor Stampings

Automatic Indexing Mechanism for Notching Operation

The automatic indexing mechanism by means of which the fixture is rotated is of similar design to that employed on certain other types of notching presses. The device illustrated, however, was especially designed for the performance of this notching operation. A slide, of which boss *C*, Fig. 22, is a part, reciprocates between two stop-collars. These collars are fastened to a curved rod *D* which is attached to a curved latch. The latch is provided with a notch which, when it enters the detent block *E*, forces the detent *F* from engagement with the notches in the periphery of the fixture. It is evident that when the notched latch is not in engagement, the detent locks the fixture by means of the tension exerted by a heavy coil spring. On the backward traverse of the slide, pawl *G* is pulled back a distance equal to the pitch of the notches, while the fixture is being held by the detent. The reciprocatory movement of the slide is transmitted by means of a universal joint connected with rod *H*, which is attached to a bellcrank lever. This bellcrank lever is given an oscillatory motion through its connection with a cam on the end of the crankshaft of the machine.

Although these notches are punched out very rapidly on the notching press, the production by this means does not equal that obtained on the machine equipped as shown in Fig. 20. The use of the notching press, however, does assure that the spacing of the notches for the entire set of stampings will be uniform, a fact which will be apparent by inspecting the method of holding the stampings in the fixture. The driving pulley is driven at 65 revolutions per minute, which is equivalent to an hourly production rate, allowing 10 per cent idle time, of about 575 stampings.

Automatic Feed and Stop for Strip Stock

In Figs. 23 and 24 there are shown partial rear and front views, respectively, of a power press equipped with two special automatic devices. This press is the product of the Niagara Machine & Tool Works, Buffalo, N. Y., and is provided with an automatic feed mechanism used when producing stampings of the design shown in the lower left-hand corner of Fig. 23.

This attachment consists of a heavy bracket *A*, attached to the frame of the machine, which contains bearings for an auxiliary shaft to which the forked arm *B* is attached. It will be seen that this shaft also carries two wide-faced spur

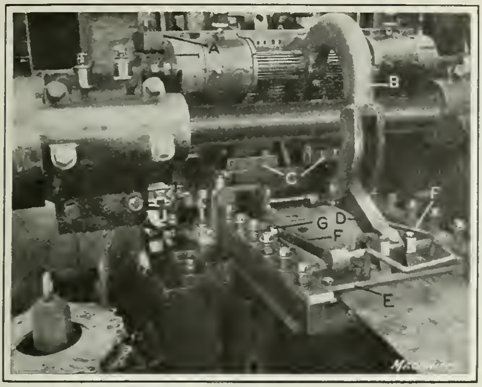


Fig. 23. Power Press with Special Attachment for automatically feeding Strip Stock into the Die when producing Stator Stampings

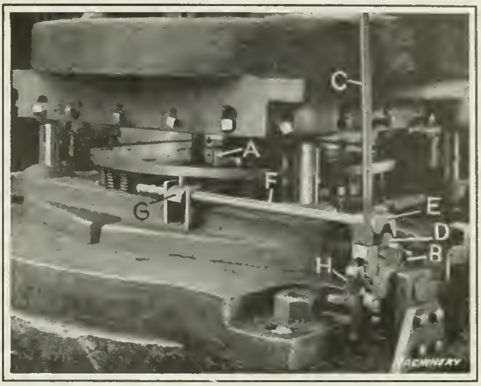


Fig. 24. Front View of Machine shown in Fig. 23, showing Automatic Stop that functions after the Strip has been completely used

gears, which mesh with racks carried in two upright bearings *C*, attached to the machine frame. It will be evident that as the ram of the press moves up and down, arm *B* will rise and fall accordingly. Through link *D*, which is hung in the forked arm, a reciprocatory movement is transmitted to slide *E*. The cross-shaft to which the connecting link is attached, carries two side arms *F*, in the further end of each of which there is an elongated slot. A roll *G* on each side of the slide is provided with a projecting pin or trunnion which extends into the slot in each side arm. The rolls are thus traversed back and forth with the slide with each rise and fall of the forked overhanging arm, a motion which results in advancing the stock at each stroke as determined by the length of the slide movement.

The feeding of the stock is accomplished by the downward pressure exerted by the side arms on the roll trunnions, binding them against the work during the downward movement of arm *B*. It is evident that normally the center of axis of the rolls would follow a horizontal plane and that the angle of the side arms produces an angle between the center line of the slots and a horizontal plane so that sufficient downward pressure is exerted on the trunnions in the slots to bind the rolls securely to the stock as a means of advancing it, as previously described. A bracket is bolted to the lower part of the machine for the purpose of supporting the slide. Two operators are employed on this job, one of whom feeds the stock into the machine at the rear while the other removes the finished work at the front of the machine. Another special automatic feature employed is a stop which is attached to the front of the machine and which is illustrated in Fig. 24. This mechanism is a ratchet device, as will readily be seen from the illustration, and operates a pin *A* which furnishes a stop for the work. The length of the strip stock is such as to enable nine stampings to be produced from it; consequently the ratchet wheel which controls the operation of the stop-pin has nine teeth.

This ratchet wheel *B* is supported by a bracket attached to the side of the machine, and is revolved one tooth at each upward traverse of the press ram. A connecting-rod *C* transmits motion to a pawl which operates the ratchet wheel in a clockwise direction. This pawl cannot be seen in the illustration, but it will be understood that it engages the teeth at the rear of the ratchet wheel and pulls downward with each upward travel of the press ram.

After the wheel has been revolved to the ninth tooth, a lug *D* on the wheel is brought into contact with pawl *E*, which results in turning the horizontal rod *F* and raising the stop-pin by means of arm *G*. It is evident that lug *D* is inoperative during the time that pawl *E* is not in engagement with the lug, and that the stop-pin is depressed, permitting the stock to pass over it as it is fed through the machine. A coil spring *H* raises the ratchet pawl so that it may be brought into engagement with the next ratchet tooth on the downward stroke of the press. Attention is called to the construction of the dies used for this work, which are of the sub-press type. The two operators employed on this job produce 1200 stampings per hour.

In the first installment of this article mention was made of the continued use of notching presses in electric motor shops. Not all the various types of stampings used on the large number of styles and sizes of motors are produced by means of multiple slotting dies; this is due partly to the excellent results obtained with the notching press on this type of work. A number of notching presses used in the General Electric Co.'s shop are shown in the illustration Fig. 25, which is a view in the press department of this company's works at Lynn, Mass.

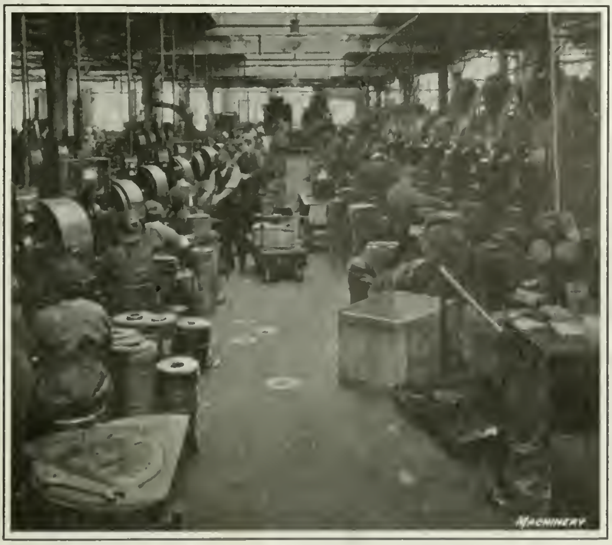


Fig. 25. View in the Power Press Department showing Notching Presses, and giving Some Idea of the Variety of Shapes handled on these Machines

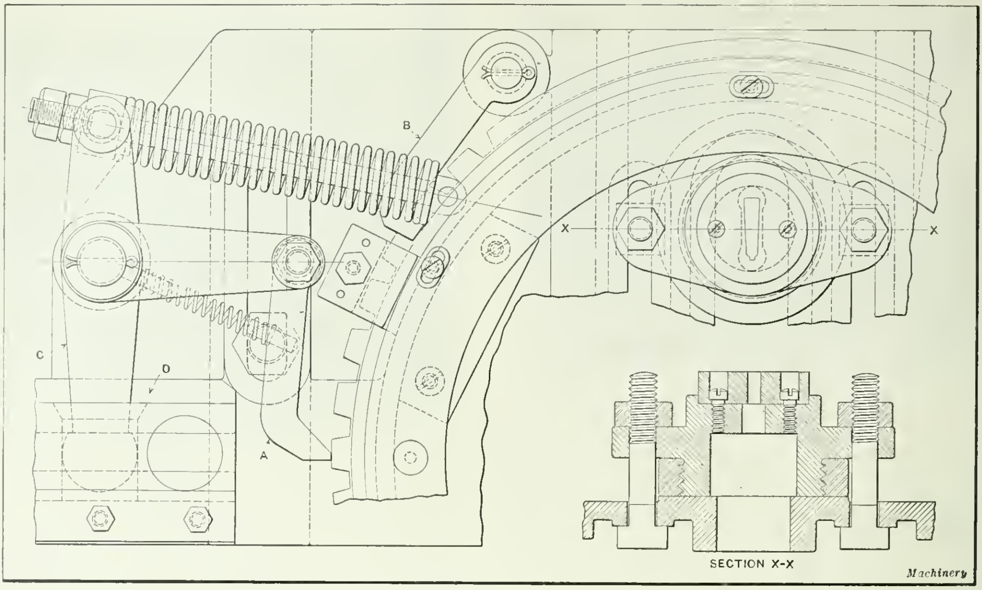


Fig. 26. Plan View of the Universal Automatic Indexing Fixture used on Notching Presses

Universal Automatic Indexing Fixture

The mechanism employed to rotate the fixture in which the work is held during the notching operation is of interest from a mechanical viewpoint and is illustrated in Fig. 27. In this illustration a motor stamping is shown located on the work-holding fixture, from which the nature of a large proportion of the work that these machines perform can be seen. This notching mechanism produces the same result as that described in connection with Fig. 22, but operates on a somewhat different principle. Fig. 26 shows a plan view of this mechanism and of a part of the holding fixture. The construction and operation of the indexing mechanism is as follows. Two pawls *A* and *B* are operated by their connection with a bronze bellcrank lever *C*. Pawl *A* is of the pusher type, and has a flexible spring connection with the bellcrank lever. Pawl *B* is of the hold-back type and is also operated by spring pressure through a rod at the end of the bellcrank lever, as shown in the illustration. The amount of tension thus produced may be varied by means of the adjusting nuts that are carried on the end of this rod.

Referring to both illustrations, the ball-end of lever *C* makes a universal joint in a sliding block *D*. Sliding lever *E* is also provided with a ball on the end for the purpose of transmitting motion to the sliding block as arm *F* is rocked back and forth by a connecting-rod attached to the crankshaft of the machine. It will be seen that as arm *F* oscillates, the sliding block *D* is made to reciprocate radially, so that when it is in the left-hand position, Fig. 26, pawl *A* is withdrawn and drags on the top of the teeth, as shown. At the same time, pawl *B* is engaged and holds the fixture during the notching operation; then, as the movement of bellcrank lever *C* is reversed, this pawl is raised while pawl *A* is engaged to advance the fixture the amount necessary to obtain the correct notch spacing. In Fig. 27 the method of holding the work and of locating it on the fixture is shown. The sectional view taken on line *X-X*, Fig. 26, shows the die opening, and the method of attaching and adjusting the die on the machine table.

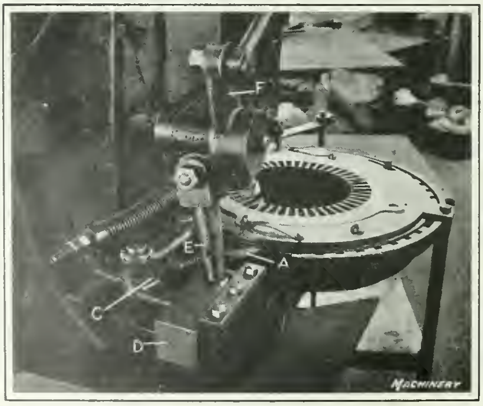


Fig. 27. Toledo Power Press with Automatic Indexing Mechanism attached and with Stator Stamping located in the Fixture

* * *

SOUTH AFRICAN INDUSTRIAL DEVELOPMENT

Official trade reports from the Union of South Africa show an enormous increase in the foreign trade of that country as compared with the trade for 1919. A considerable expansion is expected to take place in the industrial activities of South Africa, where many raw materials are abundant and where native labor is available. There is a growing demand for increased railway service, which the railways find difficult to meet because of shortage of cars, although new equipment is constantly being placed in service. Large quantities of rails, structural iron, plates and sheet iron, pig iron, etc., are required, as the country has no developed iron and steel industry. South Africa has, however, immense resources of iron ore and coal, and it is probably only a question of time when a large iron and steel industry will be developed within the union. One company was started in 1917 for the production of pig iron in a small way, the capital of this company having since been increased and now amounting to about £1,500,000. New machinery is being ordered for these works, and engineers are being engaged in Europe and the United States to develop the iron and steel industries in the Pretoria district.

Calculating the Strength of Unsymmetrical Sections

Two Methods of Determining the Moment of Inertia, Together with Formulas for Obtaining the Section Modulus and Radius of Gyration

By G. S. CHILES and R. G. KELLEY

IN calculating the strength, size, and shape of members such as beams and columns contained in designs of engineering structures and machines, it frequently happens that an unsymmetrical section must be considered. The determination of a moment of inertia of such a section of complicated design is a long and tedious procedure. The usual method is to calculate the moment of inertia for each elementary part or element of the section about its own neutral axis, and then transfer this value to the neutral axis of the entire section. The addition of the moments of inertia of all the elements about the neutral axis of the section gives the moment of inertia of the latter.

A simpler method is to calculate the moment of inertia for each element with respect to an axis along one edge of the section and parallel to the neutral axis through the center of gravity. The sum of these moments of inertia gives the moment of inertia for the section with respect to the axis along its edge, from which the moment of inertia with respect to the neutral axis can be readily determined. The last method has a decided advantage over the first; in the following a specific problem will be solved in detail by each method in order to make this apparent. Both methods are applicable to either cast, rolled, or built-up sections. The moment of inertia for the section illustrated in Fig. 1 will be calculated about the horizontal or gravity axis 1–1. As the section is symmetrical about the vertical axis 2–2, the left half only will be considered in making the calculations. Therefore, the values for the area, moment of inertia, and section modulus of this half section should be multiplied by 2, or doubled, in order to obtain the respective values for the entire section.

The method of calculating the moments of inertia for unsymmetrical sections is a comparatively long and complicated one, and any procedure tending to make problems of this kind less formidable should be of value. The present article does not contain any principles that are not well known in mechanics, but rather compares two methods of calculating, and points out the advantage of one over the other. The clear, concise presentation of the formulas should permit them to be easily understood by the reader and should enable him to make future calculations with little difficulty.

Determining the Center of Gravity

For convenience in determining the center of gravity and moment of inertia, the half section represented at *A* in Fig. 2, is divided into a series of elementary areas or elements, represented by the five rectangles enumerated at *B*, each of which is separated and dimensioned at *C*. This scheme of cutting the section up into convenient elements is equally adaptable in the case of other plane figures, such as sections of a circle, etc. As the width and height of each element is known, the areas can be calculated as follows:

	Width	× Height	= Area	
(1)	2.25	× 0.81	= 1.82	square inches
(2)	1.88	× 1.44	= 2.71	square inches
(3)	0.63	× 12.14	= 7.65	square inches
(4)	1.78	× 0.81	= 1.44	square inches
(5)	2.13	× 1.44	= 3.07	square inches
Area of half section *A*			= 16.69	square inches

In determining the moment of inertia about the horizontal axis 1–1, Fig. 2, any parallel line such as the lower edge of the section, axis 0–0, may be selected as the line of reference. The distance to the center of gravity of each element from the axis 0–0 as, for example, 0.41 inch for element (1), 0.72 inch for element (2) etc., is shown at *C*. Designating this distance as d_0, the product of the area a of each element and its respective distance d_0 is its moment of area (which is also called the first moment of area); the values of these area moments for the five elements under consideration are calculated as follows:

	a	× d_0	= Area Moment
(1)	1.82	× 0.41	= 0.75
(2)	2.71	× 0.72	= 1.95
(3)	7.65	× 6.07	= 46.44
(4)	1.44	× 11.73	= 16.89
(5)	3.07	× 11.42	= 35.06
		Total M	= 101.09

By dividing the sum of the moments M, or 101.09, by the area of the half section, 16.69 square inches, which was previously found, the distance from the lower edge of the section (or axis 0–0) to axis 1–1, which passes through the center of gravity of the section, is determined. Thus,

$$\frac{M}{A} = \frac{101.09}{16.69} = 6.06 \text{ inches}$$

The distance from axis 0–0 to the gravity axis is therefore 6.06 inches. By subtracting this amount from the total height of the section, the distance of the center of gravity from the upper edge of the section is obtained. Thus,

$$12.14 - 6.06 = 6.08 \text{ inches}$$

Since the section in Fig. 1 is symmetrical about the vertical axis, the center of gravity of the section lies in the axis of symmetry. In this and similar problems, the computation of moments about a line perpendicular to the axis of symmetry is sufficient, since the center of gravity is at the intersection of axis 1–1 with the vertical axis of symmetry (axis 2–2).

Calculating the Moment of Inertia by the First Method

Having located the center of gravity of the entire section with respect to the upper and lower edges of the section, the distance between the reference axis through the center of gravity of each element and the gravity axis 1–1 of the entire section may readily be determined. These values are shown at *C*, Fig. 2, the distance being 5.65 inches for element (1), 5.34 inches for element (2), etc. The moment of inertia of the half section about its gravity axis may then be determined by means of the general formula

$$I_1 = I_g + (a \times d_1^2) \qquad (1)$$

in which

I_1 = the moment of inertia of any element in question about the axis through the center of gravity of the complete section parallel to the reference axis;

I_g = the moment of inertia of the element about its own center of gravity or reference axis;

a = the area of the element in square inches;

d_1 = the distance between the reference axis of the element through its center of gravity and the gravity axis 1-1 of the entire section.

Sections composed of plates, angles, channels, etc., are usually referred to as compound sections. The moment of inertia of a compound section about its neutral axis is equal to the sum of the moments of inertia of the elements about the neutral axis of the section. The moment of inertia is designated by the letter I, the subscripts being added merely to indicate which axis is used. Thus, I_1 and I_0 mean moment of inertia about axes 1-1 and 0-0.

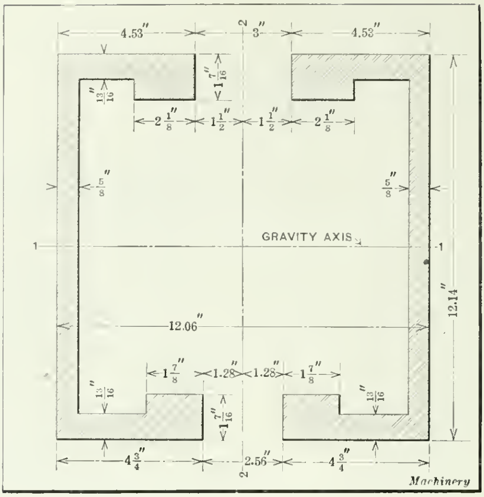


Fig. 1. Unsymmetrical Section for which the Moment of Inertia about its Gravity Axis, the Section Moduli, and the Radius of Gyration will be calculated

The moment of inertia for a rectangle with respect to an axis through its center of gravity is expressed by the following equation,

$$I_g = \frac{bh^3}{12}$$

in which b = width of rectangle in inches;

h = height of rectangle in inches.

The following computations are necessary to determine the moment of inertia I_g of each element:

$$(1)\quad I_g = \frac{2.25 \times 0.81^3}{12} = 0.10$$

$$(2)\quad I_g = \frac{1.88 \times 1.44^3}{12} = 0.46$$

$$(3)\quad I_g = \frac{0.63 \times 12.14^3}{12} = 93.93$$

$$(4)\quad I_g = \frac{1.78 \times 0.81^3}{12} = 0.08$$

$$(5)\quad I_g = \frac{2.13 \times 1.44^3}{12} = 0.53$$

$$\text{Total } I_G = 95.10$$

The moment of inertia I_1 of each element is calculated by Equation (1) and presented in Table 1. The sum of all the moments of inertia of the elements is 364.96, which is the moment of inertia of the half section about its gravity axis 1-1. The moment of inertia of the entire section is found by doubling the amount, as previously stated, thus, 2 × 364.96 = 729.92, the moment of inertia of the entire section.

Determining the Moment of Inertia by the Second Method

The second method of determining the moment of inertia of the half section with respect to the axis 1-1 is based upon the following equation:

$$I_1 = I_0 - (A \times D^2) \qquad (2)$$

in which I_1 = moment of inertia of half section about axis 1-1;

I_0 = moment of inertia of half section about axis 0-0;

A = area of half section;

D = distance from axis 0-0 to axis 1-1.

It is evident that this method involves the determination of the moment of inertia of the half section about an axis such as 0-0 and the transferral of this moment of inertia to a parallel axis 1-1, which passes through the center of gravity of the entire section. In this case, the areas of the elements and of the half section are determined as in the previous case and are the same. The moments of these individual areas about axis 0-0 are also determined as previously.

These moments of area which have been designated as the first moments of area were determined by the formula ($a \times d_0$), but in transferring the moments of inertia from one axis to another, a second moment appears. These second moments of area are obtained by multiplying each element by the square of the distance from its gravity axis to the reference line 0-0, the mathematical formula being ($a \times d_0^2$). The values for the first moments of area were previously calculated, and it is merely necessary to multiply each of these values by d_0 in order to obtain the second moments of area. Putting this in the form of an equation, and substituting the values for each element, we have:

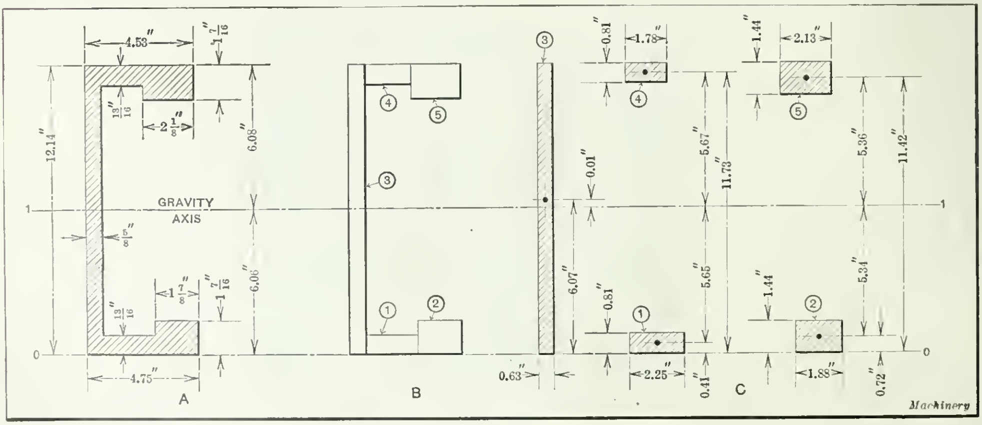


Fig. 2. Method of dividing the Section into Elements to facilitate the Determination of the Center of Gravity and the Moments of Inertia

First Area Moment ad_0 × Distance Arm d_0 = Second Area Moment ad_0^2

(1) $0.75 \times 0.41 = 0.31$
(2) $1.95 \times 0.72 = 1.40$
(3) $46.44 \times 6.07 = 281.89$
(4) $16.89 \times 11.73 = 198.12$
(5) $35.06 \times 11.42 = 400.39$

Total $M_1 = 882.11$

In this method, as in the first one, the moment of inertia of each element about its own gravity axis enters into the calculations, and these values may be obtained in the foregoing. All of the values required in Equation (2) can now be determined. The value of the total second moments of area M_1 was calculated to be 882.11, and the sum of all the moments of inertia of the elements about their own centers of gravity I_G was found to be 95.10. Therefore I_0 in Equation (2) can be determined by the following equation:

$$I_0 = I_G + M_1$$

or

$$I_0 = 95.10 + 882.11 = 977.21$$

Substituting the known values in Equation (2), we have:

$$I_1 = 977.21 - (16.69 \times 6.06^2)$$

and

$$I_1 = 977.21 - 612.92 = 364.29$$

The moment of inertia for the entire section is, of course, double this amount, or 728.58, which is approximately the same as the value obtained by the first method, the difference being due to not carrying the calculations out to a sufficient number of decimal places.

Finding the Section Moduli of the Section

The quantity $\dfrac{I}{y}$ is known as the modulus of the section or as the section modulus, and is in effect a relative measure of the strength of a section to resist bending. For sections which are symmetrical about the gravity axis, the modulus of the section is equal to the moment of inertia divided by half the depth of the section. Thus, y represents the distance in inches from the gravity axis of the section to the extreme outer edge of the section. The letter Z is ordinarily employed to designate the quantity $\dfrac{I}{y}$, that is, $Z = \dfrac{I}{y}$.

In the example under consideration the axis 1–1 through the center of gravity, which may also be termed the neutral axis for bending, does not fall midway between the extreme lower and upper edges of the figure, and as a result there are two section moduli. With respect to the lower edge of the section, the distance y from the neutral axis is 6.06 inches; hence the section modulus of the half section with respect to the bottom edge, if the moment of inertia obtained by the second method is used, is as given in the following equation:

$$Z_b = \frac{364.29}{6.06} = 60.11$$

Similarly, the section modulus of the half section with respect to the top edge equals

$$Z_t = \frac{364.29}{6.08} = 59.92$$

TABLE 1. CALCULATING I₁ FOR EACH ELEMENT AND THE HALF SECTION

$$I_g + (a \times d_1^2) = I_1$$

$$(1)\ \frac{2.25 \times 0.81^3}{12} + (1.82 \times 5.65^2) = 0.10 + 58.09 = 58.19$$

$$(2)\ \frac{1.88 \times 1.44^3}{12} + (2.71 \times 5.34^2) = 0.46 + 77.28 = 77.74$$

$$(3)\ \frac{0.63 \times 12.14^3}{12} + (7.65 \times 0.01^2) = 93.93 + 0.00 = 93.93$$

$$(4)\ \frac{1.78 \times 0.81^3}{12} + (1.44 \times 5.67^2) = 0.08 + 46.29 = 46.37$$

$$(5)\ \frac{2.13 \times 1.44^3}{12} + (3.07 \times 5.36^2) = 0.53 + 88.20 = 88.73$$

I_1 for the half section A, Fig. 2 = 364.96

Machinery

TABLE 2. CALCULATIONS FOR FINDING MOMENT OF INERTIA AND SECTION MODULUS IN COMPACT FORM

Element	Size, Inches	a Area, Sq. In.	d_0 Arm, Inch	ad_0 First Moment	ad_0^2 Second Moment	I_g Moment of Inertia
1	2¼ × 13/16	1.82	0.41	0.75	0.31	0.10
2	1⅞ × 1 7/16	2.71	0.72	1.95	1.40	0.46
3	⅝ × 12.14	7.65	6.07	46.44	281.89	93.93
4	1.78 × 13/16	1.44	11.73	16.89	198.12	0.08
5	2⅛ × 1 7/16	3.07	11.42	35.06	400.39	0.53
	Total	A 16.69	......	M 101.09	M_1 882.11	I_G 95.10

$$I_0 = I_G + M_1$$

where I_0 = moment of inertia of half section about axis 0 – 0

Therefore

$$I_0 = 95.10 + 882.11 = 977.21$$

$$D = \frac{M}{A} = \frac{101.09}{16.69} = 6.06 \text{ inches}$$

where D = distance from axis 0 – 0 to axis 1 – 1

Then distance from axis 1 – 1 to the top edge of the section is 12.14 — 6.06 = 6.08.

$$I_1 = I_0 - (A \times D^2) = 977.21 - (16.69 \times 6.06^2)$$
$$= 977.21 - 612.92 = 364.29$$

where I_1 = the moment of inertia of half section about the gravity axis 1 – 1

Therefore the moment of inertia about axis 1 – 1 for the entire section is

$$2 \times 364.29 = 728.58.$$
$$Z_b = 364.29 \div 6.06 = 60.11$$
$$Z_t = 364.29 \div 6.08 = 59.92$$

Machinery

Formula for Radius of Gyration

The radius of gyration is that property of the cross-section of a column which determines its strength. The relation of the radius of gyration R to the moment of inertia I and the area of the cross-section A, is such that it equals the square root of the quotient resulting from dividing the former by the latter, or

$$R = \sqrt{I \div A}$$

The radius of gyration is used in designing columns, and as the least radius of gyration is usually desired, it is important to select the axis where the moment of inertia is minimum.

Advantage of Second Method over First

In the foregoing, the specific problem selected has been analyzed in detail. A more condensed or abbreviated computation of this problem is presented in Table 2, wherein the values are obtained by means of the second method of analysis which has been described. Familiarity with calculations such as those given in this table would undoubtedly result in a still further abbreviated form. This would, of course, vary with the individual calculator, but where the calculations are to be submitted to others there is a possibility of abbreviating to such an extent that clearness would be doubtful.

In regard to the relative advantages of the two methods of calculation which have been presented, it is evident that the second is in some respects much to be preferred to the first. In case it is found necessary to recalculate the section, due either to an error in the calculation or a subsequent alteration in the location or size of some element of the section, it will be noted that if the calculations have been made according to the second method it will not be necessary to recalculate to the extent required if the first method had been employed. This is due to the fact that a change in the location of the neutral axis in the first method necessitates a change in all of the quantities in which it occurs, whereas only a few extra calculations are necessary if the second method has been employed.

An alteration in the size of any of the elements of the section shown in Fig. 2, such as a decrease in the thickness of element (5) from 1 7/16 to 1⅜ inches will illustrate how much additional work would be required in a set of calculations based upon the first method, whereas all the values other than those having reference to the particular element concerned, would still be valid if determined by the second method. In designing cast sections, several calculations are usually required, and in this work the advantage of the second method becomes apparent.

* * *

WALL DRAFTING MACHINE

The saving of time, the maintenance of accuracy, and the numerous other advantages that may be derived from the use of drafting machines are common knowledge. There is hardly a drafting department in which at least one of these time-saving devices is not employed. In connection with the experimental work in the engineering department of Gould & Eberhardt, Newark, N. J., a drafting machine that is hung to the wall is found a most convenient means of sketching the design of contemplated machines. The machine is used in connection with a blackboard, and the convenience with which the device can be operated when machinery is being laid out to full scale, is shown in Fig. 1.

The carriage on which the frame of the machine is held is operated lengthwise of the blackboard by means of a trolley and track. This track is hung to the wall by suitable brackets. The frame consists of a vertical rod and an angular one, the diameter of each being 1¼ inches. The vertical rod is the guide and support for the drafting machine proper, which is connected by wires that pass over suitable pulleys to the weight which rides on the angular shaft.

In making this drafting machine, the main quadrant casting *A*, Fig. 2, was made from aluminum so as to provide a lighter section. There are four fiber rollers employed to guide the machine as it is raised and lowered on the vertical rod, two of these being located at the top of the aluminum casting and two at the lower part. Rolls *B* are carried in a fixed bearing, while rolls *C* are located on opposite sides of the rod and are each carried by a swiveling aluminum lever which is attached to the main aluminum casting. These levers extend in opposite directions so that the extending finger of each may be connected by coil spring *D* for the purpose of providing a firm rolling contact with the rod and thus maintain absolute parallelism between the rod and the movement of the quadrant casting. This condition is, of course, essential, as otherwise the accuracy of the entire drafting machine would be destroyed.

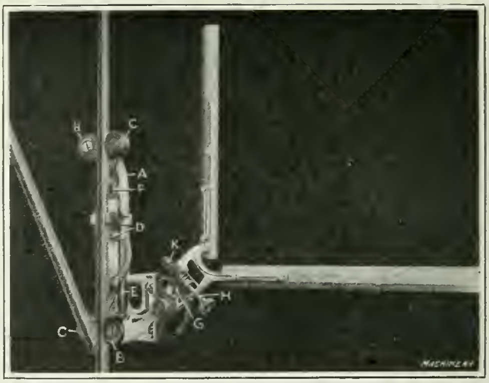


Fig. 2. Detail View of Drafting Machine shown in Fig. 1

The machine is operated by the draftsman's grasping the fiber handle *E*, after the locking screw *F* has been released. This locking screw is carried in one of the two lugs that project from the aluminum casting, so that the device may be securely held in the desired vertical position. These two projecting lugs by reason of their straddling the vertical shaft, furnish an additional means of preventing sidewise movement of the aluminum casting. The segment gear and worm, by means of which the scales may be set at any angle, are plainly shown in the illustration. The segment gear is graduated, and there is a pointer *G* by means of which the scales may be set in horizontal and vertical positions as desired. The worm-shaft *H* has a knurled knob at one end by means of which this setting may be obtained, and a graduated collar *K* at the opposite end for obtaining settings to minutes of a degree. The length of each scale is 20 inches, and the size of the blackboard is 20 by 12 feet.

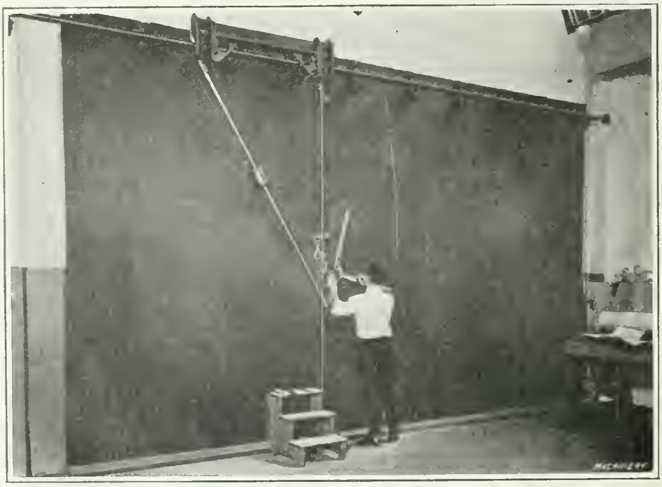


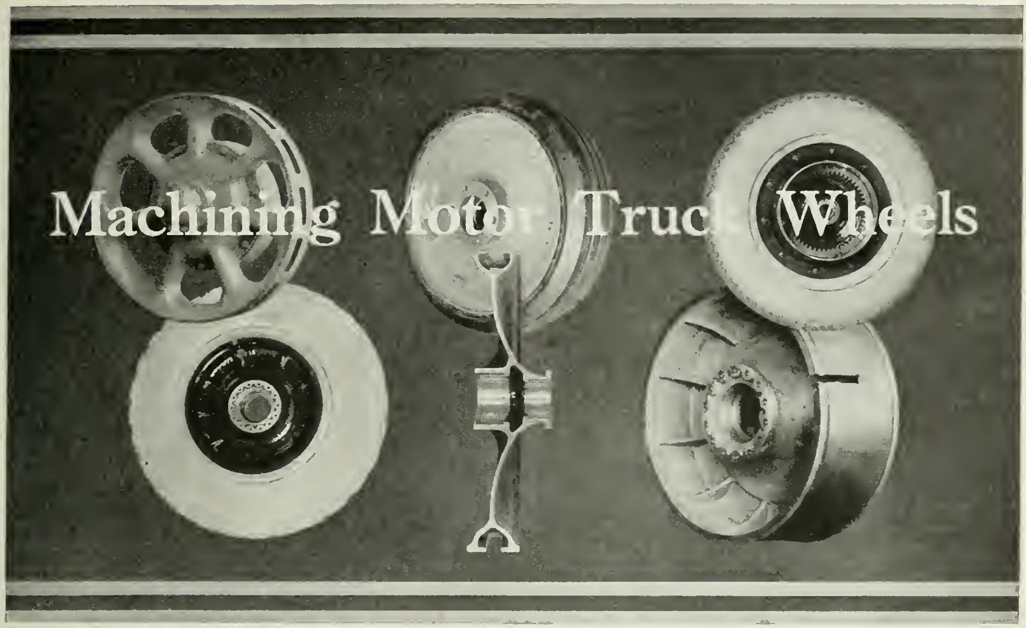
Fig. 1. Wall Drafting Machine, and Blackboard used in Connection with it

* * *

IDENTIFICATION OF PIPE LINES

In a publication issued by the Davis-Bournonville Co., Jersey City, N. J., attention is called to the fact that the scheme of marking shop piping with various colors to designate what they convey is not entirely satisfactory on account of there not being a sufficient number of primary colors to designate all fluids carried by pipes. Any method of simple color designation adopted necessarily applies only to the conditions of a particular plant, and every plant requires different color schemes or color combinations, bands, etc. The main pipes usually marked are for water, steam, compressed air, gas, and oil, but in some plants there may be several kinds of water pipes. A preferable system would be to stencil each pipe with the name of the fluid it conveys, at intervals throughout its length, or at the inlet and outlet valves.

Machining Motor Truck Wheels



Practice of the Clark Equipment Co., Buchanan, Mich., in the Production of Steel Truck Wheels

EACH succeeding year witnesses a more pronounced trend toward specialization in industry. Today each man has his specific task, and through constant practice and experience he is able to attain a wonderful degree of efficiency in its performance. This principle has been further applied in the manufacture of various products, where individual parts are made in different plants working on contracts for firms that take the finished parts and assemble them into completed units for distribution to the trade. Greater economy can be secured in this way, because each manufacturer concentrates all his energies upon the production of one class of work. Some firms employ this method of having all of the parts of their product made under contract, while others have only a few parts produced in this way, depending upon their own shops to furnish the majority of parts required.

Specialization in Machining Motor Car Parts

One of the outstanding examples of specialization in the production of parts made under contract with firms that assemble them ready for shipment is found in the motor car industry, in which there are many plants devoting themselves entirely to the manufacture of wheels, axles, transmissions, and numerous other parts. One such firm is the Clark Equipment Co., of Buchanan, Mich., which specializes in the manufacture of rear axles and steel wheels for motor trucks. In the May and June numbers of MACHINERY, two articles were published on the methods used in this company's plant for manufacturing axles; it is the purpose of the present article to explain interesting features of the shop practice in making steel truck wheels. The Clark Equipment Co. manufactures a very large number of different types of truck wheels, including both the so-called "steel disk wheel," the machining operations on which are described in the following, and the "spoked" type of wheel.

Steel Foundry Practice in Making Truck Wheels

The articles describing the manufacture of rear axles contained a general description of the facilities of the steel

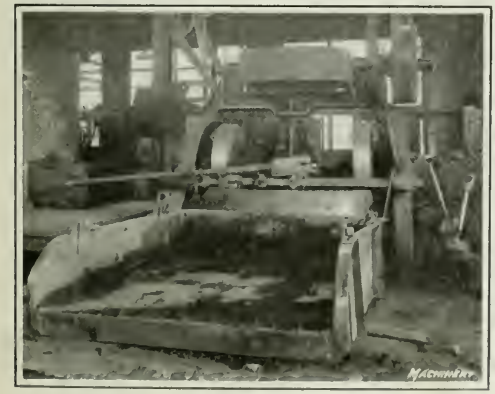


Fig. 1. View in the Foundry showing the Facilities for mixing and carrying Sand

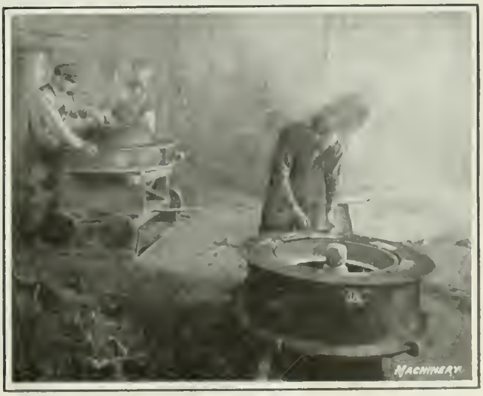


Fig. 2. Molding a Steel Disk Wheel in the Clark Equipment Co.'s Foundry

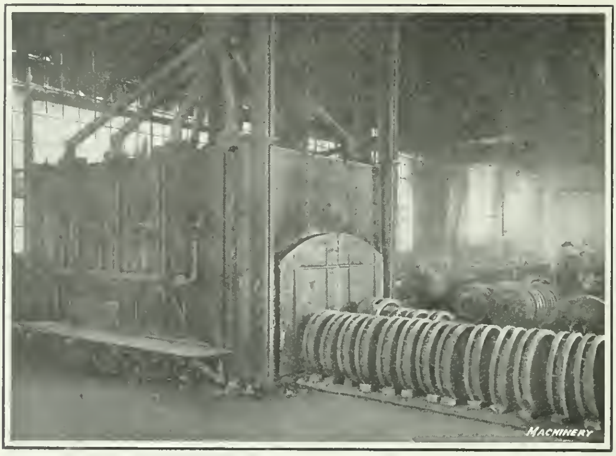


Fig. 3. View of an Annealing Furnace, showing a Charge of Steel Disk Wheels Ready to be heat-treated

foundry, so that at the present time it only remains to outline briefly the methods employed in molding the various types of wheels and in preparing the castings for delivery to the machine shop. It is found feasible to repeatedly use the molding sand, provided a suitable amount of new sand is added each time the molds are broken up, but all core sand is discarded after being used once. The molds are packed in a jolting machine built by the Osborn Mfg. Co. of Cleveland, Ohio, and in order to obtain the desired results it is important to employ a specified number of jolts in packing each mold to obtain the proper degree of density for the sand.

After the steel has been poured into the molds, sand is removed from the castings by tumbling them in a shaker; then the gates are broken off and the risers are cut off with an oxy-acetylene torch. Following this part of the work, the next step is to sand-blast the castings to remove all adhering sand, scale, and slight surface imperfections. Sand-blasting is done in an enclosed room, and before this operation all of the castings are subjected to a general inspection so that those with obvious defects may be discarded. Following the sand-blasting operation, the next step is to rough-grind the castings on grinding stands, with the work suspended from a trolley hoist so that its position may be easily adjusted relative to the wheel. All castings are next sent to a special gas furnace in which they are annealed at a temperature of 1650 degrees F. for about two hours. Fig. 3 shows one of these annealing furnaces, where it will be seen that provision is made for loading the work on a car that can be run into the furnace, after which the door is closed and sealed with fireclay.

About five hours' time is required to raise the temperature of the work to 1650 degrees F., and after being held at this temperature for two hours, another five hours is needed to allow the temperature to decrease sufficiently to allow the castings to be withdrawn from the furnace. Hence, it will be apparent that each furnace may be arranged to anneal two charges of work in twenty-four hours. After coming from the annealing furnace, the castings are again sand-blasted to remove any small amount of scale or burnt sand which may still be adhering to their surfaces, and they are then chipped with air hammers to remove any metal that is protruding much above the normal surface. Welding torches are then employed to cover up any surface defects. Finally, the castings are finish-ground with a portable electric grinder driven by a flexible shaft as shown in Fig. 4, and they are then sent to the inspection department, where a complete visual inspection is given to each casting in order to avoid having the machine shop perform work on castings which later will be found unsuitable for use.

Machining Operations on Steel Disk Wheels for Nash "Quad" Trucks

A large majority of the parts for passenger cars and trucks made by the Nash Motors Co. are manufactured in this company's plant in Kenosha, Wis., but a practice is made of having some of the parts made by specialists. Steel disk truck wheels are a case in point, and Fig. 5 shows the type of wheel used on the so-called Nash "Quad" truck that is equipped with a four-wheel steering mechanism. In machining these steel castings, there are three series of operations performed on vertical turret lathes. First, the work is set up on a Bullard 36-inch machine which is equipped with a four-jaw independent chuck that grips the casting on the inside surface *A* of the brake-drum. Height blocks are placed under the edge of the rim for leveling up the casting, and tools mounted on the first face of the turret provide for facing surfaces *B* on the hub and *C* on the rim. A tool on the side-head is next utilized for turning the outside diameter *E;* and a formed tool carried by this side-head is next brought into operation to provide for turning surfaces *F* and *G* that are beveled to an angle of 18 degrees to form a seat for the pneumatic tire rim.

Second Setting of the Work

When these operations have been completed, the work is transferred to the Bullard machine illustrated in Fig. 6, which is provided with a fixture having seats to locate the work on its beveled face *F*, Fig. 5, the work being held with the drum *A* facing upward. Referring to Fig. 6, it will be seen that the side-head is furnished with a tool *H* that provides for facing surface *I*, Fig. 5. On the first face of the turret there are two tools *J* and *K;* tool *J* is used for finishing surfaces *L* and *M*, and tool *K* roughs the drums *A*. After indexing the turret, tool *N* is brought into operation to provide for finishing the drum *A* and the gear-ring seat *O*.

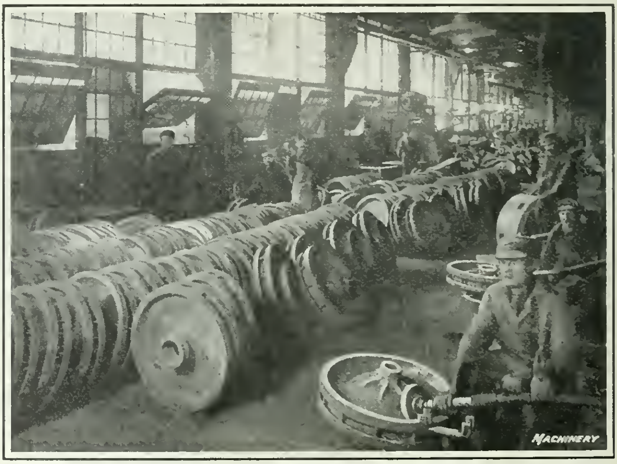


Fig. 4. Grinding Department of the Foundry where Surface Defects are removed from Castings before machining

and after taking a roughing cut, a second cut is taken over these surfaces with the same turret tool. Indexing the turret now brings two tools *P* and *Q* into operation to provide for taking a roughing cut in bore *R* of the hub and on the outside diameter *S*. Tool *T* is next utilized for finish-boring surface *R*, after which reamer *U* is brought into action to finish the bore to exactly the required diameter. Next in the order of operations comes the use of tool *K* a second time to provide for cutting the relief *V* on the horizontal surface of the rim.

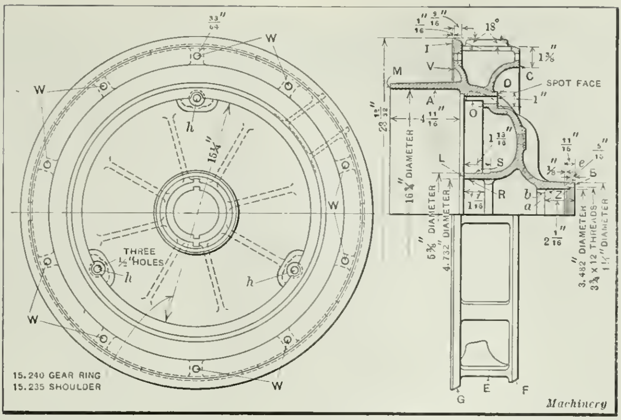


Fig. 5. Side and Cross-sectional Views of a Steel Disk Wheel for the Nash "Quad" Motor Truck

Third Sequence of Operations

Following the performance of the operations which have just been described, the next step is to drill ten 33/64-inch holes *W* in the rim, a Cincinnati-Bickford upright drilling machine being employed for this purpose. This is an ordinary drilling operation. The work is next transferred to a 28-inch Colburn vertical boring and turning mill shown in Fig. 7, on which the third sequence of operations is performed. It will be apparent from this illustration that the work is held in the same position as for the first setting. There are leveling blocks on the table on which the casting is clamped down by means of bolts *x*, and the casting is accurately located by a screw at the center which is tightened to expand four pins inside of the bore *R*, Fig. 5. On the first face of the turret there is a quadruple tool *Y* that provides for rough-boring three diameters *Z*, *a*, and *b* in the hub and rough-facing the surface *B*. A tool *c* on the second turret face is provided with three cutters for finish-boring holes *a* and *b* and finish-facing surface *B*. On the third turret face there will be seen two tools *d* which provide for cutting the locking groove *e* and the thread release groove at the bottom of hole *Z*. In the fourth turret face a Geometric collapsible tap *f* is carried, for cutting the thread in hole *Z*, and on the fifth face of the turret there is mounted a reamer *g* for reaming the diameter of hole *a*.

Next in the order of operations to be performed on these wheels comes the drilling of three half holes *h*, Fig. 5, that are subsequently used for clamping a gear ring in place. These holes are ½ inch in diameter. This would be a perfectly simple operation were it not for the fact that the holes have to be drilled in such a way that half of the drill is cutting into the perpendicular wall of the work, while the other half is running in free space. To all experienced mechanics it will be apparent that a job of this kind is likely to cause trouble, owing to the tendency of the drill to run out of the path which it is intended to follow, but the possibility of difficulty from this source is effectually overcome by employing a very simple expedient. It will be recalled that the gear-ring seat *O* was finished during the second sequence of boring mill operations, and for use in drilling the three holes *h*, dummy rings cast from the same kind of steel as the truck wheels are turned up to the same diameter as the gear ring so that they may be dropped into place preparatory to drilling the necessary holes, and thus support the drill during the operation.

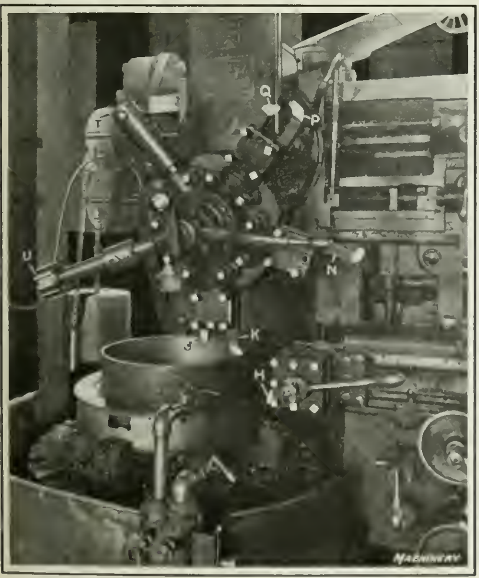


Fig. 6. Vertical Turret Lathe for performing Second Sequence of Operations on Nash "Quad" Wheels

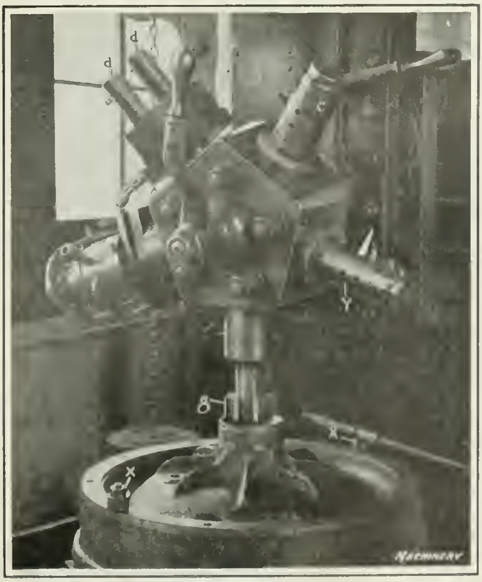


Fig. 7. Boring Mill equipped for performing Third Sequence of Operations on Nash "Quad" Wheels

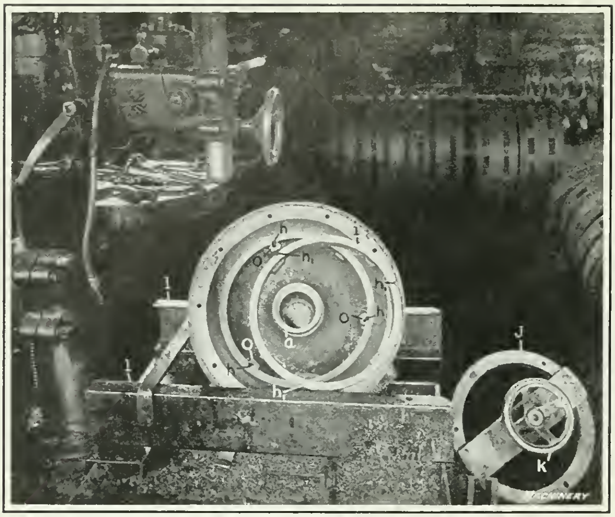


Fig. 8. Vertical Drilling Machine with Jig for Use in drilling Half Holes in Gear-ring Fit

The best idea of the manner in which this operation is performed will be gathered by referring to Fig. 8, where a Cincinnati-Bickford vertical drilling machine is shown equipped for handling this job. In this illustration it will be evident that the same reference letters are used to denote finished surfaces as are used in Fig. 5. The cast-steel ring *i* is used for supporting the drills while three holes *h* are being drilled, and it will be evident that the half holes produced in this ring are indicated by h_1. It so happens that the ring shown in this illustration has been used only once, but in practice this ring will be used repeatedly, by slightly shifting its position each time, until a complete series of half holes h_1 are cut all around its circumference, after which the ring will be discarded. Aside from this method of supporting the drills there is nothing of exceptional interest in regard to this operation.

It will be seen that a quite simple form of jig plate *J* is employed, which has three drill bushings mounted in it and a handwheel *k* that provides for clamping the jig in place on the work. This jig is piloted in the finished bore *a* of the casting, and it will be evident that the casting is laid over two rails *l*, so that after each hole *h* has been drilled, it may be turned through one third of a revolution to bring the work into position for drilling the next hole. One of these so-called "dummy rings" is used to drill thirty wheels before it has to be discarded. After drilling the three holes *h* in the truck wheel casting, the drill jig is removed and a counterbore is mounted in the drilling machine spindle to provide for counterboring the holes to a depth of ¼ inch. After this has been done, the work is subjected to the usual inspection before being painted. On this job the production time is as follows: First setting on Bullard vertical turret lathe, thirty minutes; second setting, vertical turret lathe, fifty minutes; drilling ten holes *W*. Fig. 5, twenty minutes; machining operations on Colburn boring mill, fifteen minutes; drilling three holes *h*, fifteen minutes; making the total machining time two hours and ten minutes. A few other detail operations still have to be performed on these wheels before they are ready for shipment, but as they involve no unusual features, they are not described here.

Machining Rear Wheels for Packard Five-ton Trucks

A majority of parts for motor trucks built by the Packard Motor Car Co., are manufactured in this company's plant in Detroit, Mich., but the Clark Equipment Co. makes the steel disk wheels for use on these trucks. Fig. 9 shows two views of the type of double disk rear wheel for the Packard five-ton truck. The first sequence of operations on these castings is performed on a Bullard vertical turret lathe, Fig. 10, equipped with a side-head and a four-jaw chuck for holding the work from the inside of the rim, the chuck jaws being provided with points that dig into the work to afford the necessary driving power. Reference to the cross-sectional view in Fig. 9 will at once make it apparent that this wheel is of the so-called "double disk" type; that is to say, there are two walls of steel projecting inward from the rim to the hub, the purpose being to provide a liberal amount of strength so that ample carrying capacity is assured.

In starting the machining operations, the side-head begins roughing the outside diameter *A* of the rim, and as soon as this side-head has moved its tool down far enough to afford the necessary amount of clearance, a turret tool is brought into action to start facing the top of the rim. After this turret tool has completed its work on surface *B*, the turret is raised 1⅛ inches and traversed over to bring the tool into engagement with surface *C* on the hub which is faced by the same tool. A second cut is taken over these surfaces with this tool to provide for obtaining the desired perfection of finish. On the same face of the turret there is a second tool that is utilized for turning the outside diameter *D* of the hub. Mounted on the next turret face there is a tool used for facing the chain hook lugs *E*, and after this part of the work has been completed the side-head is indexed to bring a finishing tool into position for starting a second cut over the outside diameter *A* of the rim.

It is important to have this diameter quite accurate, and for use in testing the size of the work a special circumference gage has been made, which consists of a steel tape measure that is arranged to embrace the turned surface of the work, handles being provided at both ends of the tape by means of which they are drawn together. As the movable end of the tape slides through the frame of the gage, it

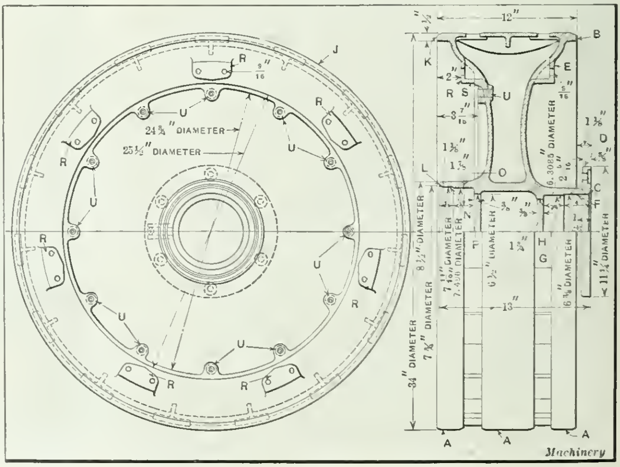


Fig. 9. Side and Cross-sectional Views of Double Disk Steel Wheel for Packard Five-ton Truck

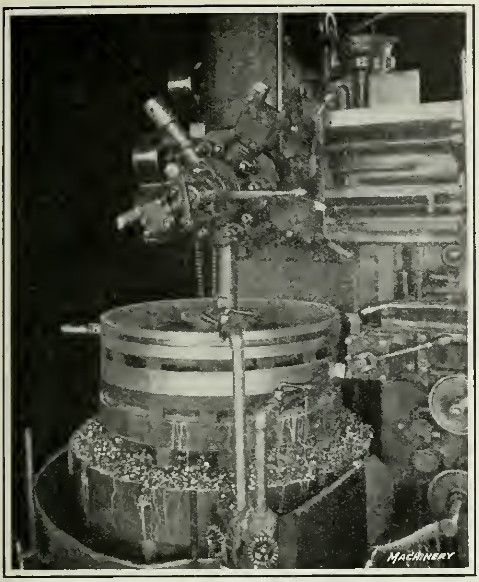


Fig. 10. Vertical Turret Lathe equipped for performing First Sequence of Operations on Packard Five-ton Truck Wheels

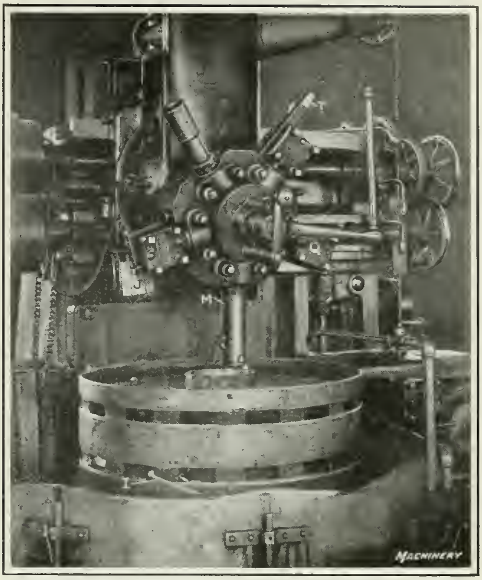


Fig. 11. Vertical Turret Lathe equipped for performing Second Sequence of Operations on Packard Five-ton Truck Wheels

assumes a position relative to two graduation marks which show whether the circumference is within the specified limits of tolerance. The importance of using a circumference gage of this type in place of a caliper for measuring the diameter is that in the event of the diameter varying slightly from point to point, there may be trouble in getting the tire rim over the wheel, but with a gage of this type, which actually measures the circumference, such trouble is not so likely to be encountered. After the side-head has started on its finishing cut, the turret is indexed to the third face to bring into operation a tool carrying three cutter-bits that is employed for boring diameters *F*, *G*, and *H* in the hub. A similar tool on the fourth turret face finish-bores the same diameters, and on the fifth face of the turret there are tools for reaming these holes. For this sequence of operations the total machining time is two hours.

Second and Third Settings of the Work

Fig. 11 shows one of the Packard five-ton wheels set up on a Bullard vertical turret lathe for the second sequence of operations. The machine used for this purpose does not employ any tools mounted on the side-head and it is provided with a fixture on which the work is centered by a pilot entering the finished bore of the hub. The work is clamped down on leveling blocks and driven by means of a hook *I*, one end of which enters a T-slot in the table, while the other end engages one of the openings in the work. While mounted on this machine, the tool *J* on the first face

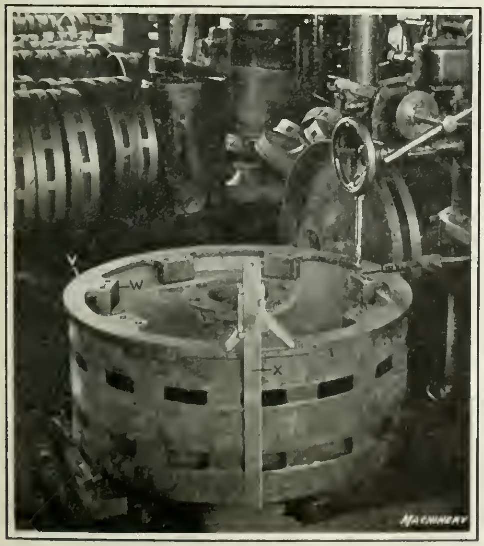


Fig. 12. Vertical Drilling Machine for drilling Holes at Opposite Side of Wheel in Accurate Alignment

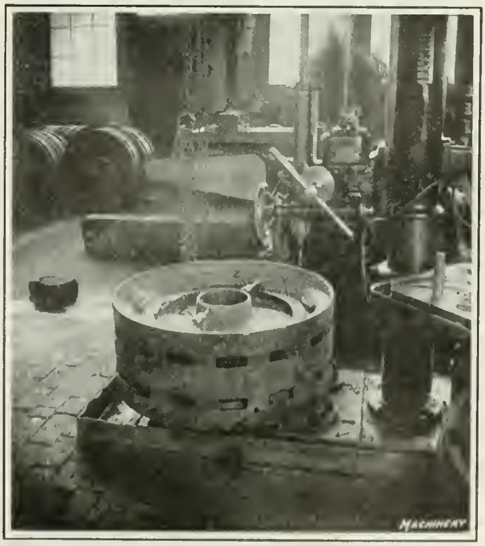


Fig. 13. Vertical Drilling Machine equipped for drilling and tapping Twelve Holes in Brake-drum Seat

of the turret faces edge *K* of the rim, and the same tool takes a second cut over this surface for finishing. Following the same procedure that was employed at the first setting of the work, the turret is then lowered 1/8 inch to bring tool *J* down into position to take a roughing and a finishing cut over the surface *L* of the hub. On the second turret face there is a tool *M* that provides for rough-boring diameters *N*, *O*, and *P* to within 1/16 inch of the required size. After this cut has been taken, the turret is indexed to bring into action a tool *Q* that faces the chain hook lugs *R*, a roughing and finishing cut being taken over these surfaces. On the next turret face, a tool *T* is provided for boring and facing the brake-ring fit *S*, 1/16 inch also being allowed on these surfaces for subsequent finishing. The machining time required to complete the second sequence of operations is fifty minutes.

For performing the third sequence of operations on these five-ton truck wheels, the work is mounted as it is shown on the vertical turret lathe that is illustrated in Fig. 11, except that a four point expanding plug is used to center the work accurately from the finished bore in the hub. While set up in this manner, a finishing cut is taken in holes *N*, *O*, and *P* and on the brake-ring fit *S* to provide for bringing the hub diameters within limits of ± 0.001 inch and the horizontal surface of the brake-ring fit *S* within ± 0.0025 inch from the level of surface *L* of the hub. For the finishing operation on the brake-ring fit *S*, a tool is employed that is similar to the tool *T* used at the second setting of the work, but for finishing diameters *N*, *O*, and *P* a boring tool and a reamer are used successively. On this job the production time is forty-five minutes. This makes the total machining time for the three sequences of operations performed on these castings three hours and thirty-five minutes.

Fig. 15. View of the Department of the Wheel Shop in which Inspections are conducted

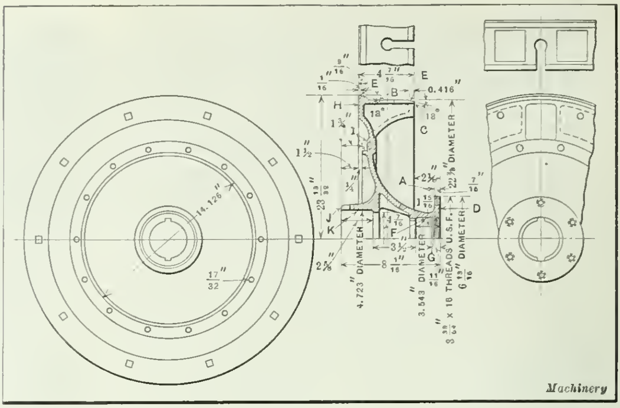


Fig. 14. Side and Cross-sectional Views of Clark Two-ton Pneumatic Tire Wheel for Use on Clark Rear Axle

Drilling Two Holes in Each Chain Hook Lug

It will be apparent from Fig. 9 that it is necessary to drill two 9/16-inch holes in each of the chain hook lugs *R* and *E* at opposite sides of the work, and these holes must be in accurate alignment. To provide for the performance of this operation, a Cincinnati-Bickford single-spindle upright drilling machine is employed, as illustrated in Fig. 12. The work-holding fixture employed for this purpose is of quite simple design, consisting of a pilot over which the work is dropped by means of a chain hoist, and roller supports to facilitate the movement of the work to bring successive chain hook lugs in position for drilling. Reference to Fig. 12 will make it apparent that quite a simple drilling jig is employed for this job, consisting of a ring *V* that fits over the finished outside diameter of the work and is provided with projections *W* that extend inward over each of the chain hook lugs and are provided with two bushings for guiding the drills. It is very important to have the holes drilled in lugs *E* and *R*, at opposite sides of the work, in accurate alignment, and for that purpose use is made of a square *X* that is used to scribe a line down the side of the work to form the continuation of a setting line provided on the edge of the drill jig *V*. By setting the index mark on the drill jig on this line for drilling the holes in one side of the work, and then setting it on the same line for drilling the holes on the opposite side of the casting, assurance is obtained that the two sets of holes will be accurately in line with each other. On this job the rate of production is three completely drilled castings per hour, and owing to the weight of the castings, part of this time is consumed in setting the work up and removing it from the machine.

Drilling and Tapping Holes in Brake-ring Fit

It still remains to drill and tap twelve 1/2- by 18-inch holes *U* in the brake-ring fit *S*, Fig. 9, and for the performance of this operation another Cincinnati-Bickford drilling machine is employed, that is equipped with quite a similar jig to the one just described for producing the holes in the chain hook lugs. The ring jig used for locating these holes is shown in place at *Y* on the machine in Fig. 13, where it will be seen to consist of a ring, the outside diameter of which is turned to locate inside of the machined fit for the brake ring. There is the usual arrangement of drill bushings around this ring to provide for drilling the holes in the proper locations, and toggles *Z* are pushed downward so that their inner ends grip the hub of the wheel and prevent the jig from shifting its position. As in the previous case, the work is rotated on the fixture by turning it on a central pilot that enters the bore in the hub. After the holes have all been drilled, the jig is removed and a tap is substituted in the drilling machine spindle to provide for cutting the threads. For drilling and tapping these holes in the brake-ring fit, the rate of production attained is 3½ castings per hour. Certain other minor operations still have to be performed on these truck wheels before they are ready for shipment, but there are no points of especial mechanical interest connected with this work.

Machining Operations on Clark Pneumatic Tire Wheels

In Fig. 14 there is illustrated a pneumatic tire truck wheel which was especially designed for use in connection with the two-ton rear axle manufactured by the Clark Equipment Co. The first sequence of machining operations on the castings for these wheels is performed on Bullard vertical turret lathes with the work held in a four-jaw chuck gripping the outside diameter at *E*, with the hub *A* at the top. A side-head on the machine rough-turns the outside diameter *B*, and at the same time a tool on the first face of the turret commences operating on face *C* of the rim. When this surface has been rough-faced, the same tool is employed to take a finishing cut; and after this operation has been completed, the same tool is raised through a distance of 2⅛ inches to provide for taking a roughing and a finishing cut over surface *D* on the hub. On the second face of the turret toolpost on the side-head there is a formed tool which provides for beveling the top surface *E* that constitutes a fit for the tire rim. After this operation has been completed, the main turret is indexed to bring a boring tool into operation for taking a roughing cut in hole *F*, and after again indexing the turret a finishing cut is taken in the same opening in the work. The fourth turret face carries a reamer for finishing hole *F*, and on the next two turret faces, tools are provided for cutting a relief for thread *G* and for cutting the thread, respectively. On this series of operations the production time is 1.6 wheels per hour.

Second Setting of the Work

The Bullard vertical turret lathe on which the second sequence of operations is performed on these castings is equipped with a solid center plug, over which the work is dropped and clamped down on height blocks. The drive is accomplished by means of a hook of the same general type as that shown at *I* in Fig. 11. On the side-head of this machine there is a tool that rough-turns the outside diameter *E*, and after this cut has been taken the side-head is indexed to bring a formed tool into the operating position to take a finishing cut over the beveled face *E*. On the first face of the turret there is a tool used for facing surface *H*, and after this cut has been completed the turret is dropped to enable the same tool to take a roughing cut over the gear-ring fit *I;* then the turret is raised to bring the tool into position to rough-face the top surface *J* of the hub. The same tool is next employed to take a finishing cut over surface *J*. Next, the turret is indexed to provide for taking a finishing cut over surfaces *I* of the gear-ring fit, and after this has been done indexing of the turret brings a tool into position for rough-boring the hub at *K*. On the next turret face there is a tool for finishing bore *K*, and after this cut has been taken the turret is again indexed to bring a reamer into operation in the same bore. On this job 1.2 castings are produced per hour. Aside from the boring mill work, there is nothing of unusual interest in the machining of these castings, the drilling operations being similar to the work done on wheels for the Nash "Quad" truck.

Methods of Conducting Inspection Work

After the machining operations have been completed on a set of wheel castings, they are transferred to a portion of the shop that is devoted to the work done by men who are specialists in inspecting. As shown in Fig. 15, it is the practice to set the castings up in a long row so that the men can walk from casting to casting, using the same gage to test the accuracy of a single dimension of the work. Then after this test has been conducted on all of the pieces, the inspector goes back to the starting point and exchanges the gage which he has been using for the one that will be employed in conducting the next test. By following this method of procedure, the inspections may be conducted very rapidly. It is the care that is taken in conducting inspection work, after every precaution has been taken in performing machining operations, that enables a product to win and hold its reputation.

* * *

CALCULATION OF DIAMETRAL PITCH AND FACE WIDTH OF PINIONS

By HUGH BOW

The following simplified method of finding the pitch and face width of pinions is based on the formulas given on page 597 of MACHINERY'S HANDBOOK. The application of the simplified method is shown by the solution of the problem given on page 596 of the HANDBOOK. In this example the load W at the pitch line is 420 pounds and the velocity V is 786 feet per minute. The allowable unit stress S for the material at the given velocity is 8660 pounds per square inch, and the pitch diameter of the pinion is 4 inches. In using the simplified method for finding the pitch, the outline factor Y in this case is taken as 0.266, this factor being the average of the factors for gears having from 12 to 30 teeth, as given in the table of outline factors on page 595 of MACHINERY'S HANDBOOK.

The width of face A in inches based on the velocity is given by the formula

$$A = \frac{(0.15\sqrt{V}) + 9}{P}$$

in which P = the diametral pitch.

Hence,

$$P = \frac{(0.15\sqrt{V}) + 9}{A}$$

But

$$P = \frac{SAY}{W}$$

Therefore:

$$P = \sqrt{\frac{(0.15\sqrt{V}) + 9}{A} \times \frac{SAY}{W}} = \sqrt{\frac{[(0.15\sqrt{V}) + 9] \times SY}{W}}$$

Substituting the values in the given example,

$$P = \sqrt{\frac{[(0.15\sqrt{786}) + 9] \times 8660 \times 0.266}{420}}$$

$P = 8.41$, or say 9 diametral pitch

The number of teeth would therefore be $9 \times 4 = 36$, and the outline factor Y for a gear having thirty-six teeth is found in the table to be 0.332.

The formula for the width of face is:

$$A = \tfrac{1}{2}\left[\frac{(0.15\sqrt{V}) + 9}{P} + \frac{WP}{SY}\right]$$

Therefore the width of face should be

$$A = \tfrac{1}{2}\left[\frac{13.2}{9} + \frac{420 \times 9}{8660 \times 0.332}\right] = 1.39 \text{ inches, say } 1\tfrac{3}{8} \text{ inches}$$

From this it will be seen that the width of face can be found without making repeated trials to determine the correct diametral pitch.

* * *

The painting of ladders is forbidden in the works of the General Electric Co. at West Lynn, Mass., on account of imperfections, such as knots, in the wooden members being hidden by the coating of paint. This rule is made to prevent accidents resulting from the use of ladders which are unsafe.

Reducing Cost of Locomotive Repair Work

At the convention of the International Railway General Foreman's Association in Chicago, September 7 to 10, factors affecting the cost of repairing locomotives and cars were considered. Prior to the general discussion, a paper was presented dealing with the reduction of the cost of repairing cars and locomotives. The following abstract covers the more important points referred to.

In handling cars and locomotives economically, so as to effect a reduction in the cost of their repairs, careful well-trained supervision is essential. The supervisors should have executive ability; they should also have the gift of handling men properly, and be interested in their men. They should be broad-minded enough to be above petty envy and jealousy. Human nature should be their hobby. Supervisors who have had the opportunity of obtaining a schooling in different departments or who have had experience in different shops, are fortunate, as such knowledge is of benefit in their work.

In order to have an efficient, energetic, and interested shop organization, it is necessary to have the cooperation of all members of the executive staff. To increase this spirit, it is advisable to have weekly shop staff meetings to discuss the welfare of the shop. At these meetings the shop superintendent or general foreman can come into personal contact with the organization and get an idea of the condition of each department by the reports that the various foremen turn in. This enables him to make any changes he deems necessary to increase the production of the shop. At these meetings, subjects may be brought up for general discussion, such as general shop conditions or methods to be adopted to shorten the time of machine or erecting shop operations. An efficient organization member will see that each man under his charge is supplied with the proper tools and materials for his work, thereby reducing the cost of an operation to a minimum.

Roundhouse Repairs and Repair Shop Schedule

The roundhouse should make minor repairs on locomotives, such as require only a short time and a small amount of material, but which may cause damage that ultimately would necessitate more costly repairs if neglected. When locomotives are properly looked after in roundhouses, trips to repair shops become less frequent. There should be a first-class shop schedule or plan in the repair shop for doing the work with the facilities at hand. One system that is giving satisfaction is to have a general shop inspector take charge of the scheduling of locomotives through the shop, under the direction of the general foreman. A meeting is held three times a week with the shop staff organization at which each locomotive is scheduled and marked on a master scheduling board.

This information is transferred the next morning to small boards located with each gang of workmen by the schedule foreman, who also checks up each department and ascertains the cause of all delays, reporting to the general foreman. On the shop boards all schedule dates are marked in white chalk. If the work on any part is completed on or before time, it is marked in blue chalk, and if it is not up to schedule, in red chalk. This scheme has a tendency to create competition between the workmen, as one group does not like to see another surpass it, and so work is finished with greater dispatch and costs are considerably reduced.

Machinery and Facilities

When it is possible to replace old machines or appliances with new ones, this should be done immediately, but when this is not possible, the best must be made of the situation. More money is wasted through the use of old and obsolete machinery in making repairs to locomotives, than from any other cause. During the last few years, locomotives have been rapidly growing in size and weight, but in many cases repair shops have not kept pace with them, and the result has been a high cost of repair.

Another means by which the cost of repairs may be materially reduced in the machine shops, is by the use of jigs, chucks, dies, box-tools, pneumatic clamps, gang tools, templets, expanding mandrels, etc., all of which reduce the cost of machine operation. In the erecting shops, power-driven valve-setting rollers, motor-driven valve-pulling bars, motor-driven flue cutters and flue rollers, and motor-driven chucks for grinding steam pipe rings and superheater units, have been found to reduce the cost of repairs greatly by reducing the time consumed in performing the operations.

All work going through the shops should be properly routed, thereby doing away with unnecessary handling, and resulting in a saving of time and money. For example, all connecting-rod work should be confined to one portion of a shop with a rod rack, drilling machine, power press, and lathe in close proximity to each other so that no time is lost between the various operations performed on the different machines. As another example, the equipment used in producing driving-boxes such as a power press, brass crucible for pouring hub liners, planer, boring mill, lathe, and shaper, should all be placed within a radius of ten or twelve feet, so that when a driving-box enters within the circle, it is not necessary for it to leave the circle until it is finished and ready for application.

Material and Labor

In some railroad shops, little attention is given to the method of handling material. A high-priced mechanic may be seen pushing a truck from the store-room with a load of material on which he is about to perform some work. Such trucks should obviously be taken care of by a trucker or laborer, thereby saving the difference between the wages of the two men, and at the same time permitting the mechanic to be used on production work. Every effort should be made to have material placed in well-regulated store-rooms, so that when men are sent for certain articles they need not waste time in looking for them.

Every employe should be imbued with the thought of reducing all unnecessary expenses. Many men are inclined to be careless about the use of material; consequently, much of it is wasted unless a strict check is kept. Again, men often attempt to get new material rather than use second-hand parts when the latter are just as good as new ones for the purpose. In order to make men think along the right lines, some roads hold monthly efficiency meetings in the office of the master mechanic, between representatives of the shop crafts and members of the executive staff, at which the subjects of shop repairs, use of material, and the elimination of waste are discussed. These men take part in the discussion and advance many ideas which, when applied, save time and material. Then, once in eight or ten weeks, a mass meeting is called in the shop thirty minutes before quitting time, at which the men are addressed by some member of the staff and a representative of the employes, who bring before them the necessity of conserving material and thereby causing a reduction in the cost of repairs.

Another manner in which the shop organization can keep the cost of repairs low is to insist upon each man doing the work thoroughly instead of accepting defective work which is sometimes done because the locomotive is wanted in a hurry. This is a poor method to follow and an expensive measure, because it is usually not long before the job must be done again at an additional expense.

Application of Welding Processes in Repair Work

A great saving of material is effected by the use of the electric welding process. Locomotive parts that formerly had to be scrapped on account of wear, such as guide bars, brake-beam ends, brake-hanger pins, radius-bar ends, forked ends of eccentric rods that have become too wide for the link, and driving-boxes that have been worn down on the shoe and wedge faces are now built up by the use of this process and made almost as good as new. In boiler departments, oxy-acetylene welding is used quite extensively in welding flues, flue sheets, side sheets, and patches, thereby effecting a saving over the old method in which the parts were attached with rivets. The cutting torch is also useful in locomotive departments; however, the cutting of holes should be avoided, as the irregular surfaces of such holes start cracks and result in the failure of parts. The patching of fireboxes by either process of welding eliminates the frequent recalking of riveted joints.

A system of careful inspection should be enforced to insure that engines and cars are thoroughly examined to find any defects that may result in the failure or rapid deterioration of parts if not given prompt attention. Engines should be kept clean, as both engine and shop men take more interest in them then. Shops and premises should also be kept clean, and all refuse and material picked up. This is an important proposition and increases the morale of the men.

* * *

SUITABLE STEELS FOR AUTOMOBILE PARTS

Steels suitable for automobile parts were specified by Dr. W. H. Hatfield of the Brown-Firth Research Laboratory, Sheffield, England, in a paper recently read at a meeting of the Institution of Automobile Engineers, London. The materials and the parts for which each is suited are given in the following list:

Air-hardening Nickel-chromium Steel—Connecting-rods, transmission gears and steering worms, pinions and pivots.

Aluminum Alloys—Cylinders, pistons, crankcases, gear-boxes, axle-casings and differential casings.

Bright Drawn Mild Steel—All nuts.

Casehardening Carbon Steel—Ball races.

Cast Iron—Water-cooled cylinders, cylinder-liners, valve-guides, valve-seats, water-jackets, pistons, piston-rings and inlet and exhaust pipes, including manifolds.

0.9 Per Cent Carbon Steel—Clutch-plates and keys.

0.40 Per Cent Carbon Steel—Internal and external cone-clutches and rear-axle housings.

Chromium-vanadium Steel—Valves, clutch and chassis springs.

High-carbon Chromium Steel—Ball bearings.

Malleable Iron—Inlet and exhaust pipes, including manifolds.

3 Per Cent Nickel Steel—Steering-arm levers, arms and rods, tubular steering columns, steering swivel forks, chassis frames, front and rear axles, and torque tubes.

5 Per Cent Nickel Casehardening Steel—Piston-pins, valve cams, camshafts, tappets, timing wheels, differential spiders, gear-box shafts, and transmission worms and worm-shafts;

3 Per Cent Nickel-chromium Steel—Connecting-rods, crankshafts, and clutch-shafts

Phosphor Bronze—Worm-wheels.

Silico-manganese Steel—Valves, rotary pump gears and wire spokes.

Steel Castings—Cylinders, brake-drums, shoes, thrust and clutch withdrawal collars, differential gear-boxes, and spring shackles

Pressed Steel—Axle castings and differential casings.

CONSTITUENTS AND CHARACTERISTICS OF RUSTLESS STEEL

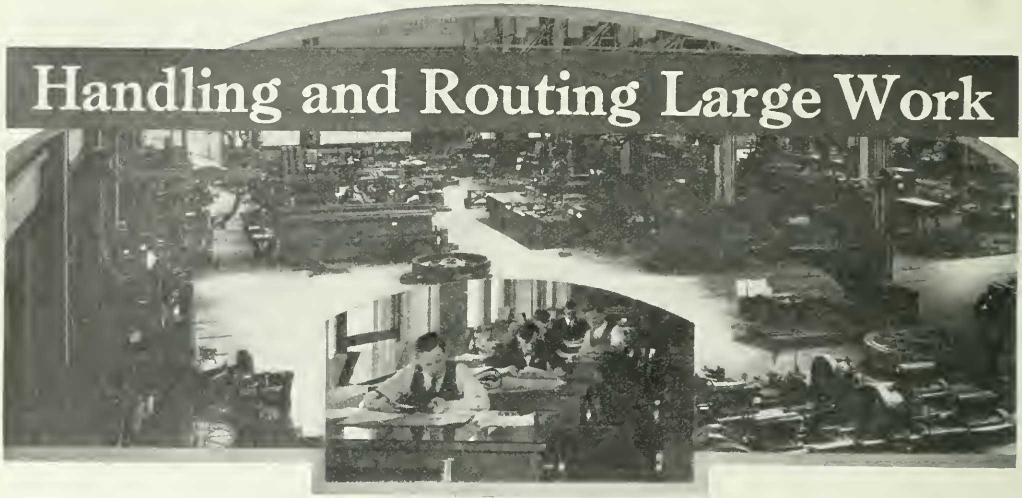
In a paper presented before the Engineers' Society of Western Pennsylvania, Elwood Haynes, president of the Haynes Automobile Co., Kokomo, Ind., stated that stainless or rustless steel consists essentially of an alloy of iron and chromium containing usually from 0.1 to 1 per cent of carbon, although the latter element may be present up to nearly 2 per cent without seriously impairing the working qualities of the steel. Owing to the high percentage of chromium and its tendency to oxidize at the melting point, even in the presence of carbon, it has been found advisable to melt the steel either in crucibles or the electric furnace. After melting, the metal can be poured into ingot molds in the usual manner and the ingots thus obtained can be forged or rolled into bars or sheets. If the ingots are of comparatively small size, they will be found to be very hard after casting, especially if they have been stripped hot and allowed to cool rather rapidly in the air. Indeed, small bars thus produced are likely to be almost file-hard.

If a small piece of steel thus produced is placed in a beaker with a piece of ordinary steel and covered with nitric acid, the ordinary steel will be dissolved with great violence, while the chromium steel will remain utterly unchanged, thus proving that its immune qualities are primarily due to its composition. This is true whether the steel contains large or only minute quantities of carbon. Cold chisels cast in iron or graphite ingot molds are sufficiently hard without tempering to cut ordinary iron or steel. By heating cast bars to a bright orange temperature, they can be forged fairly readily into various forms. After the forging is completed, the metal can be allowed to cool in the air, and will be found to possess a remarkably fine grain and good cutting qualities. Quenching in water enhances the hardness to a considerable degree, particularly if the steel contains more than 0.4 per cent of carbon. It is best, however, to use oil for quenching, to avoid local contraction stress in the finished article which might cause it to break under slight shock or jar.

Notwithstanding the comparatively high temperature at which this steel is worked, the bars show almost no scale during the forging operation. When finished, they are covered with a blue-black skin consisting of a thin film of oxide. Owing to the absence of deep oxidation and resistance to deformation at comparatively high temperatures, the alloy is admirably suited for casting engine valves, distilling apparatus and many other purposes of a similar nature. When ground and polished, the alloy resists tarnish to a remarkable degree. It is superior in this respect to brass, copper and nickel-plate, and far superior to any other steel yet produced. Axes, hatchets, saws, and chisels made from it will not rust in the atmosphere nor when exposed to salt air or salt water. The alloy will no doubt find a large use in the manufacture of propeller blades for steamers, since its modulus of elasticity is much higher than that of bronze and it resists the action of both fresh and salt water perfectly.

Its great strength and comparatively high elastic limit are likewise in its favor. It should have a large application in the manufacture of pump rods, cylinder linings, pump valves, and the like. The alloy is attacked slowly by dilute or strong sulphuric acid and also by hydrochloric acid, but nitric acid has little or no effect upon the polished surface of the metal. It is likewise unaffected, when properly made, by practically all the fruit acids, including strong vinegar. The alloy should also fill a long-felt want among carpenters and others using wood-cutting tools. Its freedom from rust, together with its capability of taking a keen cutting edge, renders it admirably suitable for tools of this nature. When made into auger bits, it has remained bright after having been used for years and subjected to all sorts of atmospheric influences.

Handling and Routing Large Work



Methods Employed by Manning, Maxwell & Moore, Inc., in the Putnam Machine Works, Fitchburg, Mass., for the Routing of Work through the Factory

THE advantages gained by systematic arrangement in a factory, and by following a pre-arranged schedule when machining work, are many. In large factories, where the product consists of many heavy parts, certain methods must be followed which are not always necessary in shops where the output consists of machines made up of many small or medium-sized members. Not only must the handling of equipment for the large castings and steel parts be different, but the planning must be more detailed. This will be appreciated when it is remembered that orders for heavy machinery seldom consist of more than fifty machines—usually less—so that it becomes necessary in the production work to make frequent change-overs in the machining of small lots. In order to obviate the possibility of the machine tools being idle through failure to schedule the work to them, a carefully laid out routing system and time schedule should be employed.

At the Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., the product consists largely of machine tools, such as car-wheel lathes and boring machines, the base castings of which generally weigh from fifteen to twenty tons. Some idea of the size and nature of the heavy castings used on these machines may be had by referring to Fig. 1, which shows the mold for a 54-inch car-wheel lathe base. The making of this mold and the setting of the cores required the services of four men and two helpers for a period of eight days. The length of the mold is 23½ feet and the width 6 feet, and the casting produced from it weighs 15 tons.

The system employed in the handling and routing of such parts is as carefully planned as that used in the operation and scheduling of a railroad. From the time the work enters the factory, either from the foundry or from the stock cars, it travels in a continuous course up one side of the shop, and when completed is transferred on flat cars to the opposite side to be assembled and returned to storage space. In this way, there is a steady flow of work on the manufacturing side of the shop which is not interfered with by congestion, since all the assembling, storing, and shipping of finished machines is done on the opposite side of the shop. The routing system is analogous to the time-table of a railroad, and means are provided to keep the passageways clear and the work moving to the scheduled departments and specially designated machines, in proper sequence and according to established time.

Arrangements of Facilities for Handling Work

There are tracks leading to the foundry and freight cars at one end of the shop, the tracks to the foundry being shown in Fig. 2. Flat cars are used for transporting the material, from which it is removed and stored or placed in readiness to start the machining operations. For the heavy

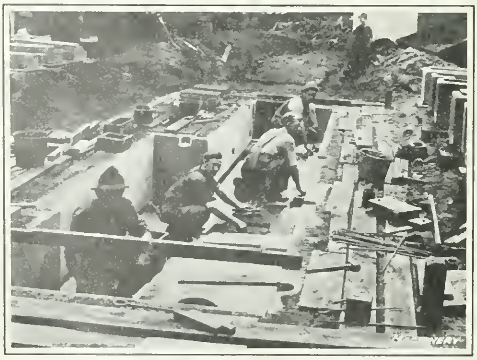


Fig. 1. Mold for 54-inch Car-wheel Lathe Base

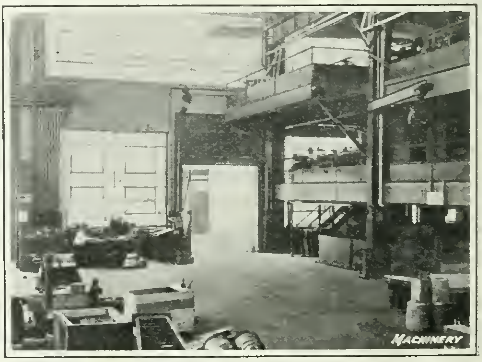


Fig. 2. Receiving Department of the Plant

castings, use is made of wall hoists and overhead cranes to move the work toward the opposite end of the shop as the various machining operations are performed. One of the wall hoists is shown in the illustration, as well as the platform and track for the overhead crane. A Shaw electric crane, of twenty tons capacity, running the entire length of the shop, and a number of Sprague electric wall hoists of one-ton capacity are used. It will be seen that there is a storage room at the right for rough castings which are small enough to be taken care of in this manner. This end of the shop contains the receiving department so that as the material arrives it can be readily recorded. The records of all material carried in stock are kept in the storage record department which is located in the lower gallery, as illustrated.

Reference to Fig. 3 will give a general idea of the arrangement of the shop as well as the gallery at the right, which contains the smaller machine tools and tool-room. Attention is also directed to the cross tracks, which are laid at regular intervals from one side of the shop to the other, and which carry flat cars that deposit the finished work on the opposite side of the shop preparatory to assembling.

Preparations for Starting an Order

When an order for a number of machines is received, the authority for starting the manufacture of parts required for the order is given to the planning department by the general manager. The first step taken by the planning department is to obtain promises of blueprints and material lists from the engineering department. These material lists contain all the parts needed to complete the order, grouped by materials, as well as all information necessary to order the material and start the actual manufacture of the work. The material lists are made up in forms, a number of which are bound together to constitute the entire bill of materials for the order.

Upon receipt of the material list in the store-room, the proper entries are made on the material list for ordering parts from storage, and the necessary raw material for filling the order. The quantity of the finished and rough parts on hand determines the number to be manufactured on each order. For example, if the material list specifies six machines, each machine requiring six castings of a kind, thirty-six such parts are required to build the six machines on this order; but if the store records show a balance of four rough and two finished castings on hand, the storekeeper will enter on the material list the information which will result in thirty new castings being ordered, and thirty-four (including the new castings and the four rough ones on hand) being sent through the shop on a machining order. The list is then delivered to the order department, from where any order for purchasing material not already in stock, is issued. The store card upon which the record of parts or rough stock on hand is kept in the storehouse is shown in Fig. 4. It contains the balance carried over from each preceding order, and the location of the bin in the storehouse in which the stock parts are carried, as well as all other necessary data regarding the piece being ordered.

When the planning department receives the blueprint and the material list containing all the information regarding name, material, and number of the part, as well as the drawing number and pattern number or stock size, the actual scheduling of the work is started. First, the necessary casting orders (see Fig. 6) are issued. These are made out on three cards of different colors, one being delivered to the foundry, one to the pattern shop, and one to the core-room. The stores requisition for material slip, shown in

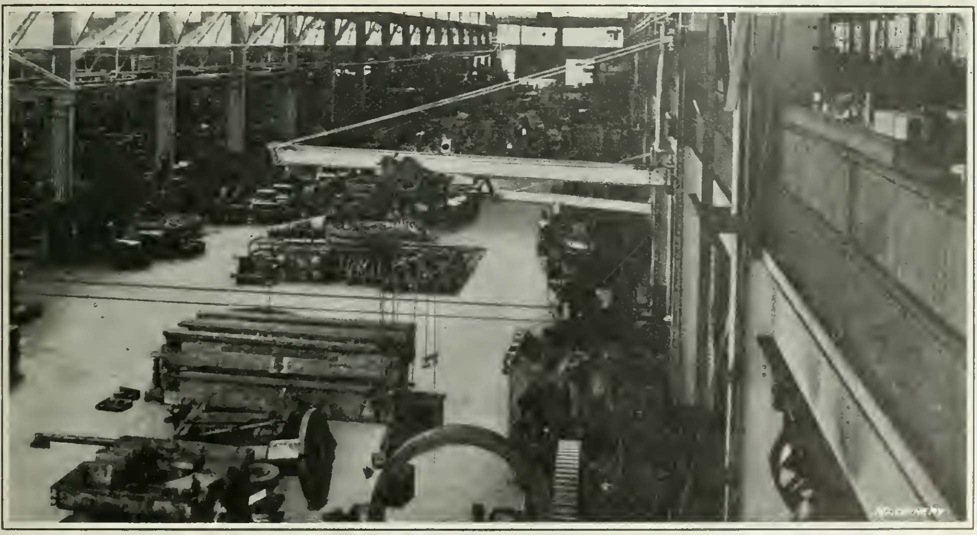
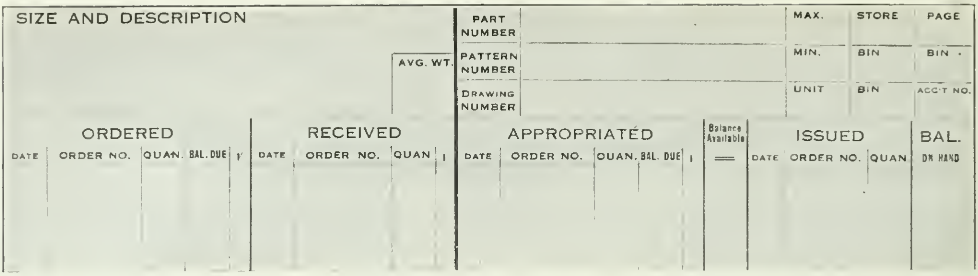


Fig. 3. General View of the Production Side of the Shop showing a Wall Hoist and Cross Tracks extending across the Shop. Note the Amount of Available Floor Space for Passageways, and the Gallery in which the Small Machine Tool Department and Tool-room are located

For boring, reaming, and facing operations on the heavy base castings, portable machines are used, these jobs being set up on floor platens, one of which may be seen in the center of Fig. 3. This illustration also shows the freedom from congestion and the amount of available floor space for transporting the work which the general arrangement affords. The high bay furnishes ample space for overhead crane installation, and also provides good ventilation and excellent lighting conditions.

Having stated in a general way the nature of the work and the method of handling, it will be apparent that failure to deliver the work promptly to the machine on which it is to be finished, would result in a serious loss of time, and would also produce a considerable amount of confusion. To this end the scheduling and routing of the work has been worked out to a very fine degree, and, though of necessity somewhat involved, it is stated that the exact location and state of completion of each part in process of manufacture can be readily determined at any time from the planning department records. In order that the system may be fully understood, the details pertaining directly to the manufacturing operations will be mentioned and the methods of recording and following the progress of the work described.

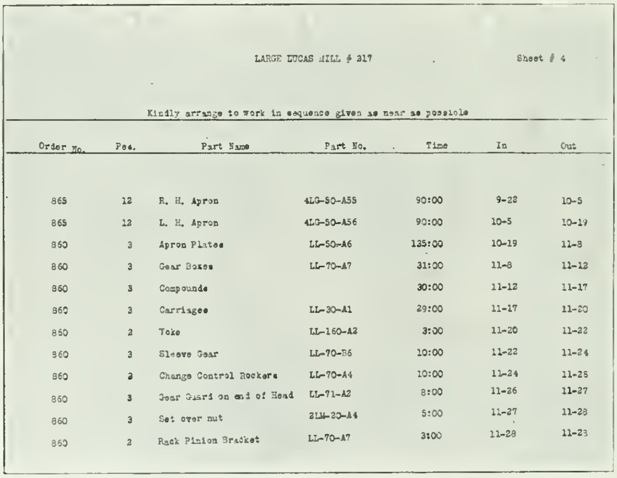


SIZE AND DESCRIPTION				AVG. WT.	PART NUMBER				MAX.	STORE	PAGE	
					PATTERN NUMBER				MIN.	BIN	BIN	
					DRAWING NUMBER				UNIT	BIN	ACC'T NO.	

ORDERED				RECEIVED			APPROPRIATED				Balance Available	ISSUED			BAL.
DATE	ORDER NO.	QUAN.	BAL. DUE	DATE	ORDER NO.	QUAN	DATE	ORDER NO.	QUAN.	BAL. DUE		DATE	ORDER NO.	QUAN	ON HAND

Fig. 4. Card used for recording Stock carried in the Storage Room

Fig. 7, is issued in duplicate, the original in white, and the carbon copy in green, both of which accompany the material as far as the department in which the first machining operation is performed. At that time the green copy is delivered to the planning department, where it serves as a formal notice that the production is about to start, and is the first marker for recording the progress of the work. The original slip, at the same time, is sent to the store-keeper.



LARGE LUCAS MILL # 317 Sheet # 4

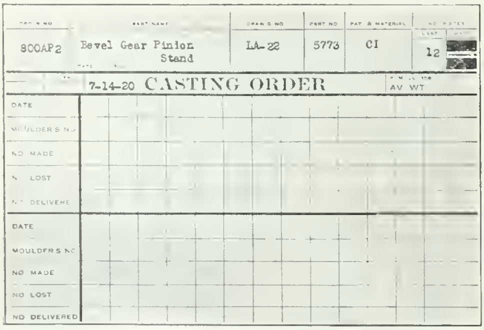
Kindly arrange to work in sequence given as near as possible

Order No.	Pcs.	Part Name	Part No.	Time	In	Out
865	12	R. H. Apron	4LG-50-A55	90:00	9-22	10-5
865	12	L. H. Apron	4LG-50-A56	90:00	10-5	10-19
860	3	Apron Plates	LL-50-A6	135:00	10-19	11-8
860	3	Gear Boxes	LL-70-A7	31:00	11-8	11-12
860	3	Compounds		30:00	11-12	11-17
860	3	Carriages	LL-30-A1	29:00	11-17	11-20
860	2	Yoke	LL-160-A2	3:00	11-20	11-22
860	3	Sleeve Gear	LL-70-B6	10:00	11-22	11-24
860	2	Change Control Rockers	LL-70-A4	10:00	11-24	11-26
860	3	Gear Guard on end of Head	LL-71-A2	8:00	11-26	11-27
860	3	Set over nut	2LM-20-A4	5:00	11-27	11-28
860	2	Rack Pinion Bracket	LL-70-A7	3:00	11-28	11-23

Fig. 5. Schedule which is kept for All Groups of Machines, furnishing the Dates on which the Work is delivered to and from the Machine

In filling out the operation order slips, one of which is shown in Fig. 8, reference is made to a work schedule for each machine or type of machine in the department through which the material is to pass in the process of manufacture. Every machine in the shop is numbered and grouped, and the work schedule for a specified department governs the sequence in which the various parts are to be machined on any particular equipment. If the department contain a number of standard machines, it is not necessary to designate by both name and number the exact machine upon which the work is to be performed, but in the case of special machines, of which there is but one of a kind in the department, a schedule for the individual machine is made out containing the order number, the number of pieces, the name and number of the part, as well as the number of hours allotted for the completion of the work, and the dates of entering and leaving the department. This information is arranged in the form shown in Fig. 5, from which the availability of any machine for the performance of the work being routed may be readily determined.

In addition to the schedule of work for each machine, a standard operation sheet, such as shown in Fig. 10, is employed to aid in filling out the operation order slip. These operation sheets specify the sequence of operations, the numbers of the departments in which the work is to be performed, the number of the machine to be employed, and the time allowance. It will be seen that Operation 4 is performed in department No. 40, but that no machine is specified, this being due to the fact that there is but one machine in this department suitable for performing the work required for this operation. The time required for this operation has not been established, and until this has been done no time entry can be made. It may be mentioned here, however, that an estimated time is carried on the cost sheets, which, when verified by average performances, will be duly carried on the operation sheet.

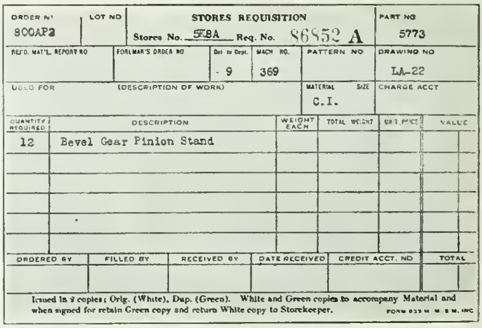


ORDER NO	PART NAME	DRAWING NO	PART NO	PAT. & MATERIAL	NO. PIECES CAST
800AP2	Bevel Gear Pinion Stand	LA-22	5773	CI	12

7-14-20 CASTING ORDER AV WT

DATE
MOULDERS NO
NO MADE
NO LOST
NO DELIVERED
DATE
MOULDERS NO
NO MADE
NO LOST
NO DELIVERED

Fig. 6. Casting Order issued immediately upon Receipt of the List of Materials



ORDER No	LOT NO	STORES REQUISITION	PART NO
800AP2		Stores No. 5KBA Req. No. 86852 A	5773

REC'D. MAT'L. REPORT NO	FOREMAN'S ORDER NO	Del. to Dept.	MACH. NO.	PATTERN NO	DRAWING NO
		- 9	369		LA-22

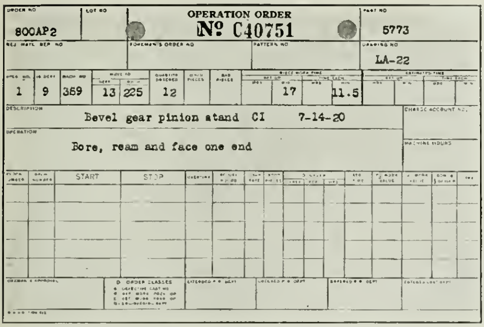
USED FOR (DESCRIPTION OF WORK)	MATERIAL SIZE	CHARGE ACCT
	C.I.	

QUANTITY REQUIRED	DESCRIPTION	WEIGHT EACH	TOTAL WEIGHT	UNIT PRICE	VALUE
12	Bevel Gear Pinion Stand				

ORDERED BY	FILLED BY	RECEIVED BY	DATE RECEIVED	CREDIT ACCT. NO	TOTAL

Issued in 2 copies; Orig. (White), Dup. (Green). White and Green copies to accompany Material and when signed for retain Green copy and return White copy to Storekeeper.

Fig. 7. Stores Requisition Slip issued to the Storage Room when entering a New Order



ORDER NO
800AP2

OPERATION ORDER
Nº C40751

PART NO
5773

DRAWING NO
LA-22

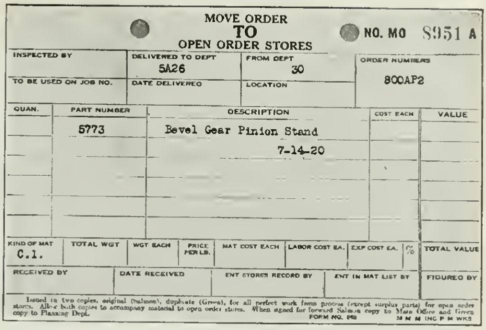
1	9	369	13	225	12		17		11.5

DESCRIPTION
Bevel gear pinion stand CI 7-14-20

OPERATION
Bore, ream and face one end

START STOP

Fig. 8. Operation Order Slip issued in Duplicate for Each Separate Operation



MOVE ORDER
TO
OPEN ORDER STORES
NO. MO 8951 A

INSPECTED BY
DELIVERED TO DEPT 5A26
FROM DEPT 30
ORDER NUMBERS 800AP2
TO BE USED ON JOB NO.
DATE DELIVERED
LOCATION

QUAN.	PART NUMBER	DESCRIPTION	COST EACH	VALUE
	5773	Bevel Gear Pinion Stand 7-14-20		

KIND OF MAT	TOTAL WGT	WGT EACH	PRICE PER LB.	MAT COST EACH	LABOR COST EA.	EXP COST EA.	%	TOTAL VALUE
C.I.								

RECEIVED BY
DATE RECEIVED
ENT STORES RECORD BY
ENT IN MAT LIST BY
FIGURED BY

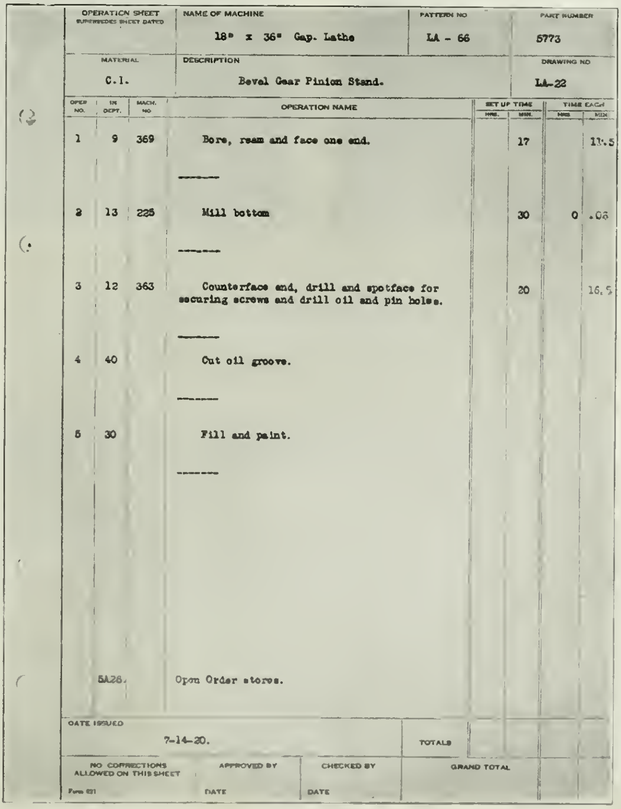
Issued in two copies, original (Salmon), duplicate (Green), for all perfect work from process (except surplus parts) for open order stores. Allow both copies to accompany material to open order stores. When signed for forward Salmon copy to Main Office and Green copy to Planning Dept.
FORM NO. [illegible]

Fig. 9. Move Order Slip which authorizes Delivery of Finished Work to Storage

The final disposition of the bevel gear pinion stand for which this operation sheet is filled out, is department 5 A26, the storage-room from which material is drawn to fill a pending shipment.

Having determined upon the sequence of operations and the department and machine numbers, these data may then be entered on the operation order slip, together with the number of pieces required and the setting-up and machining time allowances. For each operation two of these operation order slips are made out, the slips for each preceding operation furnishing the number of the machine and department in which the next operation is to be performed, following the sequence shown in Fig. 10. The operation order shown in Fig. 8 illustrates the method of routing the work from one department to another. In the case shown, the work is routed from department No. 9 in which one end of the work is bored, reamed, and faced, to department No. 13, where according to operation sheet Fig. 10, the second operation is performed on machine No. 225. Operation orders for the third, fourth, and fifth operations would be made out in the same general way.

The move order, Fig. 9, is also made out by the planning department, and furnishes the authority to move the parts into what is known as "open order stores"; that is, they are placed in readiness to be shipped on the current order. The two copies each, of the stores requisition slip, the operation slip, and the move order slip are clipped together, so that as the work progresses these slips can be torn off without disturbing the others, until only the move order slips remain. In the present case, a bevel gear pinion stand, part No. 5773, is being machined, and there would therefore be fourteen slips accompanying the material at the start of the order. These, as well as the blueprint of the piece of work, are enclosed in an envelope, one side of which is shown in Fig. 11, so that all the information regarding machining and routing the work is kept intact. This envelope contains on the front a suitable record for identification of the job and instructions for following it up. On the reverse side of the envelope, space is provided for entering rejections, partial shipments, and the sequence of department numbers through which the work is scheduled to pass.



OPERATION SHEET SUPERSEDES SHEET DATED	NAME OF MACHINE	PATTERN NO	PART NUMBER
	18" x 36" Gap. Lathe	LA - 66	5773

MATERIAL	DESCRIPTION	DRAWING NO
C.I.	Bevel Gear Pinion Stand.	LA-22

OPER NO.	IN DEPT.	MACH. NO	OPERATION NAME	SET UP TIME HRS.	SET UP TIME MIN.	TIME EACH HRS.	TIME EACH MIN.
1	9	369	Bore, ream and face one end.		17		11.5
2	13	225	Mill bottom		30	0	.06
3	12	363	Counterface end, drill and spotface for securing screws and drill oil and pin holes.		20		16.5
4	40		Cut oil groove.				
5	30		Fill and paint.				
	5A26.		Open Order stores.				

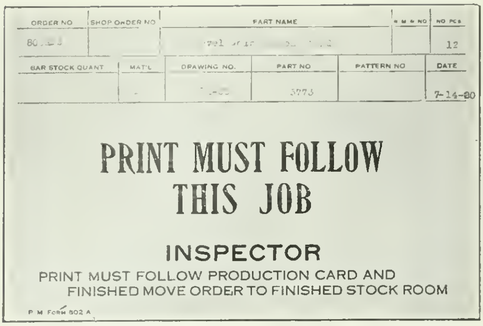
DATE ISSUED
7-14-20.
TOTALS

NO CORRECTIONS ALLOWED ON THIS SHEET
APPROVED BY
CHECKED BY
GRAND TOTAL
Form 621
DATE
DATE

Fig. 10. Operation Sheet on which Sequence of Operations, Order of Departments in which the Work is performed and Machine Numbers, Name of Operation, and Time Allowance are carried

The Dispatcher and his Duties

The passage of the work from department to department is directed by dispatchers. Dispatchers' offices, such as shown in Fig. 13, are located throughout the plant, there being one of these offices for every two or three departments, depending upon the number of machines and work capacity of the departments. When the work arrives at the first dispatcher's office, he detaches the stores requisition slips, Fig. 7, and the first two operation order slips for each operation to be performed in the departments under his jurisdiction. He then sends one stores requisition slip to the storekeeper and one to the planning department, and retains the operation orders in his office where they furnish the necessary reference for assigning work. The operation order slips are chronologically arranged for each machine, and

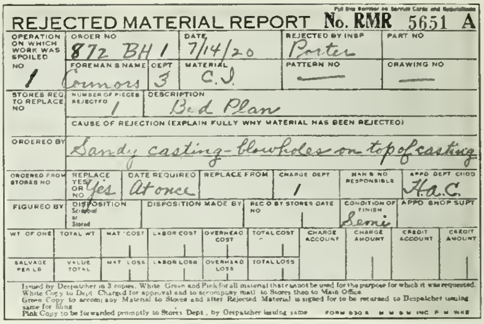

ORDER NO 80[illegible]
SHOP ORDER NO
PART NAME [illegible]
M M & NO
NO PCS 12
BAR STOCK QUANT
MAT'L
DRAWING NO. [illegible]
PART NO 3773
PATTERN NO
DATE 7-14-20

PRINT MUST FOLLOW
THIS JOB

INSPECTOR
PRINT MUST FOLLOW PRODUCTION CARD AND
FINISHED MOVE ORDER TO FINISHED STOCK ROOM

P M FORM 802 A

Fig. 11. The Envelope in which the Blueprint of the Work and the Operation Orders are enclosed carries Instructions for routing the Work through the Shop


REJECTED MATERIAL REPORT No. RMR 5651 A
OPERATION ON WHICH WORK WAS SPOILED NO 1
ORDER NO 872 BH 1
DATE 7/14/20
REJECTED BY INSP Porter
PART NO
FOREMAN'S NAME Connors
DEPT 3
MATERIAL C.I.
PATTERN NO —
DRAWING NO —
STORES REQ TO REPLACE NO
NUMBER OF PIECES REJECTED 1
DESCRIPTION Bed Plan
CAUSE OF REJECTION (EXPLAIN FULLY WHY MATERIAL HAS BEEN REJECTED)
ORDERED BY
Sandy casting-blowholes on top of casting
ORDERED FROM STORES NO
REPLACE YES OR NO Yes
DATE REQUIRED At once
REPLACE FROM
CHARGE DEPT 1
MAN & NO RESPONSIBLE
APPD DEPT CHGD H.a.C.
FIGURED BY
DISPOSITION Scrapped or Stored
DISPOSITION MADE BY
REC'D BY STORES DATE NO
CONDITION OF FINISH Semi
APPD SHOP SUPT

WT OF ONE	TOTAL WT	MAT COST	LABOR COST	OVERHEAD COST	TOTAL COST	CHARGE ACCOUNT	CHARGE AMOUNT	CREDIT ACCOUNT	CREDIT AMOUNT
SALVAGE PER LB	VALUE TOTAL	MAT LOSS	LABOR LOSS	OVERHEAD LOSS	TOTAL LOSS				

Issued by Despatcher in 3 copies. White, Green and Pink for all material that cannot be used for the purpose for which it was requested.
White Copy to Dept. Charged for approval and to accompany mat'l to Stores then to Main Office.
Green Copy to accompany Material to Stores and after Rejected Material is signed for to be returned to Despatcher issuing same for filing.
Pink Copy to be forwarded promptly to Stores Dept., by Despatcher issuing same. FORM 830 A

Fig. 12. When Material is rejected on Account of Failure to pass Inspection, a Rejected Material Report is required stating the Nature and Cause of Rejection

are hung on boards. The operation order for the job in process hangs on an upper pair of hooks, while that for the next operation in order hangs directly beneath it. These boards may be seen in Fig. 13.

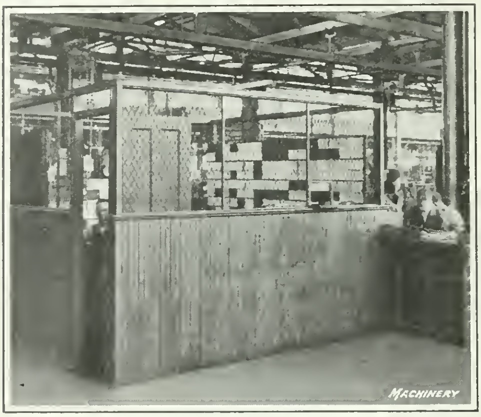


Fig. 13. Dispatcher's Office from which the Records of the Work in Progress are kept and the Jobs distributed

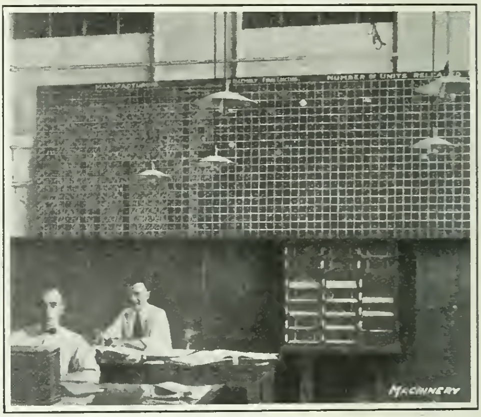
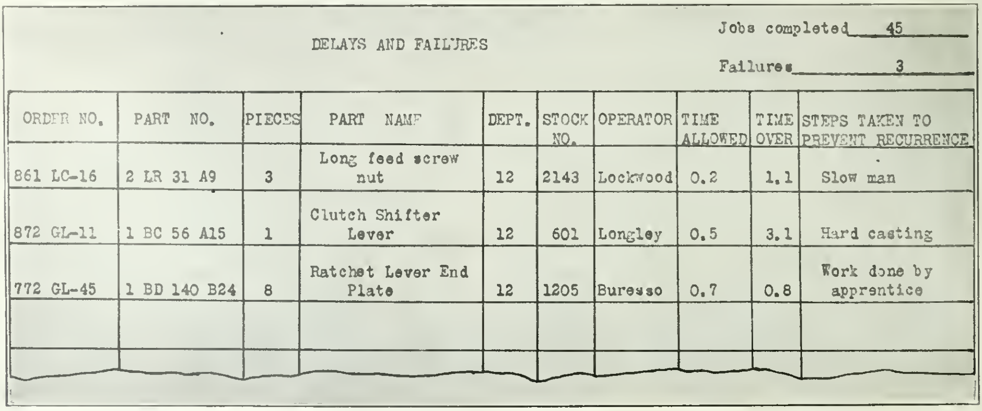


Fig. 14. Partial View of the Planning Department where the Scheduling and Routing of All Work is done

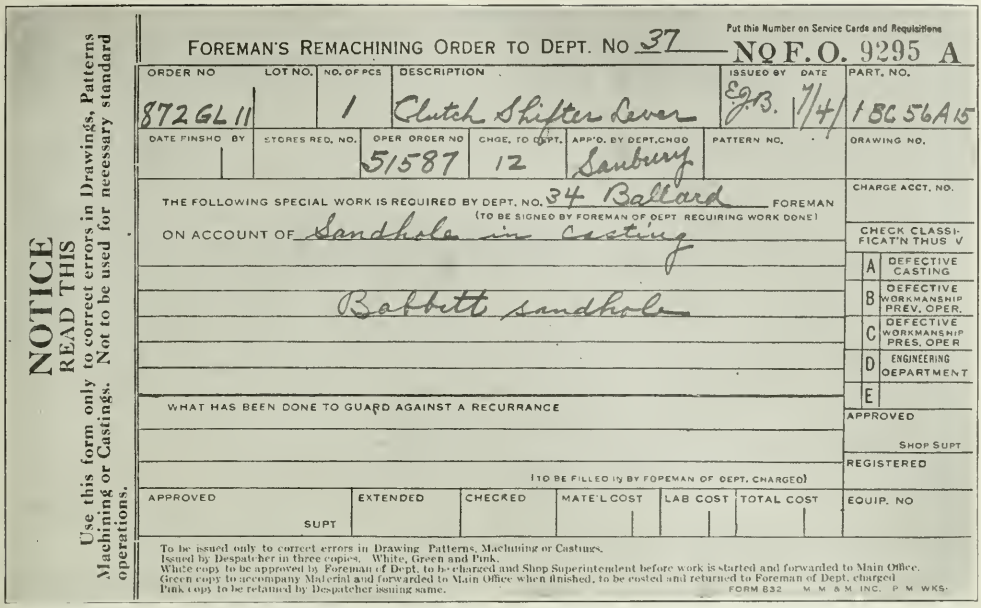
The presentation of the envelope, Fig. 11, in which the blueprint and remaining operation orders are enclosed, to the dispatcher's office by the workman or foreman is the request for a new job. The dispatcher then removes from the board the operation order for the job just completed, and in assigning the next work for that machine, advances the operation order hanging on the lower pair of hooks to the upper pair, and substitutes the next job in order. In this way the dispatcher can readily maintain a steady supply of material for each machine within his territory. The order slips for the finished jobs are filed in the dispatcher's office and are collected by the inspector at regular intervals. After inspecting the work and making the proper notations as regards the number of parts passed, the amount


DELAYS AND FAILURES

Jobs completed 45
Failures 3

ORDER NO.	PART NO.	PIECES	PART NAME	DEPT.	STOCK NO.	OPERATOR	TIME ALLOWED	TIME OVER	STEPS TAKEN TO PREVENT RECURRENCE
861 LC-16	2 LR 31 A9	3	Long feed screw nut	12	2143	Lockwood	0.2	1.1	Slow man
872 GL-11	1 BC 56 A15	1	Clutch Shifter Lever	12	601	Longley	0.5	3.1	Hard casting
772 GL-45	1 BD 140 B24	8	Ratchet Lever End Plate	12	1205	Buresso	0.7	0.8	Work done by apprentice

Fig. 15. When more Time has been consumed in an Operation than has been allowed, or, when Failures occur, a Daily Report stating the Facts is required



NOTICE
READ THIS
Use this form only to correct errors in Drawings, Patterns, Machining or Castings. Not to be used for necessary standard operations.

Put this Number on Service Cards and Requisitions

FOREMAN'S REMACHINING ORDER TO DEPT. NO 37 — NO F. O. 9295 A

ORDER NO 872 GL 11	LOT NO.	NO. OF PCS 1	DESCRIPTION Clutch Shifter Lever	ISSUED BY E.J.B.	DATE 7/4/	PART. NO. 1 BC 56 A 15
DATE FINSHD BY	STORES REQ. NO.	OPER ORDER NO 51587	CHGE. TO DEPT. 12	APP'D. BY DEPT. CHGD Sanbury	PATTERN NO.	DRAWING NO.

THE FOLLOWING SPECIAL WORK IS REQUIRED BY DEPT. NO. 34 Ballard FOREMAN
(TO BE SIGNED BY FOREMAN OF DEPT REQUIRING WORK DONE)
ON ACCOUNT OF Sandhole in casting

Babbitt sandhole

WHAT HAS BEEN DONE TO GUARD AGAINST A RECURRANCE

(TO BE FILLED IN BY FOREMAN OF DEPT. CHARGED)

CHARGE ACCT. NO.

CHECK CLASSIFICAT'N THUS V

A	DEFECTIVE CASTING
B	DEFECTIVE WORKMANSHIP PREV. OPER.
C	DEFECTIVE WORKMANSHIP PRES. OPER
D	ENGINEERING DEPARTMENT
E	

APPROVED
SHOP SUPT

REGISTERED

APPROVED SUPT	EXTENDED	CHECKED	MATE'L COST	LAB COST	TOTAL COST	EQUIP. NO

To be issued only to correct errors in Drawing Patterns, Machining or Castings.
Issued by Despatcher in three copies. White, Green and Pink.
White copy to be approved by Foreman of Dept. to be charged and Shop Superintendent before work is started and forwarded to Main Office.
Green copy to accompany Material and forwarded to Main Office when finished, to be costed and returned to Foreman of Dept. charged
Pink copy to be retained by Despatcher issuing same. FORM 832 M M & M INC. P M WKS.

Fig. 16. Errors occurring on the Drawings, Patterns, in the Machining Operations, or in the Foundry sometimes require the Work to be remachined. An Order for performing this Extra Operation must be made out

of time consumed, etc., the inspector returns the slips to the dispatcher, and one set is delivered to the planning department where the information is recorded on follow-up records, and then filed. The other set of operation order slips is retained by the dispatcher for future reference. It is apparent that the selection of the follow-up job by the dispatcher is governed by the work schedule (Fig. 5) for the machines in the department in which the work is being performed, and that this schedule also furnishes the date on which the job should be finished.

As soon as the work on any part has been completed in a department, the dispatcher issues directions for transporting the work to the next department in order, as indicated on the opposite side of the envelope, Fig. 11. If for any cause the work is rejected by the inspector, the dispatcher, when examining the operation order slips, issues a rejected material report, Fig. 12, which must be signed by the inspector. These slips are made out in triplicate, and contain the department number and the name of the foreman, in addition to the description of the work and the cause for rejection. The disposition of the rejected stock is determined by the storekeeper, to whom one of these slips is sent. He then decides whether the piece is to be replaced or not. The slip is required to be signed by the foreman

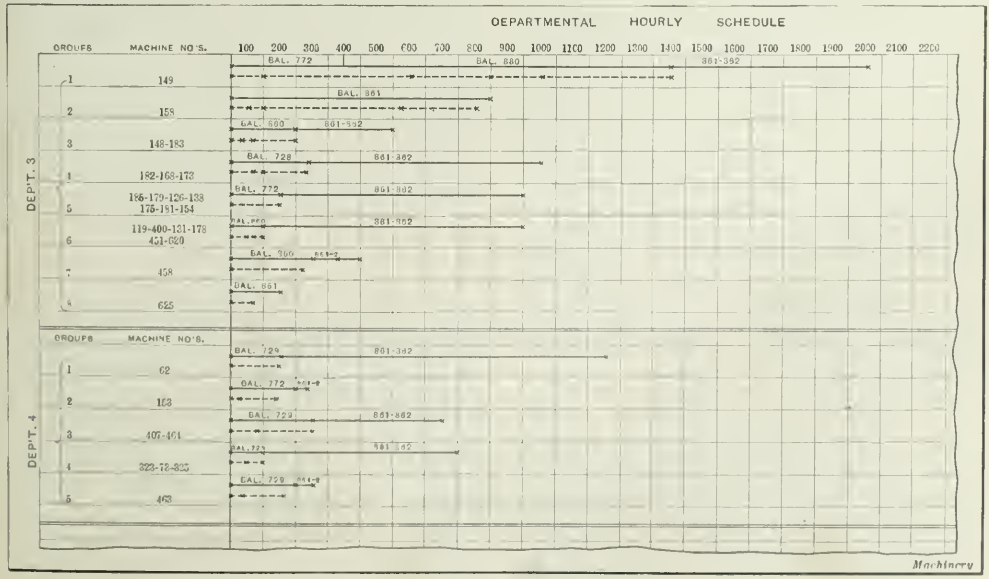


Fig. 17. Diagrammatic Chart from which the Number of Hours assigned to Each Machine Group may be determined as well as the Amount already used, so that Time Estimates may be made in Anticipation of New Orders

of the department in the space marked "Approved Department Charged." At the end of each month a cost account for the amount of spoiled work is submitted to the foreman. This has the effect of producing a greater amount of precaution in the department and results in keeping the amount of rejected material down to a minimum. It is evident that an excessive amount of rejected material is an unfavorable condition against which the foreman constantly guards in order to maintain a high degree of efficiency for his department.

If more time is consumed on a job than had been estimated or established by the planning department, the foreman determines the reason for this and writes it on the back of the operation order slip. These entries are placed on a "delay and failure" sheet, which is shown in Fig. 15, and all information concerning the job is entered, including the time consumption. These are daily reports giving the number of jobs completed and the number of failures, and the total amount of time in excess of that planned is placed at the bottom of the sheet. These daily reports are sent to the superintendent and to the production manager, so that these executives are posted daily as to the causes for not meeting the production time and the steps being taken to prevent a recurrence. For example, if the cause of the delay or failure lies with the foundry, this department is charged with the inefficiency, which serves to create a greater effort on the part of the foundry foreman to prevent similar delays or failures in his department.

The necessity for remachining work requires a foreman's remachining order, Fig. 16, which is issued in three colors and only as a result of errors which are due to poor drawings, patterns, machining, or casting. One of these copies is filed by the foreman of the department in which the work is to be remachined so that he, as well as the superintendent to whom one of the copies is sent, is able to check up the quality of work that his department is doing at all times, and if there is much of this repair work, he is able to take the necessary steps to prevent it. In the case of time losses over which the operator has no influence, due credit is allowed, and an additional operation slip is filled out by the dispatcher, on which the additional time costs are entered and the proper extra charge made on the expense of the job. This slip, which is a duplicate of the regular operation order slip, contains the foreman's order number. which furnishes the authority for the extra time allowance.

Departmental Schedule and Progress Board

A departmental hourly schedule is maintained in the planning department in which the burden of each machine in the shop is diagrammatically indicated. This chart is based on the time element contained in the schedule of machines previously mentioned in connection with Fig. 5. A section of one of the sheets which constitute the hourly schedule is shown in Fig. 17. Such a schedule, in connection with routing the work, to indicate instantly the number of hours assigned to any machine, is very valuable. In furnishing the executives and the order department with the estimated dates for shipment of contemplated orders, this diagram is of prime importance, since the governing machine can be determined at a glance. The number of hours that are already assigned to a machine are shown in heavy full lines and the number consumed, in heavy dotted lines, the difference being used to estimate the earliest date on which a new order could be handled on the machine.

It is stated that, barring unforeseen delays, accurate results can be obtained by employing this chart. In the illustration, it will be seen that for department No. 3 there are eight groups of machines, some of these groups containing but one machine and others several. The schedule enables the planning department to know at once that machine No. 149 in this department is already burdened with 2000 hours' work, and that if this machine must be used on an order, it must first be cleared. Therefore, this machine is the governing one, and the only one which must be considered when making a shipment date estimate. This enables the planner to furnish a close approximation as to the date on which the various operations can be completed with the available equipment. The opposite side of the schedule contains a record of material and finished parts purchased from outside the shop, the vender's name, the dates ordered and promised, and any additional remarks which may be necessary.

In Fig. 14 a general view of a corner of the planning department is illustrated, which also shows a view of the progress board used in this department to record the state of completion of any manufacturing order listed thereon. This board records the date of shipment for each order, and that of the several steps in manufacturing. The location of the various parts after machining is indicated by markers, so that whether the work is in the unit assembly or in the erecting stage this can be quickly seen, as well as the number of parts released either for assembly or for storage. There are a number of incidental items which might be mentioned in connection with the functions of this department, but for the purpose of general analysis those to which attention has been called should serve to illustrate the scope of the work performed.

* * *

OXY-ACETYLENE WELDING APPLICATIONS IN BOILER SHOPS

Few products offer so many applications of oxy-acetylene welding in proportion to the number of operations involved in their manufacture, maintenance, and ultimate disposition, as boilers. Welding can be applied in various ways during their manufacture, in making repairs at intervals throughout their life, and in finally cutting up the worn-out boilers into scrap. Some of the applications of oxy-acetylene welding in making the various parts entering into the construction of a boiler are as follows: In cutting the sheets to facilitate handling when they are brought into the shop for laying out; in cutting out dome saddles and wash-out and cleaning holes by using a simple one-wheel attachment for circular work; and in welding holes punched wrong on the punching machines, edges or angles damaged by shears, and flanges cracked while being shaped or in fitting up.

In assembling a boiler, the dome must be driven into the saddle and the mud ring into the water space. These heavy parts can be fitted by applying a welding flame to a small area, which permits the parts to be fitted easily. Occasionally, staybolt holes are tapped too large, and when this occurs instead of using an over-size bolt, the hole can be welded and another one of correct size drilled and tapped. In attaching the firebox to a boiler, the sheets can be welded together. One of the most profitable applications of the welding process in repairing boilers is in the reclamation of fire flues and tubes. This is accomplished by cutting off defective ends and welding on new short lengths. Patches can also be satisfactorily attached to firebox sheets, and the edges of riveted fireboxes can be calked by welding. at small cost.

* * *

Workmen's compensation laws have been enacted in forty-three states of the Union, and in addition are in force in Alaska, Porto Rico, and the Hawaiian Islands. Only five states have no workmen's compensation laws, and these are non-industrial states in the South. Most of the workmen's compensation laws have been passed since 1910. There is a marked tendency in nearly all states to strengthen the laws in the direction of larger amounts of compensation, shorter waiting periods before payment begins, and wider scope of application. Sixteen states have established state funds for insuring, at cost, the liability of employers; and in seven of these states, the state insurance is exclusive, eliminating commercial insurance competition. Ohio's state insurance law, which is said to have the united support of both employers and employes, is claimed to have given the best results to both industry and labor.

Industrial Conditions in Spain

By D. RAMON CASALS, Barcelona, Spain

GENERALLY speaking, there is considerable activity in the Spanish industry and there doubtless is a period of great development ahead, but at least 80 per cent of the prospective buyers of machine tools are not placing orders at the present time, because they expect either a fall in prices or are awaiting more suitable conditions in the political, industrial, and economic situation. Many Spanish manufacturers have orders on hand which would make it possible for them to enlarge their works. The automobile industry has been prosperous during the last year, and the makers are confident that this industry can be permanently established in Spain. Of the automobiles in Spain at present, from 80 to 85 per cent are of foreign make, mostly American, French, and English. As yet there is no firm that has started to manufacture trucks in Spain in spite of the fact that the use of this class of vehicle is greatly increasing. The duty on automobiles is 300 pesetas ($41.46 at present exchange) per 100 kilograms (220 pounds). This high tariff, it is believed, will make it possible for the Spanish makers to compete in the domestic market. In spite of the increased wages paid, the wages in Spain are still lower than in most other industrial countries with which Spain competes.

Important Industrial Developments

Among the automobile builders in Spain may be mentioned America Autos S. A. in Barcelona; this company up to the present time has built only a few cars, but it is now erecting a large and modern works for the manufacture of cars in quantity. This company has also made considerable developments along the line of improved wheels, a so-called "elastic" wheel having been developed which is used as a substitute for the prevailing types of pneumatic tires. This wheel has been tried out under actual running conditions, and has given excellent results. Other automobile companies in Barcelona as well as the Hispano firm of Guadalajara have also increased their facilities considerably. A general development is also apparent in other industries, chiefly among the makers of railway equipment. Hitherto most of the locomotives of Spain have been imported, but a new works established here is prepared to build fifty engines a year. Several factories devoted to the making of flying machines have made contracts with the government for the building of planes for mail service. One Barcelona firm is experimenting with a plane which will rise vertically after having attained a 10-degree inclination at the beginning of the flight. This firm expects to win the prize of 500,000 francs offered by the firm of Michelin in France for a plane capable of rising vertically from the ground.

The Machine Tool Field

In the machine tool field, the few makers that there were in Spain are decreasing in number. Most of the domestic machines, although built in accordance with American models, did not prove reliable, as they were made from inferior materials and by men who were inexperienced in this class of work. There are some dealers who sell domestic-made machines under the pretense that they are imported. Makers of small tools are quite numerous, and they also endeavor to sell their products as if made in foreign countries. These tools are cheaper when manufactured in Spain, and as a rule give better results than the machine tools that have been built by domestic concerns.

The largest demand for machine tools in Spain is for lathes. Milling machines are also in demand, and in nearly every case American machines are asked for. The tariff on machine tools is quite low, amounting only to 20 pesetas ($2.76) per 100 kilograms (220 pounds). The present rate of exchange is 13.82 cents per peseta (normal, 19.3 cents).

German and English Competition

There has been some evidence of German competition during the last four months, and some machine tools from Germany have arrived in Spain. Most of these machines, however, are those that remained in stock in Germany at the end of the war; the majority are new machines, and some are second-hand. The prices of these machines are quite low. A good American lathe with quick-change gear-box, 16 or 18 inches swing, costs from 12,000 to 14,800 pesetas in Spain; whereas, the German machines, when 5 marks were equal to 1 peseta, would sell for from 4000 to 5000 pesetas. At the present time, dealers in German machine tools here have no stocks on hand, but deliver from the German works in about eight weeks. The prices quoted seem low enough, and the smaller plants appear to be anxious to take advantage of these German offers, but the large factories belonging to more important firms, which have had an opportunity to compare the results obtained from German machines with those of American machine tools are at present asking for bids only from dealers in American and English tools.

The competition with English machine tool builders is beginning to be more keen. The delivery quoted by the British firms is satisfactory, but the prices are considered high. There is also competition from Sweden. The machinery offered by that country is considered in Spain to be comparable with the machines offered by Germany. A considerable amount of machinery is also coming from Switzerland.

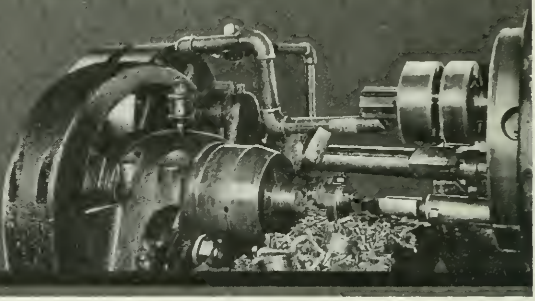
Labor Conditions

Labor conditions are not favorable to the development of important industries. Although most of the factories in Spain are able to obtain an abundance of orders, they have difficulties with their workmen, and these difficulties seem to be increasing rather than decreasing. Many of the factories that are trying to develop along modern lines find that they must act very carefully in the adoption of modern labor-saving machinery and in the introduction of modifications tending to reduce the labor cost, because such efforts serve as a reason for a strike, not only in one factory, but in a whole branch of the industry. There has been a considerable increase in wages, and working hours have been reduced from one to two hours a day. The following table shows a comparison of wages in and around Barcelona and other industrial centers in 1914 and 1920:

	Pesetas per Hour	
	1914	1920
Lathe operators	0.45 to 0.60	1.55 to 1.80
Milling machine operators	0.45 to 0.60	1.55 to 1.80
Bench hands	0.35 to 0.50	1.40 to 1.60
Assemblers	0.40 to 0.60	1.50 to 1.80
Helpers	0.30	1.20
Molders	0.50	1.70

In view of the increased wages it is evident that it is necessary to procure labor-saving machinery in order to increase output. There is not a demand as yet for many automatic machines, because the output of each class of manufacture is not large enough for the advantageous use of that kind of machine tool, but there is a considerable market for turret lathes and universal milling machines, because these machines would greatly decrease manufacturing costs.

Design of Circular Forming Tools



Calculations for Designing Circular Forming Tools Having Top Rake

By EARL H. SMILEY and J. H. DAVIS

As the circular forming tools used on automatic screw machines have the cutting edges below the center line of the tool in order to provide clearance, the radial length of the step or shoulder on the tool must be less than the corresponding radial length of the shoulder to be formed on the work, in order to compensate for the difference between heights of the work and tool centers. When the circular tool has top rake, the radial length of each step must be still further reduced, due to the inclination of the cutting edge. Tools without top rake may be used to advantage when cutting brass and drill rods of very small diameters, but when cutting steel, bronze, or copper, a rake on the form tool is necessary in order to give a better cutting action.

Formulas for standard sizes of circular tools without rake were published in the April number of MACHINERY (page 765), and tables such as the one beginning on page 830 of MACHINERY'S HANDBOOK may also be used for obtaining the radii of various steps on the tools more readily than by the use of formulas. This article will be confined to the design of circular forming tools having rake.

Circular forming tools with or without rake may be made by first making a master tool, which is used to make a straight form tool, the latter finally being employed for turning the circular form tool. The master tool method (which was fully described in the January, 1920, number of MACHINERY) is necessarily expensive and is not warranted except for the production of parts in large quantities.

When circular tools having rake are made without resorting to the form tool method, the diameters of the different steps on the tool may be calculated readily by the use of the formulas which are to be given, together with their derivation. As some of the dimensions of these forming tools have been standardized for different sizes of screw machines, the design of the forming tools is simplified. For instance, the outside diameter and amount that the cutting edge is offset relative to the center of the tool, is standard for the tools used on a given size and make of machine.

Formulas for Circular Tools Having Rake

In order to determine the shape and the number of steps required on the forming tool, the sequence of operations for producing the piece to be made should first be laid out. Fig. 3 shows the relative positions of the forming tool and work. The radius of each step of the tool is then determined. The derivation of the formula for finding the radius of a given step on the tool will be made clear by referring to the

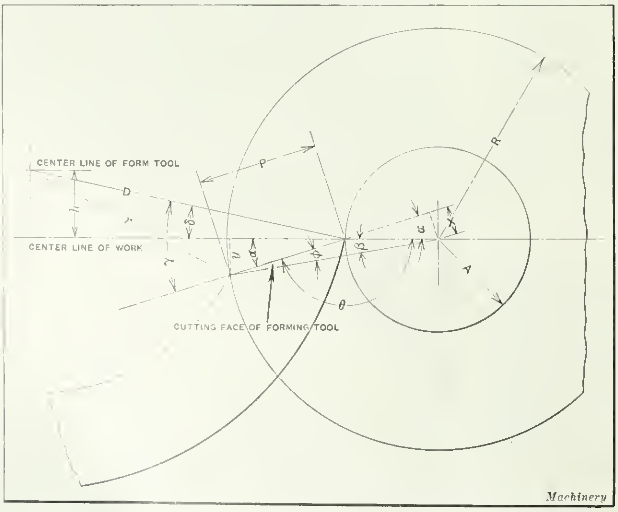


Fig. 1. Diagram showing Construction Lines used in deriving Formula for Circular Forming Tools having Rake

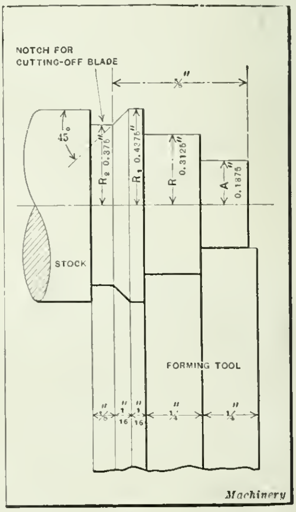


Fig. 2. Practical Example illustrating Forming Tool Calculations

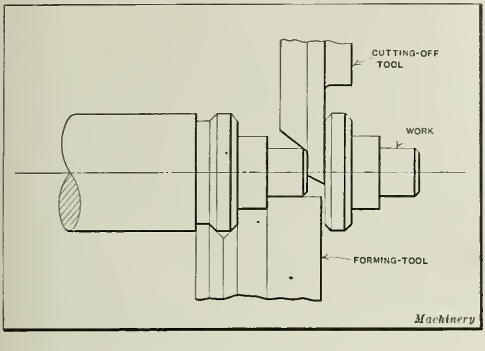


Fig. 3. Example illustrating Application of Forming and Cutting-off Tool

diagram, Fig. 1, which represents the cutting edges of the tool and the two diameters on the part formed by the tool. The notation used in the formulas conforms to the lettering on this diagram, and is as follows:

A = small radius on part to be turned;
R = large radius on part to be turned;
D = outside radius of circular forming tool;
h = vertical distance between center lines of forming tool and work;
α = angle of rake on cutting face of forming tool;
r = radius required on tool for turning a given radius on the work.

An inspection of the diagram will show that:

$$\theta = 180 - \alpha \qquad (1)$$

$$\text{Sin } \phi = \frac{X}{R} \qquad \text{and} \qquad \text{Sin } \theta = \frac{X}{A}$$

Then

$$X = R \sin \phi \qquad \text{and} \qquad X = A \sin \theta$$

$$R \sin \phi = A \sin \theta$$

$$\text{Sin } \phi = \frac{A \sin \theta}{R} \qquad (2)$$

$$\beta + \phi + \theta = 180 \text{ degrees}$$

$$\theta = 180 \text{ degrees} - \alpha$$

Subtracting

$$\beta + \phi = \alpha$$

$$\beta = \alpha - \phi \qquad (3)$$

$$\text{Sin } \theta = \frac{y}{P} \qquad \text{and} \qquad \text{Sin } \beta = \frac{y}{R}$$

$$y = P \sin \theta \qquad \text{and} \qquad y = R \sin \beta$$

$$P \sin \theta = R \sin \beta$$

$$P = \frac{R \sin \beta}{\sin \theta} \quad (4) \qquad \text{Sin } \delta = \frac{h}{D} \quad (5)$$

$$\gamma = \alpha + \delta \qquad (6)$$

From the law of cosines the following formula is derived:

$$r^2 = P^2 + D^2 - 2PD \cos \gamma$$

Solving for r

$$r = \sqrt{P^2 + D^2 - 2PD \cos \gamma} \qquad (7)$$

$2r$ = the required diameter of the forming tool to cut the diameter $2R$ on the work.

When the part to be turned has several diameters, the radius of each step on the tool may be determined by successive calculations, always using the smallest radius on the work (as A, Fig. 1) for all calculations on the same tool.

The accompanying table, which applies to the circular tools used on four sizes of Brown & Sharpe screw machines, is convenient for the designers of these tools, as it contains most of the dimensions required on the working drawing. As will be seen, radius D and certain other dimensions are standard for all tools used on a given size of machine. As the product of $2D \cos \gamma$ (see Formula 7) is the same for each machine, the logarithm of this product is given in the table for the convenience of those who desire to use logarithms. When logarithms are employed in the calculations, a seven-place table should be used, preferably, to insure a result that is accurate to three decimal places or to thousandths of an inch.

Example of Forming Tool Calculations

The method of calculating the diameters of a forming tool having top rake will be given to illustrate the procedure. The forming tool for making the dowel-screw shown in Fig. 2 will be taken as an example. Assume that the rake angle equals 8 degrees and that the dimension for that step on the tool which is to turn a radius of 0.3125 inch is to be determined first. Inserting these values in the formulas previously given, we have:

$$\theta = 180 - 8 = 172 \text{ degrees} \qquad (1)$$

$$\text{Sin } \phi = \frac{0.1875 \times 0.13917}{0.3125} = 0.0835 \qquad (2)$$

$$\phi = 4 \text{ degrees } 47 \text{ minutes, nearly}$$

$$\beta = 8 \text{ deg.} - 4 \text{ deg. } 47 \text{ min.} = 3 \text{ deg. } 13 \text{ min.} \qquad (3)$$

$$P = \frac{0.3125 \times 0.05611}{0.13917} = 0.126 \qquad (4)$$

$$\text{Sin } \delta = \frac{0.25}{1.5} \qquad (5)$$

and

$$\delta = 9 \text{ degrees } 36 \text{ minutes}$$

$$\gamma = 8 \text{ deg.} + 9 \text{ deg. } 36 \text{ min.} = 17 \text{ deg. } 36 \text{ min.} \qquad (6)$$

$$r = \sqrt{0.126^2 + 1.5^2 - 0.126 \times 2 \times 1.5 \times 0.95319}$$

$$= \sqrt{1.906} = 1.3806 \qquad (7)$$

Therefore the diameter on the forming tool for cutting a radius R of 0.3125 inch equals 1.3806 × 2 = 2.7612 inches. The radii of the other steps of the tool may be determined in the same way by substituting the values 0.4375 and 0.375 for radius R.

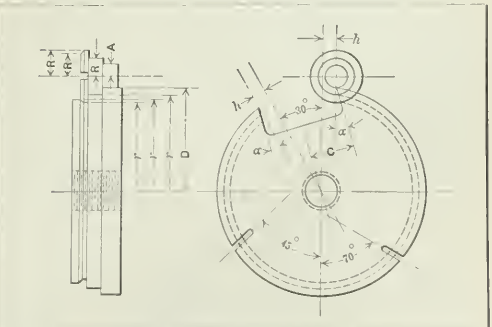
While the radius can be calculated as shown in the foregoing, the use of logarithms will be found more convenient and also more accurate when a seven-place table is used. The solution of the preceding example by the use of logarithms follows:

$$A = 0.1875 \text{ and } \log A = \bar{1}.2730013$$

By adding and then subtracting 10, the actual logarithm is given a positive characteristic so that it will conform to the logarithms as given for trigonometrical functions; thus

$\bar{1}.2730013 = 9.2730013 - 10$ or, as commonly written, 9.2730013, the − 10 being omitted.

DIMENSIONS AND CONSTANTS FOR CALCULATING CIRCULAR FORMING TOOLS



Type of Mach.	Max. Diam. Stock, Inch	Max. Length of Cut, Inches	Max. Length of Feed, Inches	Diam. of Formed Tool Inches	h, Inch	C, Inches	Size Tapped Hole	Constants	
								D², Inches	Log 2D × Cos γ
A	5/16	1¼	2	1¾	⅛	0.215	⅜-16	0.765625	0.2254146
B	½	2	3	2¼	5/32	0.311	½-13	1.265625	0.3350608
C	⅞	3	4	3	¼	0.426	⅝-11	2.250000	0.4563164
D	2	5	6	4	5/16	0.584	¾-10	4.000000	0.5826815

Machinery

$$R = 0.3125 \text{ and } \log R = \bar{1}.4948500 \text{ or } 9.4948500$$

$$\text{Log} \sin \theta = 9.1435553$$

$$\text{Log} \sin \phi = \log 9.2730013 + \log 9.1435553 - \log 9.4948500$$
$$= \log 8.9217066$$

Hence

$$\phi = 4 \text{ degrees } 47 \text{ minutes } 24 \text{ seconds}$$

$$\beta = 8 \text{ deg.} - 4 \text{ deg. } 47 \text{ min. } 24 \text{ sec.} = 3 \text{ deg. } 12 \text{ min. } 36 \text{ sec.}$$

$$\text{Log } P = \log 9.4948500 + \log 8.7481552 - \log 9.1435553$$
$$= \log 9.0994499$$

$$\text{Log } P^2 = 9.0994499 \times 2 = 18.1988998 - 20 \text{ or } \log 8.1988998$$
$$= 0.015809$$

$$r = 0.015809 + 2.25 - (\log 9.0994499 + \log 0.4563164)$$
$$= 1.3806$$

$2r = 2.7612$ inches = the required diameter on the forming tool to cut a radius R equal to 0.3125 inch.

Calculations for Combined Forming and Cutting-off Tools

When the heel of a cutting-off tool is required to pass the center of the work, as when the tool is used to form and cut off at one operation, this changes the relation between the cutting edge of the tool and the diameter at the step, so that another set of formulas must be derived before designing the tool. The diagram Fig. 4 shows graphically the meaning of the following notation:

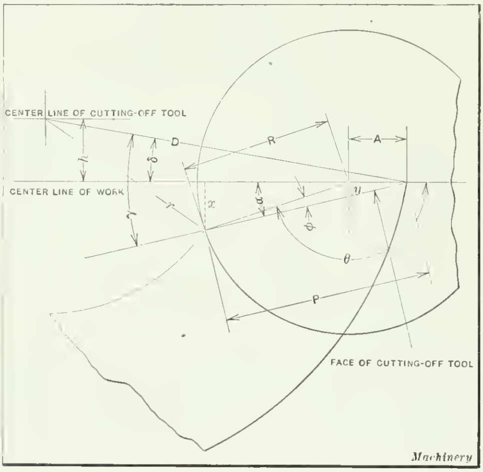


Fig. 4. Diagram showing Construction Lines used in deriving the Formula for Circular Forming and Cutting-off Tool

A = distance cut-off tool passes center of work;
R = radius to be cut at step;
D = outside radius of cut-off tool;
α = angle of rake on cutting face of tool;
r = radius of cut-off tool to form the required diameter on the work.

An inspection of the diagram will show that:

$$\text{Sin } \phi = \frac{y}{R} \quad \text{and} \quad \text{Sin } \alpha = \frac{y}{A}$$

$$y = R \sin \phi \quad \text{and} \quad y = A \sin \alpha$$

$$R \sin \phi = A \sin \alpha$$

$$\text{Sin } \phi = \frac{A \sin \alpha}{R} \tag{8}$$

$$\alpha + \phi + \theta = 180 \text{ degrees}$$

$$\theta = 180 \text{ degrees} - (\alpha + \phi) \tag{9}$$

$$\text{Sin } \alpha = \frac{x}{P} \quad \text{and} \quad \text{Sin } \theta = \frac{x}{R}$$

$$x = P \sin \alpha \quad \text{and} \quad x = R \sin \theta$$

$$P \sin \alpha = R \sin \theta$$

$$P = \frac{R \sin \theta}{\sin \alpha} \tag{10}$$

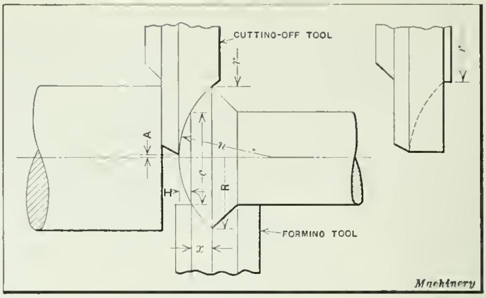


Fig. 5. Forming and Cutting-off Tools for forming a Spherical End on Screw-head

$$\text{Sin } \delta = \frac{h}{D} \tag{11}$$

$$\gamma = \alpha + \delta \tag{12}$$

$$r = \sqrt{P^2 + D^2 - 2PD \cos \gamma} \tag{13}$$

Forming and Cutting-off Tools for Forming a Spherical End on Work

When a screw-head or other part is to have a spherical end, the forming tool may be used to turn part of the spherical surface (as illustrated in Fig. 5), and the cutting-off tool completes the curvature during the cutting-off operation. Formulas (1) to (7), inclusive, are used for the calculations, but it is first necessary to determine either the height H or the length c of the chord extending from the point where the forming tool completes its part of the work.

If H = height of chord;
n = radius of spherical shaped part;
c = length of chord

Then

$$H = n - \tfrac{1}{2} \sqrt{4n^2 - c^2} \tag{14}$$

If the conditions of the problem are such that the length c of the chord is required, the formula can be transposed as follows:

$$c = 2\sqrt{H\ (2n - H)} \tag{15}$$

The screw-head shown in Fig. 6 will be used as an example to illustrate the method of calculating the tools. It will be seen from Fig. 5, that the length c of the chord in this case is 5/8 inch, as the forming tool is to turn the head down to the same diameter as the body of the screw; therefore, it is necessary to find height H. The radius of the head n equals 1.6875 inches and c equals 0.625 inch. Inserting these values in Formula (14), we have:

$$H = 1.6875 - 0.5\ \sqrt{4 \times 1.6875^2 - 0.625^2} = 0.029$$

$$x \text{ (see Fig. 5)} = 0.096 - 0.029 = 0.067$$

The next step is to calculate radius r of the forming tool, by the use of Formulas (1) to (7) inclusive, as previously explained. As Fig. 5 indicates, the cutting-off tool is to finish that part of the spherical end which is not turned by the forming tool, the work of the cutting-off tool beginning where the spherical surface left by the forming tool ends. Since the finished screw will drop off before the cutting-off tool has reached the center, some allowance must be made

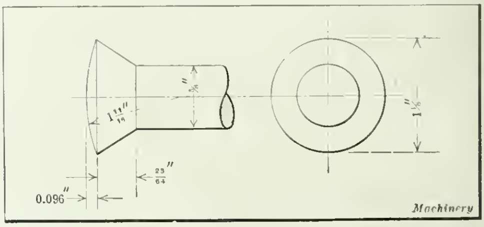


Fig. 6. Screw-head used as Example to illustrate Method of calculating Forming and Cutting-off Tools

when calculating the cutting-off tool so that the screw-head will be correctly formed before it is severed. If 1/32 inch is allowed as the diameter of the teat on the end of the stock, the radius A used in the calculations for determining the tool radius r will equal 0.015 inch. This value of 1/32 inch is approximate, but is close enough for all practical purposes, and it allows the complete arc to be formed before the finished screw drops off the bar.

We shall assume that the cutting-off tool to be used for the screw-head illustrated in Fig. 6 has a rake angle a of 8 degrees, and it is to be used on a Type D machine; therefore, the outside radius D of the tool equals 2 inches. (See table previously referred to.) The radius R of the screw-head equals 0.5625 inch. Having these values we can proceed to determine the radius r of the tool corresponding to the radius R of the head when the point of the cutting-off tool is within 0.015 inch of the center.

$$\theta = 180 \text{ degrees} - 8 \text{ degrees} = 172 \text{ degrees} \qquad (8)$$

$$\sin \phi = \frac{0.015 \times 0.13917}{0.5625} = 0.0037 \qquad (9)$$

$$\phi = 0 \text{ degrees } 12 \text{ minutes } 46 \text{ seconds}$$

$$\beta = 8 \text{ deg.} - 0 \text{ deg. } 12 \text{ min. } 46 \text{ sec.} = 7 \text{ deg. } 47 \text{ min. } 14 \text{ sec.}$$

$$P = \frac{0.5625 \times 0.13549}{0.13917} = 0.5476 \qquad (10)$$

$$\text{Sin } \delta = \frac{0.3125}{2} = 0.15625 \qquad (11)$$

$$\delta = 8 \text{ degrees } 59 \text{ minutes } 21 \text{ seconds}$$

$$\gamma = 8 \text{ degrees} + 8 \text{ degrees } 59 \text{ minutes } 21 \text{ seconds}$$
$$= 16 \text{ degrees } 59 \text{ minutes } 21 \text{ seconds} \qquad (12)$$

$$r = \sqrt{0.5476^2 + 2^2 - 2 \times 0.5476 \times 2 \times 0.95636}$$
$$= 1.4849 \text{ inches} \qquad (13)$$

The toolmaker when making the cutting-off tool can readily turn or grind it to the required diameter ($2r$) by forming a shoulder on the tool as illustrated by the view at the right-hand side of Fig. 5; then by the use of a radius tool of the proper shape, the cutting-off tool can be turned to the radius of the screw-head, the tool blank being turned away as indicated by the dotted line.

* * *

INDUSTRIAL COST ASSOCIATION

The Industrial Cost Association, which has executive offices in the People's Bank Bldg., Pittsburg, Pa., reports that considerable progress has been made in enlisting the interest of firms and corporations and of industrial organizations. The objects of the association are to stimulate the interest of all manufacturers in accurately determined costs; to standardize cost and accounting nomenclature; to establish governing principles; to simplify cost accounting; to educate the members in the use and advantages of graphic charts and other modern methods of cost analysis and control; to assist members of the association who are identified with cost committees of trade organizations in formulating uniform cost methods, and to recommend to members the adoption of such uniform methods; to facilitate the elimination of unintelligent competition by encouraging the interchange of cost data among members engaged in similar lines of industry; to provide a forum for the discussion of cost problems and practices through general and local meetings; to gather and disseminate news of interest to members; to establish a library of cost literature, and to maintain a bureau of information through which members may be assisted in the solution of their individual cost problems; and to coordinate the efforts of members to the end that cost of production may be considered in its proper relation to the complex problems of industrial management. Membership in the association is open to officers, directors, and managers of industrial corporations, firms, and trade associations, and to employes having executive supervision of cost accounting.

EXECUTIVES AND HOW THEY ARE MADE

By M. L. JEFFREY
Superintendent, Columbia Axle Co., Cleveland, Ohio

Experience has proved that the most successful managers of industrial undertakings are men who in their younger days started to work as common laborers or machine operators and forced their way upward by having a solid organization in back of them. A man usually starts out in the business world with the determination to make a success of himself and win promotion. The reception that he receives controls to a great measure his future. Few people realize the amount of influence which a foreman, who has direct control of a man, has in shaping and developing his future usefulness and ability to advance to a higher position. Neither do they realize the influence which the workman has in shaping the future advancement of his foreman. However, the success of the workman reflects upon his supervisor.

The first step in shaping the usefulness of a future employe is to interview him properly. At this time it is highly important to impress upon him the high standards of the company and the kindly interest that it takes in its employes. Even though an applicant for a position is not hired, such an interview will give him a good opinion of the company and he will eventually pass on to others this opinion. The fact that a man is a first-class lathe operator alone should not qualify him for a position. He should be the type of man who will prove himself a loyal, honest, and agreeable employe. Only such men are wanted who are dependable, anxious to grow with the organization, and who will work in its interest. After a man is employed, he immediately begins to form his opinion of the concern, and sets his plans for the future accordingly.

"A proper start is the job half finished," is an old saying which may be well applied to new employes. It is a duty of the foreman to become acquainted with an employe as soon as the latter arrives in his department, and display an interest in the man by showing him the place or machine to which he is assigned. The foreman should explain the duties of the new workman, giving instructions as to what methods it is desirable for the man to use in his work and acquainting him with any other information that might save him from embarrassment among the men during his first few and strange days in the shop. If this procedure is followed, a new employe will immediately notice the interest of the foreman in making him comfortable so that he may more easily and cheerfully execute his duties from the beginning. The result is that the man goes at his work in the spirit that spells success.

When a new man has been under a foreman for a sufficient length of time for the latter to determine whether the man wants to continue, the foreman should also have determined through careful observation whether the employe is aggressive and capable of holding a better position or deserving of greater remuneration for his services. Neither of these two rewards should be delayed in the case of a deserving workman. Most men are ambitious and want to attain a higher position and greater responsibility, but foremen should remember that the men working under their supervision are responsible to some extent for their success. All men are entitled to equal consideration, a cheery word, and a pleasant smile.

Every man in a department should be given all the opportunities he deserves. In this way a foreman will gain the backing of his department, and without such support, the attainments of a foreman are small. The fact that he has men under him who can readily step into a better position or continue his duties while he is absent, not only reflects upon the good judgment of the foreman in handling men, but also paves the way for his future success and promotion. A manufacturing establishment may be likened to a ladder of which each rung is an executive position, from the lowest to the highest, which serves as a stepping-stone for progress.

Machine-hour Rate Method of Distributing Manufacturing Expense[1]

By C. HAIGH, Supervisor of Costs, General Electric Co., Schenectady, N. Y.

THERE are five methods in general use for distributing overhead expenses. These are as follows: Man-rate; man-hour; material and labor; sold-hour; and machine-hour rate. The man-rate method is the one in most general use because of its simplicity. To use this method, it is only necessary to find the ratio of total expenses to total labor for a given business, and to apply this ratio to the labor cost of each job. For a factory making one kind of product, this method of distributing overhead is quite satisfactory, but where the product itself is varied and the tools used in getting out the product are different for each of the various units produced, this method of distributing overhead is incorrect and misleading as to final results. There is no more justification for considering that one dollar's worth of labor actually applied to the product should always take the same percentage of expense than there is for the assumption that a lathe and a boring mill cost the same, are operated for the same amount, and occupy the same floor space, or that the overhead cost of maintaining benches and assembly floors is the same as the overhead cost of maintaining and operating machinery.

Application of Man-rate Method of Distributing Overhead Expense

This method of applying overhead also assumes that the highest paid workman requires the most overhead expense, when actually the lowest paid man often requires the most supervision, and frequently the machine tools used by the low-priced man are more expensive and require greater expenditures for operation and maintenance than those used by the skilled mechanic, because there is incorporated in the machine which enables lower grade labor to be used the skill that the high-grade man has in himself. Thus, if a semi-automatic machine is used for making any part, a man who is not an expert mechanic can be employed to run this machine or even several of these machines, but if this special equipment were not used a skilled man would be required to be in constant attendance on a simpler machine. It is obvious in this case that the overhead expense that is incurred in running the automatic machines is much greater in proportion to the wages paid the operator of these automatic machines than is the overhead incurred in running the mechanical equipment required by the skilled mechanic.

It is also true that even if the same wages were paid all men in a manufacturing establishment, it would still be wrong to apply the overhead to each job on the basis of a percentage of labor cost, for we would still have the condition of one man running more machines than another and of the difference in cost of the machines operated; also that some men would be occupied on jobs such as cleaning castings, checking finished product, painting, etc., which require little mechanical equipment and therefore do not increase the overhead expense at the same rate as their wages increase the direct labor payroll. From the foregoing, it would appear that the man-hour rate method of distributing expenses is a dangerous one, in some instances, and will result in a loss of money. There are cases, however, where this method may give results which will be satisfactory from the standpoint of profit, as cited in the following:

In a manufacturing establishment where the mechanical equipment is fairly well standardized, where the product, while varied as to different types, still has the same average types of output, and where these types all require substantially the same machining operations, it will be found that the ratio of profit to total output will come up to expectations when the man-rate method of distributing overhead is used. There is also a factor that must not be overlooked when considering any business, and that is, the amount of information which the man or men at the head of it have of that business independent of records, as I have frequently found that when estimating the cost of new work, allowances are made by the owner of a business for a higher expected cost due to special facilities which will be necessary and to the expectation that the bigger machines in the plant will be used on the work. By making such allowances, the final price submitted includes some of the factors of expense cost that are not actually subject to proof from any records of overhead expense which would be available if the man-rate method of distributing overhead were in use.

There is, however, a question as to how many men who manufacture a wide variety of gears can give the necessary weight to all the expense factors which will increase or decrease the cost of a particular kind of gear, and it is undoubtedly true that many of the manufacturers who are making good profits on their total business are losing money on some particular type of gear because of their lack of knowledge of the operating costs of their machines. Also that they turn down business on which there may be good profit because their selling price is figured on the basis of the average overhead which brings the price up higher than the buyer will pay.

The Man-hour Method

The man-hour method of distributing overhead has for its base the number of hours spent on a job instead of the amount of wages paid. This method is subject to the same criticism as the man-rate method in that the assumption is made that the overhead expenses have a fixed ratio to the number of hours of time spent on a job. The advocates of this method point out that certain items of expense do bear a direct relation to the number of hours worked, and include under this head the expenses of the payroll and welfare departments, compensation, insurance, and supervision. To a certain extent these items do bear a closer relation to hours worked than to wages paid, but as they represent a small part of the total expense, and as it would be erroneous to distribute the major part of the overhead on this basis, I see no advantage in this method over the man-hour basis. Moreover, it can be pointed out that we do not reduce our payroll and supervisory force every time business falls off to such a point that we lay off some of the men, and therefore, the cost per man-hour of operating these departments would fluctuate sufficiently to nullify any advantage gained over the man-rate method, particularly where this advantage consists chiefly in compensating for the difference in labor rates by substituting hours worked for wages paid.

Material and Labor Basis

The application of overhead on the basis of prime cost (material and labor) does not seem to be in very general use. This method requires that the total expenses of a business be divided by the sum of the direct labor and direct material and that the ratio or percentage so obtained be applied to the direct material and labor cost of each job turned out. It is manifestly wrong to apply this method to the product of a business that uses various kinds of material, but, where the product is all made from iron or steel, this method has some good points, as, by taking the material into consideration as well as the labor, we apply more accurately the expense of handling the material in the shop which, of course, varies with the size of the piece handled. In a shop using both copper and iron castings, this method would be worse than the two previous ones, as by adding the value of a copper casting to the labor of machining it, we would get a total figure which would carry a very high amount of expense; this, when compared with the expense cost applied to an iron casting of identical size requiring about the same amount of labor, would indicate that the expense cost of machining the copper casting was as much higher than that of the iron casting as the difference in the price per pound of copper and iron.

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[1] Paper read before the convention of the American Gear Manufacturers' Association, October 29, 1920.

This method has many of the same kind of inherent defects as the man-rate and man-hour methods, as we would still be applying an average expense to jobs instead of an actual cost, the difference between this and the other two systems being only that the material is added to the labor before determining the expense to be applied. Even were this method correct for some kinds of business, the places where it could be applied would be limited in number, and this method could never be applied generally.

The Sold-hour Plan

The sold-hour plan of distributing expenses provides that the total direct labor wages in a department be divided by the number of hours worked in the same period to get a flat average cost per hour for labor. The time in hours consumed on any job is valued at this flat rate per hour, and the result is called the direct labor cost. The expense is applied on the man-hour method previously mentioned.

This method is not in very general use, and little can be said in its favor. The man-hour method of distributing expenses has been criticized before and not much need be said regarding the determination of labor costs under this plan, as unless the rates paid workmen were practically uniform, still another error would be included in the final cost by using an average rate per hour for labor.

There are other methods of distributing overhead for special kinds of business, but because of their limited application, they will not be included here.

The Machine-hour Rate Method

The machine-hour rate method consists of distributing all the manufacturing expenses of an establishment by a charge to each job of the overhead cost of operating the machines and other facilities used on that job. This overhead charge is not an average for the whole plant or department, but is, as nearly as possible, the actual overhead cost of maintaining and operating each of the machines, group of machines, benches, etc., which are found in the plant. By the proper use of this method it is possible to show the difference between the expense cost of a boring mill and a lathe, a gear-cutter and a splining machine, etc.

To install a machine-rate method, the number of feet of productive floor space available for manufacture is first found, eliminating the space used for foremen's offices, stairways, wash-rooms, stock-rooms, etc. The number of square feet so obtained is used as a divisor for determining the cost per square foot per year for maintenance, depreciation, taxes, insurance, and other kindred charges applying against the land and building. No expenses are included in this group that are incident to the actual operation of the machines, but only those charges that apply against the empty building ready for manufacture. However, the expense of lighting and heating the building and charges of a similar nature are included. In this way a charge per square foot is obtained which is practically the same charge as the owner of a building would make if he rented it and furnished the light, heat, and water used in the building, except that he would include a profit on his investment.

The factory is next divided into production centers, including in each center machines of a similar type located together, or individual machines where there are no convenient groups. Different kinds of machines should not be included in one production center, as this would defeat the object of the system. After the division into production centers has been made, the number of square feet occupied by each center is determined, including in this area the space required for the material waiting to go on the machines, the space required for the workman, etc., and each center is charged with a part of the rental of the whole building based upon the area occupied. This division gives the rent per year for each production center, and in this way the total charges of the building which we have called rental charges would be allocated to various production centers. Thus it will be seen that one part of the expenses is now divided in such a way that these items can be included as one factor in the machine-hour rate.

The next step is to determine the actual cost of the expense items incident to the operation and maintenance of each of the production centers. These expenses consist of depreciation of the machinery and equipment, taxes, repairs, small tools, cutting oils and other charges which can be definitely allocated to the machines that have been included in one production center. If a small group of machines, all included in one center, requires the entire time of one foreman, the wages paid this foreman would be included with the other expenses in arriving at the total cost of operating the centers. The distribution of the power charge can best be made on the basis of the horsepower required by each production center. In this power charge we would include the expense of running the power plant as well as the shafting, belting, etc.

The expenses under consideration should cover a period long enough to insure correct results, as well as a period of normal operations so that the results will represent the hourly cost of operating the production centers in normal times and under normal conditions. The best results are obtained if the expenses for a whole year are used as a basis for the machine-hour rate; and if these expenses are carefully analyzed and allocated to the various production centers, the hourly rates first determined will not require much adjustment. In fact, the success or failure of the system depends on the amount of attention given to the division of the expenses at the beginning, as, unless the first rates are approximately correct, the first results obtained from the system will be so disappointing and misleading as to cause a manufacturer to condemn it and to insist for all time that the plan is no good. In this article we will assume that the expenses analyzed cover a period of one year.

Determination of Hourly Charge

Two groups of the annual expenses are now divided among the various production centers, and by adding the rental charges and the charges for operating and maintaining the machines, we have the basis for determining the hourly cost of expense applicable to work on the machine-hour basis. To determine the hourly charge, the total normal hours which each production center will work per year is estimated; then the amount of the expenses allocated to each production center is divided by the normal hours this center should operate, and the result is expense cost per hour.

There still remain a few items of expense which have not been distributed, such as supervision, clerical, and general administrative expenses. These expenses should be totaled, and the total divided by the sum of the normal hours of all the production centers. The result of this is another hourly expense cost which must be added to each machine rate as a supplementary charge.

Attention is called to the fact that the machine-hour rate is based entirely on the assumption that the production centers will work a certain number of hours in a certain time, a year having been used as the basis. It is obvious that no man can predetermine accurately the number of hours any machine in his plant will be occupied, and many people reject the idea of installing this system for that reason alone. However, a close approximation of the normal working time of any machine can be found, either by keeping records or examining records already available, and if the expenses of operating the machine are based on an approximately correct operating time, we have, by the machine-hour rate method, a means of showing immediately the financial effect of any variation of the operating time of the machines from the predetermined normal or standard operating time.

In making up the hourly rates, we assumed that we had a certain amount of expense, say $1200, to absorb in a certain period, say one year, over one production center. Let us say that we estimated the normal hours that this center would be used in the year to be 2400, or 200 per month. On this basis, the hourly expense cost of operating this production center is fifty cents. By adding fifty cents for each hour that a job required the facilities of this production center, we would expect to absorb all the expenses connected with it. Now, if the jobs passing through this center in a month required the use of the facilities for only 180 hours, we would see at the end of the month that on this particular center we had failed to absorb $10 of our expenses. We would have the same information for all other centers and, therefore, for the whole shop, and would know at the end of the month how much of the manufacturing facilities had not been used or had been used more than we expected, this information being available both in terms of hours and money. It is not, of course, expected that any manufacturer would absorb all of the difference between the amount of expense actually absorbed and the amount he expected to absorb, and to insure that all expenses are included in cost, a supplementary charge is made to each job to liquidate the amount of expense that has not actually been absorbed through the machine rates in use. This supplementary rate is a part of this system of expense distribution and is, in fact, a valuable factor because we know from the amount we add to the cost to absorb these supplemental charges, how far from normal the plant is running. In fact, one of the great benefits of this system is that the supplementary rate soon shows if machines are idle, because the expenses that would be absorbed by machines having work to do become, when these machines are not in use, a part of the supplementary charges, and the fluctuations in the monthly amounts liquidated by means of this charge show to a great extent the efficiency with which the facilities of the plant are being used. It will be evident that the machine-hour rate method permits of a very close knowledge and control of overhead expenses, and that by this system actual costs of each job can be obtained.

When comparing the way in which expenses are distributed by machine-rate costs with the distribution by means of any other method, it will be seen that, as far as accuracy is concerned, everything is in favor of the machine-rate method. All other methods of absorbing manufacturing expense depend in one way or another on averages, and yet there is no more reason for averaging the expenses over costs of all the work produced than there is for averaging the material items.

* * *

The report of a French commission states that the water power resources of France are calculated to be about 9,000,000 horsepower, and of this amount approximately 1,165,000 horsepower is being used. At present, equipment is being installed for obtaining an additional energy of about 500,000 horsepower. Plans are also being made for developing 3,000,000 horsepower additional in the next fifteen years.

RAPID DRILLING RECORDS

Whitman & Barnes "Hercules" high-speed twist drills established what is claimed to be the new world's production and penetration records in steel and cast iron at the Foundrymen's Convention, Columbus, Ohio, in October. The accompanying table gives the records attained, and indicates the excessive strains that these drills will withstand. The production record established by the 2-inch drill in drilling machine steel was made after 15 holes had been drilled through cast iron 3½ inches thick at 309 revolutions per minute with a feed of 0.096 inch per revolution. Therefore, with only one grinding this drill produced a total of 43 holes.

RAPID DRILLING DATA

Production Records

Size of Drill, Inches	R.P.M. of Drill	Feed per Rev., Inch	Penetration per Min., Inches	Thickness of Material, Inches	Time per Hole, Seconds	No. Holes Drilled per Grinding
Cast Iron						
1	665	0.096	63.8	3½	3¼	61
1⅛	309	0.060	18.5	4¼	13¾	303
Machine Steel						
2	157	0.045	7.1	3	25½	28
0.50 Per Cent Carbon Chrome-nickel Steel						
1	309	0.030	9.3	3	19 1/3	72

Penetration Records

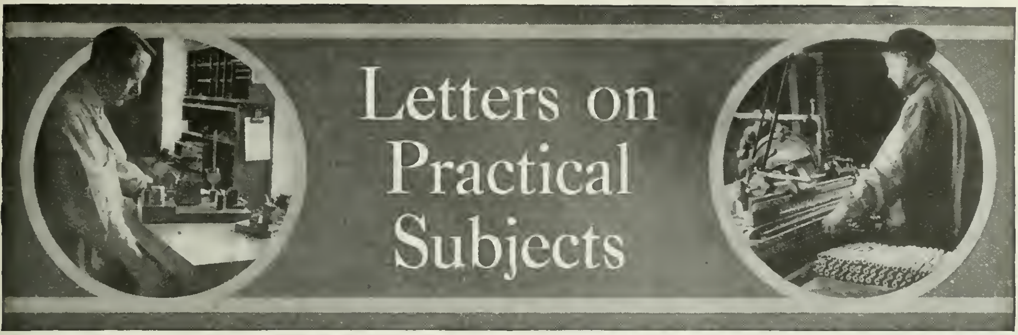
Size of Drill, Inches	R.P.M. of Drill	Feed per Rev., Inch	Penetration per Min., Inches	Size of Drill, Inches	R.P.M. of Drill	Feed per Rev., Inch	Penetration per Min., Inches
Cast Iron				Machine Steel			
⅞	873	0.096	83.8	1	665	0.060	39.9
1	873	0.096	83.8	1¼	442	0.060	26.5
2	597	0.096	57.3	1½	442	0.051	22.5

Machinery

* * *

IMPROVEMENT IN MOVEMENT OF FREIGHT

Encouraging evidence of the progress being made by the railroads in their efforts to speed up the movement of freight is found in a recent report of the Bureau of Railway Economics, which shows that the mileage made by the average freight car per day during the month of July was 26.1; this represented an increase of two miles per car per day over the corresponding month in 1919, and was the greatest mileage made since the month of October, 1919. For June the average was 25, and for each month of this year for which the figures have been compiled, there has been an improvement, both as compared with the preceding month and as compared with the corresponding month of last year, with the exception of April, when the switchmen's strike was at its height. An improvement of one mile in the average is equivalent to an addition of 100,000 cars to the freight equipment of the country. The report also shows that the average number of tons of freight per loaded car in July was 29.6, which was the greatest number for any month since December, 1918, when the average was 29.8 tons. For July, 1919 the average was 27.8 and for June of this year it was 29. These figures explain in part how the railroads have been able to handle the increased freight traffic in spite of inadequate facilities and labor difficulties.



Letters on Practical Subjects

LOCATING WORK FOR ACCURATE BORING ON MILLING MACHINES

It is often desirable to perform boring operations on milling machines, particularly on jig and fixture work where a high degree of accuracy is required. There is considerable variety in the methods which toolmakers employ on such machines for locating holes on finished and rough surfaces within the prescribed limits of accuracy. However, the writer has found the method here described the best and quickest that he has ever tried. This method gives accurate results, regardless of whether the milling machine is in a good or bad condition, the necessary adjustments of the work in both vertical and horizontal directions being made by an inside micrometer and several stops attached to the machine.

In order to locate the work horizontally, a stop is attached to the front of the table saddle and another is mounted on the front of the table. Then, when the machine has been set for finishing one hole, the distance between the two stops is measured by means of the micrometer. When it is necessary to adjust the table for machining another hole, the horizontal distance between the two holes is determined by calculation and this amount is either added or subtracted, as the case may be, from the distance to which the micrometer has previously been set. The micrometer is then reset to this new dimension, and the table shifted until the micrometer just fits between the two stops. Vertical settings of the work are obtained in a similar manner by using the micrometer between the top of the knee and a stop attached to the front of the column. A specific example will be presented to permit a clear understanding of the procedure.

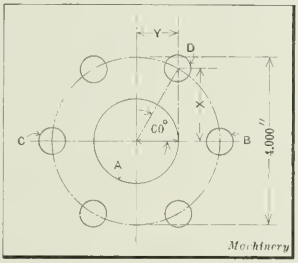


Fig. 1. Lay-out of Holes bored in Jig

Fig. 1 shows a lay-out of seven holes which were bored in a number of jigs of a certain type. Hole *A* was machined first, the other holes being located from it by the method outlined in the foregoing. Fig. 2 illustrates the method of locating the work horizontally for each of the holes. It will be seen that stop *A* is attached to the saddle and another stop *B* mounted on the table, while the inside micrometer *C* is shown in position between the two. When the table was set for boring hole *A*, Fig. 1, the reading of the micrometer was 11.668 inches. The next hole in the group to be bored was hole *B*, the distance between the center of this hole and that previously machined being 2 inches. Thus the micrometer was set to 13.668 inches and the table moved until the micrometer fitted between the two stops. In setting the table for boring hole *C*, the micrometer was set to 9.668 inches.

It is considerably more work to set the table for boring hole *D;* first it is necessary to calculate the horizontal and vertical distances between the center of this hole and that of hole *A*. Distance *Y* was calculated to be 1.000 inch, so that the micrometer was set to a dimension equivalent to 11.668 + 1 or 12.668 inches, and the horizontal setting of the table made as formerly. The distance *X* was calculated to be 1.732 inches which meant that the table had to be lowered that amount in order to bring the center of hole *D* in line with the spindle. Fig. 3 shows the application of the micrometer in this step of the operation, it being placed between the knee and stop *A* on the column. When hole *A*, Fig. 1, was being bored, the reading of the micrometer when placed between the knee and this stop, was 14.252 inches. Therefore, in locating the work for boring hole *D*, the micrometer was set to 14.252 + 1.732 or 15.984 inches, and the knee lowered until the micrometer fitted between it and the stop.

It is unnecessary to describe in detail the procedure followed in boring the remaining holes, as this should be apparent from the foregoing. Fig. 4 shows four jigs which

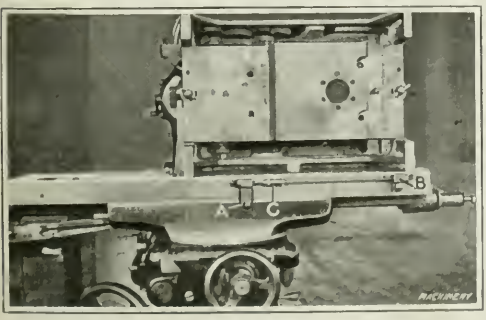


Fig. 2. Application of Inside Micrometer and Stops for locating Work horizontally

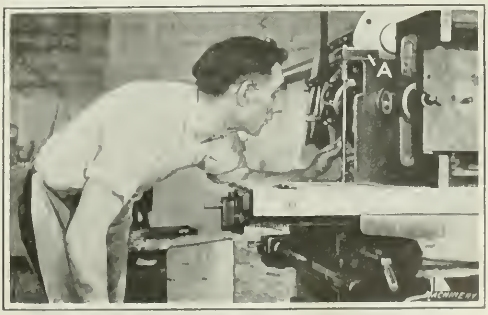


Fig. 3. Method followed in adjusting Table vertically for boring Holes in Work

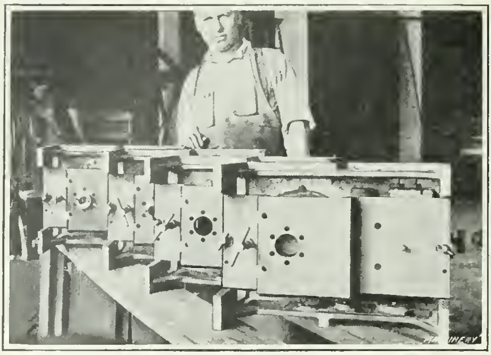


Fig. 4. Four Jigs having Holes machined within Tolerances of 0.0005 Inch by the Method described

were machined by the method described in the foregoing. The holes that were bored in these jigs were located within tolerances of 0.0005 inch.

Pittsburg, Pa. JOSEPH BOLKOVAC

A CASE OF FALSE ECONOMY

The writer recently observed an incident which occasioned surprise as to the readiness with which men jump at conclusions when endeavoring to reduce operating costs. Many inaugurate systems which apparently result in increased production, but which really produce the opposite effect. The following incident will serve to make this statement clear. One of the jobs in a certain shop consisted of punching broad flat stock wound on reels. Two operations were required to complete the work. In the first operation the stock was fed through a punch press and wound on another reel, the operation being automatic. The stock was then fed through a second press and again wound on a reel. This method was followed until one of the workmen hit upon an idea which was readily approved by the management.

The two presses were then placed in alignment and operated at the same number of revolutions per minute so that the stock could be fed through the first press and then fed directly through the second press without necessitating the winding of the material on another reel. It was generally believed in the shop that this method produced a considerable saving. On first thought this might seem true, but the operating costs were actually increased instead of being decreased.

In the first place, all the adjustments needed on the presses and the setting of the dies for each job were made by the foreman of the department, because the services of a skilled workman were necessary for this work. Besides this, two operators were still required for the presses. It took fifteen minutes to set up each press, and under the new system the first press, after having been set up, had to stand idle while the second press was being set up. Thus, there was a dead loss of fifteen minutes over the old system, in which one of the presses would be working while the other was being set up. During operation, a five-minute shutdown was required every hour on each press to permit adjustments to be made. Again, both presses were idle when an adjustment was being made on either of them. Thus, the time lost in making adjustments was twice that obtained when the two presses were operated independently, and so there was a dead loss of ten minutes per hour over the old system. Therefore, it will be seen that the loss over the old system amounted to fifteen minutes for setting up the machines for each job and ten minutes per hour during the performance of the operation.

The advantage of the old system over the new was, of course, due to the fact that one of the presses would continue running when the other was stopped. The fact that the two presses were operated simultaneously on the same job was perhaps responsible for the illusion that a saving would be realized by the new system, it being overlooked that the cost of operating two presses for one-half hour would be the same as the cost of operating one press for one hour. The disadvantages of the new system soon became apparent.

Philadelphia, Pa. R. H. KASPER

GRINDING-WHEEL SPINDLES

Grinding-wheel spindles such as are employed for ordinary grinding operations are usually unsuited for the various precision grinding operations required in the manufacture of ball bearings. For instance, the grinding-wheel spindle of an oscillating grinding machine used for finish-grinding ball races generally runs at a higher speed than that of an ordinary surface or cylindrical grinder, and at the same time must be so designed that all end thrust will be effectively taken up. The oscillatory motion imparted to the work produces an end thrust on the spindle, first in one direction and then in the other, due to the reversal of the direction of feed which takes place at each end of the stroke. The provision of suitable means for taking up the end thrust is therefore quite a problem in itself. Spindles of various designs have been developed and considerable time has been devoted to the study of this subject by the designers of ball-bearing manufacturing concerns.

The writer has made a personal study of the subject and although nothing new is claimed for the two designs here illustrated, which are the result of his efforts, they are offered as two examples of spindles which have given satisfactory results. No advantage is claimed for one type of spindle over the other. In Fig. 1 is shown one method of designing the wheel-spindle. In this case the spindle is made very heavy in order to prevent chattering. The end thrust on the spindle is taken up by the ball bearings at the ends. If the spindle were made light in weight, or about the same diameter throughout its length, as is generally the case, the high speed of rotation in combination with the thrust resulting from the reversal of the feed stroke would set up a certain amount of vibration which would be detrimental to the quality of finish required in the ball race of a high-grade bearing.

Spindle *D* is made of machine steel, casehardened on the ends, and ground all over. The ball race is also ground as a part of the spindle to insure a higher degree of concentricity than could be obtained by mounting an ordinary ball bearing on the spindle. The balls for the bearing are carefully selected, and the cups at the ends that support the spindle are made of tool steel, and are hardened and ground all over. The cups are a push fit in housing *A* and are adjusted by means of nuts *B* and set by means of screws *C*. The housing is made of cast iron, machined all over, and mounted in the spindle head.

In Fig. 2 is shown another type of spindle. A few more parts are required in the mounting of this spindle, and the

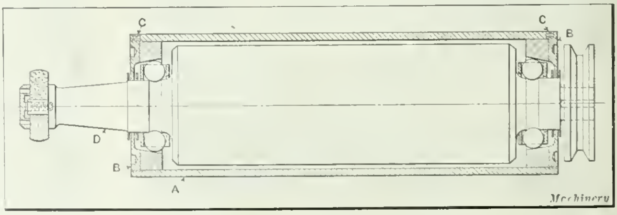


Fig. 1. Grinding-wheel Spindle equipped with Ball Bearings

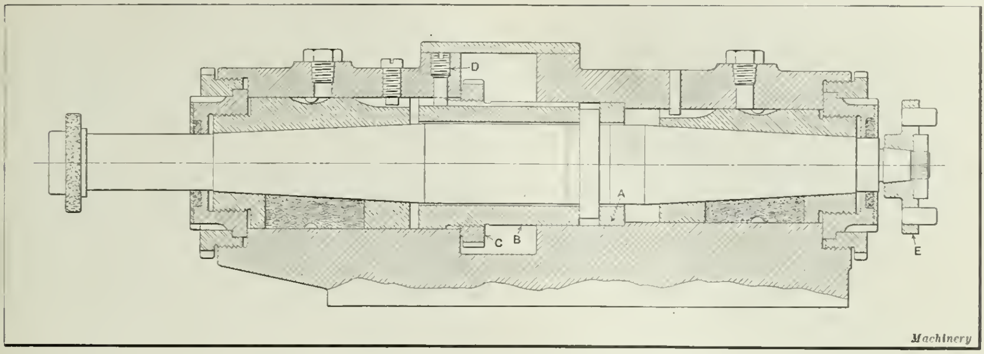


Fig. 2. Grinding-wheel Spindle equipped with Adjustable Taper Bearings

cost of making it is therefore greater. From the illustration it will be seen that the end thrust of the wheel is taken up by washer *A* and screw bushing *B*, which can be adjusted by nut *C* and locked by screw *D*. The end bearings and journals are tapered so that the bearings can be adjusted for wear without employing the usual split bushing. The objection to a split bushing is that it seems to have a tendency to warp when the spindle becomes slightly overheated, resulting in an increase in friction.

New York City **Charles Ruiz**

ATTACHMENT FOR MACHINIST'S SCALE

A scale provided with an attachment that makes it suitable for use as an inside caliper in measuring the diameter of large holes is shown in the illustration. The attachment can be placed on a scale of any length and of various widths, clamp *A* being adjustable to suit the width of the scale. It will be noted that the over-all length of the attachment is 6 inches, and so in order to determine the distance from the measuring end of the attachment to the opposite end of the scale, it is only necessary to add that amount to the distance that the scale projects past the attached end of the device. Thus, in the illustration, the distance between the extreme ends of the attachment and scale is 8 inches. In setting the device for measuring a hole of a certain size, screw *B* is loosened until clamp *A* has been withdrawn sufficiently from the scale to permit it to be slid easily along the device. After the scale has been moved to the proper setting, it is clamped in place by again tightening screw *B*. The end of this screw in the clamp is provided with a groove into which extends a pin driven in a hole in the clamp and thus secures the clamp to the screw.

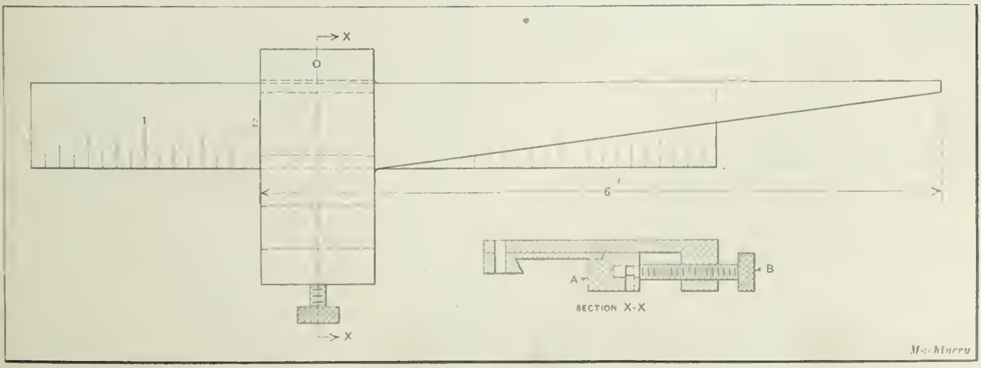
This tool is not so cumbersome as many types of inside calipers and after being set does not need to be handled with the care that large calipers require in order that their settings will not become altered. Accurate measurements can be taken, because the width of the scale causes the user to place it in the hole in the proper manner. It is obvious that the combined scale and attachment can also be used as a depth gage.

Montreal, Canada **Harry Moore**

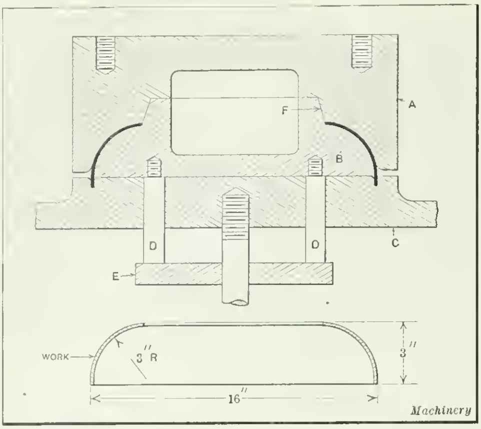
DIE FOR CURLING STOVE RINGS

Circular rings, such as are mounted on the tops of some stoves of the heater type for ornamental purposes, are bent or curled by means of the punch and die shown in the accompanying illustration. These rings are formed from flat steel strips $3\frac{5}{8}$ inches wide and 0.065 inch thick, which are cut to the proper length. A drawing of a completed ring, giving adequate dimensions to convey an idea of its size, is shown beneath the die. The strip from which a ring is formed is first rolled so that the ends may be butted together or spot-welded and then ground to a uniform thickness. This produces a circular band, and the only function of the punch and die is to curl over the band as shown. Punch *A* and die parts *B* and *C* are made of cast iron, the punch and part *B* being cored out at the center to reduce their weight. It will be noted that the punch is not provided with a shank, as it is used on a large press and is attached to the end of the ram by machine screws.

On each return stroke of the punch, the curling die *B* is raised a distance of about $2\frac{7}{8}$ inches by means of pins *D* and plate *E*, which is actuated by a rubber buffer. A band of strip metal is then slipped over the curling die and placed in the groove on the top surface of die-block *C*, the lower surface of die *B* being about $\frac{1}{2}$ inch beneath the top edge of the band. Then, on the downward stroke of the press ram, the punch descends until the tapered surface in the



Scale provided with Attachment permitting it to be used as an Inside Caliper or as a Depth Gage



Punch and Die for producing Ornamental Rings for Stove Tops

opening of the punch makes contact with a corresponding surface on the curling die as shown at *F*, after which the two parts descend together and curl the ring as indicated.

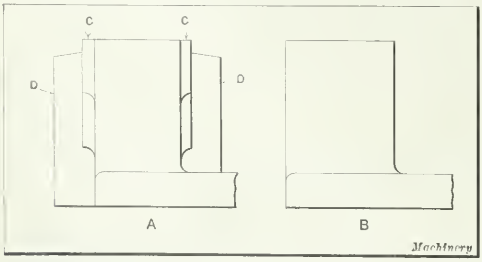
The pressure exerted by the buffer beneath plate *E* is sufficient to hold die *B* well against the punch during the downward stroke so that the metal of the ring is held to the desired thickness and the ring is properly formed. The top of the space between the punch *A* and die *B*, in which the ring becomes curled, is about 0.025 inch wider than the remainder of the space. This is for the purpose of allowing the ring to thicken slightly at the upper end. The die construction under consideration renders efficient service, and many dies for forming various sizes of rings have been built along this line. An important point to be remembered in constructing dies of this type is that the tapered surfaces of the punch and die must fit well together so that there is no chance for the metal to creep between them.

Toledo, Ohio J. Bingham

DESIGNING CASTINGS FOR ECONOMICAL PATTERNMAKING AND MOLDING

Bearings cast integral on machine tool parts usually consist of a lug having a boss on one or both sides which is finished if any other part comes in contact with it. This is considered good designing practice, as a casting so built has a good appearance. However, when a machine is to be constructed as cheaply as possible, or when a part is only to be used temporarily, the appearance of the part is usually not a vital factor, and in such cases the lugs should be designed without bosses.

The illustration at *A* shows the construction of a pattern when bosses are to be cast on a bearing. Loose pieces *C* are necessary to form the bosses in the mold; otherwise the mold would be destroyed when the pattern is withdrawn. These loose pieces are held in place by dowel-pins (not shown in the illustration). They are extracted by drawing them in and up through the mold, after the main pattern has been removed. When the drawing indicates that the hole through the bearing is to be cored, it is necessary to provide core-prints *D* to form pockets in the mold for supporting the required core. Unless the hole is large in diameter, it should not be cored, as unnecessary expense is involved in making the pattern and in molding the casting, and the machining operations are frequently made more difficult on account of the cored hole. When the hole does not need to be cored and when bosses are not required for appearance, the pattern can be built as shown at *B*. This construction permits a cheap pattern to be made and facilitates molding. The length of the bearing should be sufficient to allow the faces to be finished to the correct dimension.

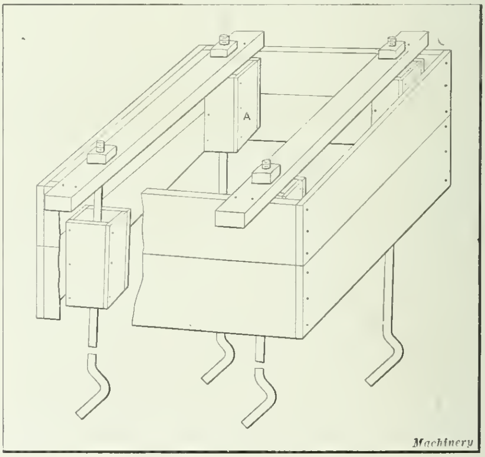


Two Methods of making Patterns for molding Bearings to be cast Integral with Part

Kenosha, Wis. M. E. Dugoan

BOLTS FOR SECURING MACHINES TO CONCRETE FOUNDATIONS

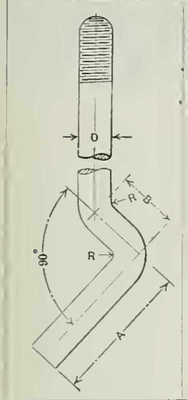
Foundation or anchor bolts for fastening heavy machines to concrete foundations usually project a considerable distance above the floor line, and it is desirable to have them hang truly vertical in the hole provided for the foundation, before the concrete is poured. The illustration in the accompanying table shows a type of bolt which has proved satisfactory, its design permitting it to be readily forged and at the same time giving it good holding power. The table also gives the dimensions of the end of the bolt which is embedded in the concrete, for various sizes of stock.



Method of locating and holding Foundation Bolts in Place

The accompanying illustration shows the method of placing the bolts in the foundation hole, wooden strips being laid across the top of the concrete form for the purpose. These strips are provided with properly located holes through which the threaded ends of the bolts are inserted and from which they are kept from falling by means of nuts screwed on them. Obviously, the distance the bolts must project above the floor after the foundation has been completed, can be regulated by adjusting the position of the nuts. It is customary to provide pockets around the bolts near the top of the foundation so that the bolts can be bent sufficiently to permit them to enter the holes in the base of the machine when either the bolts or the holes are inaccurately spaced. These pockets can be formed by placing square sections made of light boards around the bolts as shown at *A*, the boards being sawed in such a manner that the grain in each of them will run in a vertical direction when they are nailed together.

DIMENSIONS OF FOUNDATION BOLTS IN INCHES



D	A	B	R
⅝	2⅞	1¼	5/32
¾	3 7/16	1½	3/16
⅞	4	1¾	7/32
1	4⅝	2	¼
1⅛	5 3/16	2¼	9/32
1¼	5¾	2½	5/16
1⅜	6 5/16	2¾	11/32
1½	6⅞	3	⅜
1¾	8 1/16	3½	7/16
2	9 3/16	4	½
2¼	10 5/16	4½	9/16
2½	11½	5	⅝
2¾	12⅝	5½	11/16
3	13 13/16	6	¾
3½	16 1/16	7	⅞
4	18⅜	8	1

Machinery

The sections do not require bottoms and can be nailed to the strips which support the foundation bolts. They can be easily removed when the concrete has hardened, and the pockets produced can be filled with a grouting mixture after the machine has been set in place.

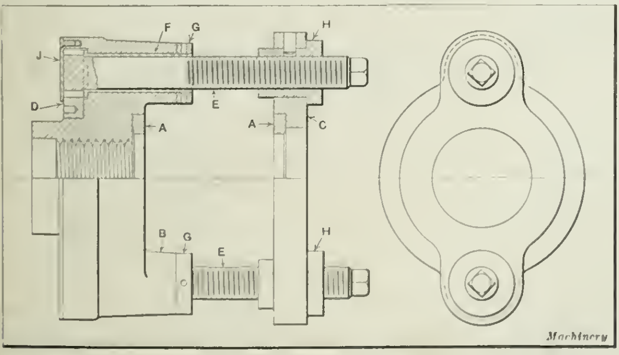
Watervliet, N. Y. M. H. Ball

CHUCK FOR INTERNAL GRINDING

A device permitting the rapid and accurate chucking of such work as bushings, circular cutters, hobs, etc., for internal grinding, is here illustrated. The ends of the part to be ground are located in the two hardened steel rings *A* that fit snugly into counterbored holes in the cast-iron body *B* and the movable yoke *C*. Body *B* is mounted on the spindle of the grinding machine, and is provided with a machined hub upon which a hardened ring gear *D* is fitted. The teeth of this gear mesh with the teeth of the pinions cut on the left-hand ends of screws *E*. Each of these screws rotates in a long tool-steel bushing *F* which is secured in place by means of nut *G*. Yoke *C* is provided with two hardened nuts *H* which are pinned to the yoke and are threaded to fit screws *E*. The chuck is operated by inserting the pins of a special wrench into holes in the face of gear *D* and then revolving the wrench slightly. This action turns the two screws in unison, and causes the nut and yoke to be moved either forward or backward, according to the direction in which the wrench is applied.

Proper care must be taken in assembling to adjust the nuts so that both ends of the yoke are equidistant from the body of the chuck. The holes in rings *A* are ground to a slight taper to take care of small variations in the diameter of the work, and the rings are under-cut on their inside faces to indicate which face is the inner one and to facilitate the removal of the ring in the counterbored hole in the body of the chuck. Screws *E* have square ends at the right so that they can be turned rapidly by means of a wrench when desiring to change the position of the yoke to suit longer or shorter work. A canvas cover is placed over the screws to prevent dirt or grinding dust from getting on them. The teeth of the pinions and ring gear are also completely covered by means of plate *J* which is screwed on the back of body *B*.

Chicago, Ill. Ralph R. Weddell



Chuck Suitable for Internal Grinding of Bushings, Cutters, Hobs, etc., which permits Rapid and Accurate Insertion and Removal of the Work

DETERMINING HEIGHT OF ARC WHEN MILLING KEYWAYS

When milling keyways it is often desirable to know the total depth from the outside of the shaft to the bottom of the keyway. With this depth known, the cutter can be fed down to the required depth without taking any measurements other than that indicated by the feed graduations on the machine. In order to determine the total depth, it is necessary to calculate the height of the arc, which is designated as dimension *A* in the accompanying illustration.

The formula usually employed to determine *A* for a given diameter of shaft *D* and width of key *W* is

$$A = \frac{D}{2} - \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{W}{2}\right)^2}$$

The values of *A* for shafts and keys of ordinary size, are given on page 499 in Machinery's Handbook. However, it sometimes happens that use is made of keyways or shafts of unusual size which are not included in the table, and in such cases the writer has found the following method of determining dimension *A* much simpler than the one first given. Using a table of trigonometric functions as arranged in Machinery's Handbook, the method is to apply the formula

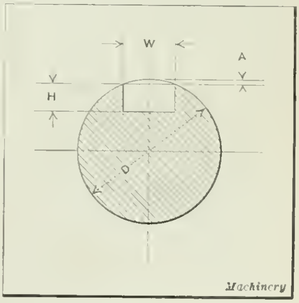


Diagram illustrating Method of determining Total Depth of Keyways

$$A = \frac{D}{2} \times \text{versed sine of an angle whose cosecant} = \frac{D}{W}.$$

To illustrate the application of this formula, let it be required to find the height *A* when the shaft diameter *D* is ⅞ inch and the width *W* of the key is 7/32 inch. Then,

$$\frac{D}{W} = \frac{7/8}{7/32} = \frac{7}{8} \times \frac{32}{7} = 4$$

Now in a table of trigonometric functions, locate the value nearest 4 in the column headed "Cosecants," which is 3.9984. Next, in the column headed "Versed Sine," and on the same line with this cosecant, find the value 0.03178.

Then,

$$A = \frac{D}{2} \times 0.03178$$

$$= \frac{7 \times 0.03178}{8 \times 2} = 0.0139 \text{ inch}$$

The total depth of the keyway equals dimension *H* plus 0.0139 inch.

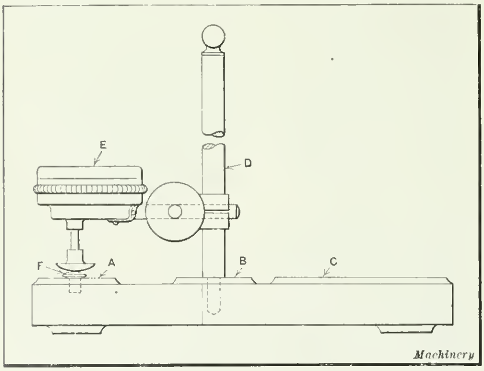
Anderson, Ind. C. W. Mapes

SHOP AND DRAFTING-ROOM KINKS

STAND FOR DIAL TEST INDICATOR

A dial test indicator makes a convenient thickness gage for sheet metal, wire, paper, etc., when clamped to a surface plate, so that the pieces to be gaged may be quickly slipped under the contact point and the readings taken direct. The accompanying illustration shows a stand especially constructed for a Starrett indicator which permits the dial indicator to be instantly removed for use elsewhere, if required. It consists of a cast-iron base with three feet cast on the bottom to form a steady three-point bearing. Three bosses, *A*, *B*, and *C* are cast on the top surface; boss *C* is rectangular and is given a surface-plate finish. The middle boss *B* is circular and serves as an insertion point for the vertical column *D* which supports the dial *E*. Boss *A* is circular and is drilled either to take one of the extra contact points *F*, sent with the indicator outfit, or a steel bearing ball about 1/4 inch in diameter. The steel column sent out with the indicator may be screwed into the base, but if a special one is made to serve permanently, the other may be used with the dial when it is required elsewhere.

In use, the dial may be set at any required height above the surface of boss *C* and swung around from the large boss over to the contact point *F* set in boss *A*. Wires and various other pieces may be gaged between the two points, while sheets of metal or paper can usually be gaged more easily by placing them on the surface of boss *C*. The apparatus may also be used as a limit gage by setting the dial to zero with a standard piece in place. The amount the parts vary in thickness below or above the standard may then be read off as they are pushed under the dial.

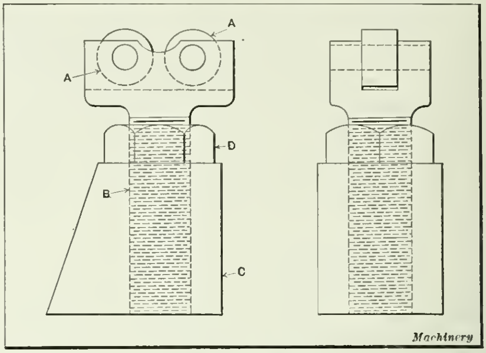


Stand with Surface Plate and Point Contact for Use with Dial Test Indicator

Oakland, Cal. H. H. PARKER

ROLLER JACK FOR MILLING MACHINES

A screw jack having two rollers for supporting the work, which is especially suited for use on milling machines in connection with an indexing head, is shown in the accompanying illustration. The rollers *A* upon which the work rests are a loose fit on two pins which are driven into holes through the forked end of screw *B*. Base *C* is tapped to suit the screw, so that the distance from the bottom of the base to the top of the rollers can be adjusted to suit the work by revolving the screw. Nut *D* is screwed tight against the top of the base to prevent the screw from turning after the rollers have been set.



Screw Jack with Rollers for supporting the Work Suitable for Use on Milling Machines

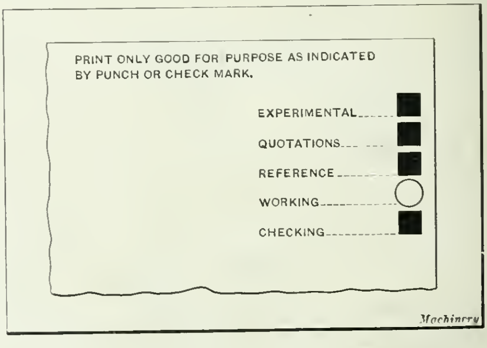
As this jack has two supporting points, it cannot tilt and throw the work out of position. The work is also better supported, and there is less chatter while it is being rotated. It is advisable to place a piece of paper between the work and the rollers to eliminate the danger of chips coming between them. The rollers are 9/16 inch in diameter and 3/8 inch thick, while screw *B* is 5/8 inch in diameter and has 18 U. S. form threads per inch. The rollers and screw are made of machine steel and are casehardened.

Los Angeles, Cal. E. F. TUTTLE, JR.

MARKING BLUEPRINTS TO INDICATE THEIR USE

It is customary in many drawing-rooms to employ rubber stamps for the purpose of marking blueprints so that the use for which they are intended may be readily understood. A better method of marking, which is utilized on standard tracings that have the title and border lines printed on the back, is to have a set of instructions also printed on the back at the same time and in the upper left-hand corner, as shown in the illustration. The purpose of the print is indicated by punching out the solid square opposite the word describing the purpose. Sometimes the same print can be used more than once; it may first be desired for experimental purposes, and when the part is ready for production, the print may be punched as a working drawing.

Warren, Ohio C. C. SPREEN



PRINT ONLY GOOD FOR PURPOSE AS INDICATED
BY PUNCH OR CHECK MARK.

EXPERIMENTAL ■
QUOTATIONS ■
REFERENCE ■
WORKING ○
CHECKING ■

Instructions printed on Tracing Cloth to indicate Use to which Print is to be put

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

CALCULATING THE OUTER RADIUS OF A HOLLOW SPHERE

C. E. B.—If the shell of a hollow iron ball is 4 inches thick, and contains one-fifth the cubical contents of the whole ball, how can the outer radius of the ball be found?

A.—Let R be the outer radius of the ball; then $R - 4$ will be the radius of the hollow sphere enclosed by the shell. As the volume of a sphere is proportional to the cube of its radius, the conditions of the problem are given by the equation:

$$R^3 - (R - 4)^2 = 1/5\ R^3$$

or

$$4/5\ R^3 = (R - 4)^3$$

Extracting the cube root, transposing, and combining,

$$R = \frac{4}{1 - \sqrt[3]{4/5}}$$

Since 4/5 = 8/10 and 8 is a perfect cube, the above equation may be written

$$R = \frac{4\sqrt[3]{10}}{\sqrt[3]{10} - 2}$$

By reference to a table of cube roots the proper values can be easily ascertained, and then, by working out the formula, it will be found that $R = 55.80$ inches. W. W. J.

A GEOMETRICAL PROBLEM

H. K. D.—Will you please show how to find the radius x from the dimensions given in Fig. 1?

A.—From Fig. 1 we have the conditions shown in Fig. 2, from which the value of x can be found as follows:

In triangle ABC

$$\text{Cos } B = \frac{a^2 + c^2 - b^2}{2ac} \qquad (1)$$

In triangle OBC

$$\text{Cos } B = \frac{a^2 + m^2 - h^2}{2am} \qquad (2)$$

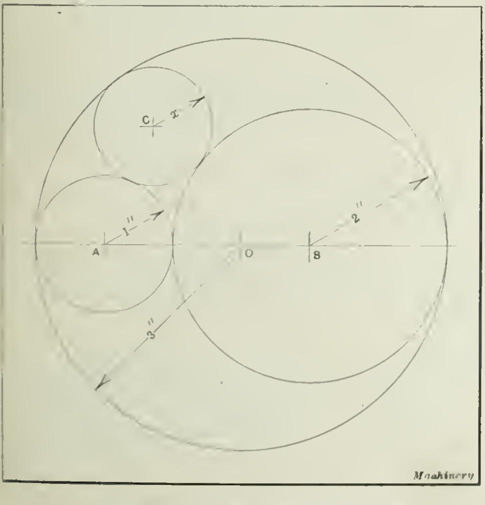


Fig. 1. Problem in which Dimension x is required

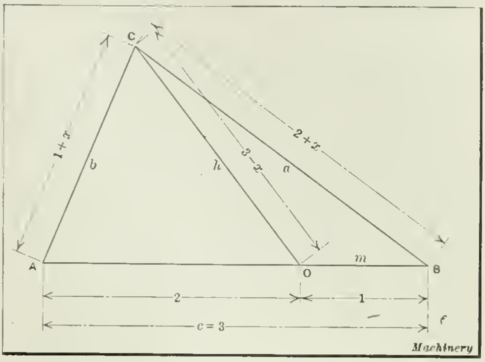


Fig. 2. Diagram illustrating Method of finding x Fig. 1

From (1) and (2) by comparison

$$m(a^2 + c^2 - b^2) = c(a^2 + m^2 - h^2)$$

or

$$m[a^2 + (c + b)(c - b)] = c[a^2 + (m + h)(m - h)] \qquad (3)$$

Let $a = 2 + x$, $b = 1 + x$, $c = 3$, $h = 3 - x$, and $m = 1$.

Then

$$1[(2 + x)^2 + (4 + x)(2 - x)] =$$
$$3[(2 + x)^2 + (4 - x)(x - 2)]$$
$$12 + 2x = 3(10x - 4) \text{ or } 28x = 24$$
$$x = \frac{6}{7} = 0.857 \text{ inch}$$

W. W. J.

A MATHEMATICAL PROBLEM

P. P. H.—Referring to the accompanying diagram, can someone show how to find the distances x, x_1, y, and y_1, when $b = 1\frac{1}{4}$ inches, $r = 2\frac{1}{2}$ inches, and angle $P = 15$ degrees?

A.—Let O-X and O-Y be the axes of rectangular coordinates with O as the center. Then by analytical geometry, the equation of the line AC is,

$$x = y \tan P + b \qquad (1)$$

The value x_1 can be determined by substituting y_1 for y in this equation. Considering x as one-half the chord of a circle,

$$x = \sqrt{2ry - y^2} \qquad (2)$$

Since line AC and the circle intersect at B and C, they have common coordinates for the point of intersection, and the values of x may be equated as follows:

$$y \tan P + b = \sqrt{2ry - y^2}$$

By squaring, transposing and collecting terms, we get

$$y^2(1 + \tan^2 P) - 2(r - b \tan P)y + b^2 = 0 \qquad (3)$$

But, as $1 + \tan^2 P = \sec^2 P$, Equation (3) may be written,

$$y^2 \sec^2 P - 2(r - b \tan P)y + b^2 = 0$$

Solving this quadratic equation for y,

$$y = \frac{r - b \tan P}{\sec^2 P} \pm \frac{\sqrt{(r - b \tan P + b \sec P)(r - b \tan P - b \sec P)}}{\sec^2 P} \qquad (4)$$

This equation gives two values for y; when it is used with the minus sign before the radical, the value for y is obtained, but when the plus sign is used, the value of y_1 is obtained.

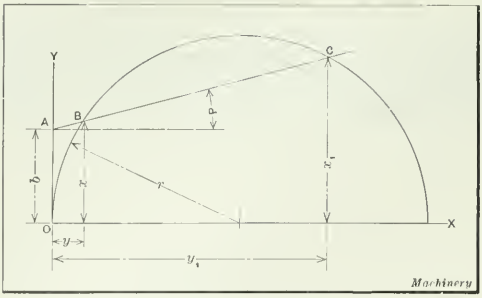


Diagram used in Solution of Mathematical Problem

Having found y and y_1, then x and x_1 may be found from Equation (1). Inserting the values of b, r, and P in Equation (4) and solving,

$$y = 0.4005 \text{ inch, and } y_1 = 3.6395 \text{ inches}$$

Substituting these values in Equation (1) and solving,

$$x = 1.3573 \text{ inches, and } x_1 = 2.2252 \text{ inches.}$$

W. W. J.

MATHEMATICAL PROBLEM

W. A. H.—Referring to the accompanying diagram, it is desired to find angle x when the lengths of lines E and D and the radius R are known.

ANSWERED BY HENRY DENOTTER, MUSKEGON, MICH.

Erect a perpendicular at F passing through point C, from which the arc is struck, and construct AB parallel with E, extending it to intersect the perpendicular. In the triangle ABC, side $AB = E$; and side $BC = D - R$

Therefore

$$AC = \sqrt{E^2 + (D - R)^2}$$

Then

$$\text{Tan } a = \frac{BC}{AB} = \frac{D - R}{E}$$

$$\text{Sin } b = \frac{R}{AC} = \frac{R}{\sqrt{E^2 + (D - R)^2}}$$

$$c = 90 \text{ degrees} - (a + b)$$

Hence,

$$x = 180 \text{ degrees} - (90 \text{ degrees} + c)$$

Example: If $D = 3.75$ inches, $R = 2.50$ inches, and $E = 5$ inches, then

$$\text{Tan } a = \frac{3.75 - 2.5}{5} = 0.25$$

$$a = 14 \text{ degrees } 2 \text{ minutes}$$

$$\text{Sin } b = \frac{2.5}{\sqrt{5^2 + (3.75 - 2.5)^2}} = 0.48507$$

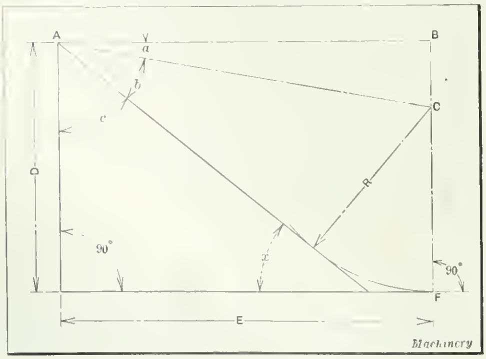


Diagram used in Solution of Mathematical Problem

$$b = 29 \text{ degrees } 1 \text{ minute}$$

$$c = 90 \text{ deg.} - (14 \text{ deg. } 2 \text{ min.} + 29 \text{ deg. } 1 \text{ min.}) = 46 \text{ degrees } 57 \text{ minutes}$$

Therefore,

$$x = 180 \text{ deg.} - (90 \text{ deg.} + 46 \text{ deg. } 57 \text{ min.}) = 43 \text{ degrees } 3 \text{ minutes}$$

DETERMINING THE CENTER OF GRAVITY OF AN ODD SECTION

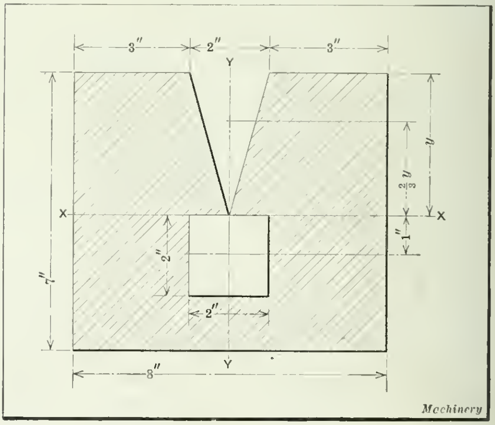
L. E. S.—Referring to the accompanying illustration, can anyone give an algebraic equation for finding the required depth of the V-notch so that its point and the upper edge of the square hole will lie on line X–X passing through the center of gravity of the section.

A.—A formula for determining the desired dimension y was evolved by the writer in the following manner: First, divide the section into elementary rectangles and triangles, the areas and centers of gravity of which can easily be found. The center of gravity of the triangle which forms the V-notch is two-thirds the length of the perpendicular distance y from axis X–X. Then, since the section is symmetrical about axis Y–Y, and the center of gravity lies on axis X–X, the center of gravity will be at the point of the V-notch, and the algebraic sum of the moments of the elementary areas about axis X–X will be equal.

Thus,

$$(8y)\left(\frac{y}{2}\right) - \left(\frac{2y}{2}\right)\left(\frac{2}{3}\,y\right) = 8\,(7 - y)\left(\frac{7-y}{2}\right) - (1 \times 4)$$

Clearing of fractions and combining terms, the following quadratic equation is obtained:



Section having the Point of the V-notch and Upper Edge of the Hole along an Axis through the Center of Gravity

$$y^2 - 84y + 288 = 0$$

which may be written

$$y^2 - 2(42)y + 288 = 0$$

Solving this quadratic equation,

$$y = 42 \pm 6\sqrt{41}$$

Using the equation with the minus sign before the radical, $y = 42 - 38.419 = 3.581$ inches, which is the depth of the V-notch.

W. W. J.

* * *

When repairs are being made on a machine, all possibility of the machine being started without the knowledge of the person making the repairs should be eliminated. One method of doing this is to lock the switch, clutch, valve, starting lever, or other starting device by means of a padlock and short piece of chain or rope. Similarly, all inlet control valves of boilers, gas tanks, acid vats, etc., should be locked when it is necessary for a man to enter them.

Electro-deposition of Iron in Automobile Repair Work

BY a process developed in England during the war, it is possible to deposit a layer of iron up to approximately 0.08 inch in thickness on any simple cylindrical surface of wrought iron or steel. The process was described by B. H. Thomas before the British Institution of Automobile Engineers. If properly done, the layer deposited is firmly adherent, and it is practically impossible to chip it away from the basic metal with hammer and chisel. It is deposited directly on the surface without coppering first, and can be subjected to red heat without apparent deterioration. It can be carburized and hardened in the ordinary way, and when thus treated under favorable conditions, it appears to associate itself so closely with the basic material that the dividing line shown in photomicrographs of the untreated deposit passes away. The layer presents an extremely smooth surface, and the thickness deposited in a given time can be predicted with considerable accuracy.

The layer can be filed or ground and takes a high finish. Its wearing qualities are perfectly satisfactory on such parts as the ends of brake and clutch shafts which wear considerably in their brackets, and there is no obvious reason why the process would not be satisfactory for building up worn journals. Its chief limitation has been the inability to deposit satisfactorily on such materials as cast iron or aluminum. This is regrettable, because if it were possible to deposit an adherent coating of iron on such parts as worn ball-race housings in gear-boxes, the scope and usefulness of the process would be greatly increased. It is possible to deposit copper on aluminum parts, but such deposits are never permanently adherent. The practice of putting on a copper deposit which will not adhere is not worth while, as the same end is achieved more easily by simply coppering the outside of the ball races where necessary. This has the disadvantage of rendering such parts non-standard, but in many cases it is the only way of saving a part, and is preferable to tinning or knurling.

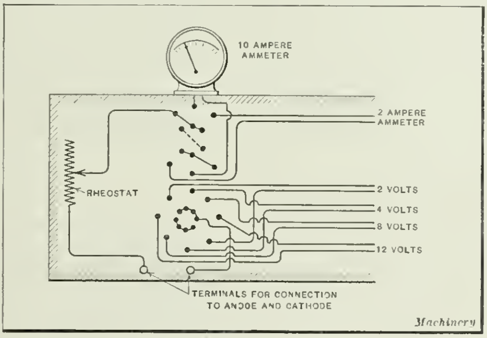


Diagram showing the Electric Wiring of a Depositing Bench

Types of Work Built up by Electro-deposition

Over 6000 parts have been reclaimed by the process to be described, some of which are as follows: Steering spindles on front axles; steering-spindle pins; brake and clutch shaft ends; gear-shift lever shafts; wheel hubs, where the housings have worn loose on the ball races; various shafts, on which ball races are required to fit, including magneto armature shafts; tubular axles, where worn in the saddle brackets; and universal joint pins. In many cases an automobile that has had parts reclaimed in this manner has been returned to the shops after a sufficient period of use to make a complete overhaul again necessary, and it has been possible to examine the wear of deposits under severe conditions. Such examinations have shown that the deposited parts stand up well in service.

The following is a list of the equipment contained in an actual electro-deposition shop in England: Depositing benches: Two double benches, having batteries of 12 vats per side, giving a total of 48 vats; and one bench with a large separate vat for simple repetition work, such as quantities of pins and bushings. Machine tools: One universal internal and external grinder; one thread-cutting lathe having a distance of 6 inches between centers; one polishing machine; and one electric drill. Miscellaneous: One earthenware sink with drain; two large cleaning vats fitted for electrolytic cleaning; one extra large vat for decantation of the iron solution; two steam-heated wax containers; one set of fine chemists' scales; one set of graduated beakers; one burette for titration; one set of internal and external micrometers; three ¼-horsepower electric motors for rocking anodes; one set of accumulators coupled in groups for 12, 8, 4, and 2 volts, and arranged for charging; and instrument boards, rheostats, vises, small tools, etc.

Details of Depositing Bench

The essential parts of a depositing bench are as follows. A double-pole four-way switch, for obtaining currents of 2, 4, 8, and 12 volts; a double-pole three-way switch for supplying current to the bath, through a 2- or a 10-ampere ammeter; an adjustable rheostat; a clock face for recording the hour when work is put on or taken off; plugs and sockets for recording the day that work is put on or taken off; an ammeter; a cross-shaft carrying rocker arms with anodes; an adjustable holder for the work; a wooden depositing vat, pitch lined; and terminals for connecting to the bath. The cross-shaft receives its motion through an eccentric driven by means of a ¼-horsepower electric motor and reduction gearing. The accompanying illustration shows diagrammatically the wiring of a depositing bench.

Cleaning and Preparing Work for Operation

It should be understood clearly that the process to be described refers to direct deposition; that is, without any intermediate copper coating. It was found essential to provide means for keeping the shop at a reasonably even temperature, as otherwise in cold weather the deposits became brittle and would not adhere. Therefore, a steam heating system was installed and kept in operation night and day when necessary. The efficient cleaning of the work is naturally of the highest importance, and is, indeed, almost the crux of the whole process.

This cleaning may be divided into seven stages: (1) The work is washed by gasoline to remove the coating of oil or grease that it usually has when brought to the shop. (2) The work is boiled in a caustic soda solution consisting of 1¾ avoirdupois ounces of caustic soda, 1¾ ounces of washing soda, and about 1 quart of water. The temperature of this bath is approximately 194 degrees F. This operation takes about twelve hours. Attempts to improve the action of the bath by making it electrolytic were inconclusive. (3) After rinsing off the caustic soda, the work is cleaned as thoroughly as possible by means of scratch brushes. The portions not to be deposited on, are waxed after this step. (4) The work is again washed with gasoline after which, if it cannot be passed straight to the depositing bench, it is covered with a protecting coat of organic grease consisting of 50 per cent tallow and 50 per cent linseed oil. (5) After wiping off the grease put on the work in the preceding step, it is made the cathode in another soda bath similar to that used in the second step, but at the normal room temperature. A current of 30 to 50 amperes is applied for three minutes, using a sheet-iron anode. The fluid film left on the work after this operation should not be permitted to dry; the work should be washed in running water and put through the next step. (6) The work is made the anode in an electrolytic acid bath consisting of 25 per cent sulphuric acid and 75 per cent water. A current of from 30 to 60 amperes is applied for several minutes. (7) Where extra firm adhesion is required, an acid dip is preferable prior to the sixth step, as photomicrographs show that when a surface is eroded there is a better opportunity for the deposit to interlock with the basic material. The composition of the dip used is 50 per cent nitric acid and 50 per cent water. After the work has been placed in this bath for several seconds it will be covered with a black slime, presumably free carbon. This will clean off easily in the electrolytic bath to which the work is submitted in the sixth step.

The exact manipulation of the bath in the sixth step, depends greatly on the class and condition of the work. If it is much pitted with rust or scores which are not cleaned up within three minutes or so, the current may be reversed for another three minutes. Finally, the current is again reversed; this usually suffices to produce a fine white mat surface. There are a number of precautions that must be taken in connection with this bath: It must be changed frequently, as the metal dissolved appears to hinder the action, even though the acid may still be fairly strong, and the amount of sulphate in solution small; the solution should not be stirred, nor the work moved while the current is turned on; the anode and cathode should be separated by means of a porous screen to prevent the gas given off from the cathode from disturbing the acid around the anode; when the work is clean, the current should be switched off, the work removed and rinsed in running water as rapidly as possible, and then transferred at once to the depositing bath; as a rule a current density below 7 square centimeters per ampere is not satisfactory; the cleaning effect seems to be largely dependent on the free gassing at the anode; and the temperature of the bath should be kept low.

Waxing the Work

Where part of a surface is to remain unaltered, it is necessary to cover it with wax or some other composition, as mentioned after the third step in the cleaning process. Either of the following compositions has been found satisfactory in practice: Beeswax, 90 per cent; resin, 7 per cent; and boiled linseed oil, 3 per cent; or bitumen, 70 per cent, and paraffine wax 30 per cent. There are two precautions to be taken in waxing the work: First, the work should be heated before applying the compound; and, second, too thick a coating of wax should not be applied and the edges should be finished off neatly. A copper-wire lead is next sweated to the work, and the latter is measured with a micrometer. A ticket is then made out to accompany the work to the next process. This ticket shows the thickness of the layer to be added, the finished diameter required, the total area to be deposited on, and the current necessary to give the prearranged density.

Deposition of the Iron Layer

The solution used in the deposition is ferrous ammonium sulphate having a strength of 2.5 avoirdupois ounces per quart of water, with a current density of 30 square centimeters per 0.1 ampere. The rate of deposition is a layer about 0.0002 inch thick per hour. The operation is performed in separate vats having capacities of about 28 quarts.

The general method of operation is to suspend the work in a vertical position in the vat. This is accomplished by means of rods fixed to the bench, which are provided with arms having universal joints and fitted with clamps at the end to hold the work. The anode is then suspended from the rocker arm and made to surround the work concentrically, as, especially with thick deposits, it is important to keep the anode equidistant from the work at all points so that the deposit will be uniform in thickness.

The anodes are made of Swedish iron of about No. 16 British Imperial wire gage, thoroughly annealed, and wound into the form of a woven cylinder. They are suspended and stiffened by means of a 1/4-inch iron rod on one side, which is attached at the top to the rocker arm. The anodes are also fitted with two celluloid cones to produce an upward pumping action, the effect of this action being essential to avoid having a stagnant solution in contact with the work. It also keeps the ferrous carbonate in the solution in a state of suspension. The anodes should be kept clean by scrubbing off the black slime which tends to collect.

After completing the cleaning processes already described, the work is transferred to the depositing vat as rapidly as possible, and electrical contact made at once. It is important to immerse the work before the water film from the last cleaning step is dry, and to start the current at once. The current is adjusted to the prearranged value by means of the variable voltage switches and the adjustable rheostat provided. Either of the two ameters can be put in circuit with each separate vat at will. The more delicate of the two reads 2 amperes by 0.05 ampere.

The constancy of the current is a matter of supreme importance; so it is essential that the source of supply and the electrical arrangements be entirely satisfactory, and the current value checked frequently. It should be remembered that some work may be on the bench for two weeks, though most jobs only average one or two days. With careful treatment long jobs have been found when finished to be within 2½ per cent of the calculated thickness.

Acidity and Current Density of Solution

From the results of experiments, it was decided that the most satisfactory method was to work the solution as nearly neutral as possible, and to keep the current density down to 30 square centimeters per 0.1 ampere for all thick deposits. The solution always tends to become acid, and when this occurs it has been found that the deposit becomes hard, bright, brittle and non-adherent, or badly pitted. In order to reduce the acid content, freshly prepared and well-washed ferrous carbonate should be added from time to time. The determining factor in the process is the personal equation; an inefficient operator will make little or nothing of it, while in skilled hands the process yields valuable results.

Causes of Failure in Process

Some of the most common defects met with in this process and their causes will be considered in the following: Bad adherence; this is usually due to faulty cleaning, acidity of the solution, and having the temperature of the solution too low. Roughness; this results from a lack of efficient agitation of the anode; foreign matter in the iron solution due to dirt and dust from the atmosphere and infrequent decantation; and too high a current density. Brittleness and splitting of the deposit, and pitting; these result from acidity of the solution and too low a temperature. Excessive banking at the edges; this is due to too much agitation of the anode, and too high a current density. Tree growths; these also result from too high a current density, and foreign matter in the solution. Layers or concentric strata; these are apparently due to interruption or excessive variation of current density. Finally, excessive departure from the calculated rate of deposit; this results from the variation of current density and from the formation of tree growths, which absorb a portion of the energy of the bath.

Aluminum Alloys

THE phenomena of the growth and aging of parts made from aluminum alloys, the effect on the physical properties of aluminum when it is alloyed, the physical properties of an aluminum forging alloy, and the conclusions arrived at when aluminum was compared with other metals were discussed in a paper presented before the Detroit section of the Society of Automotive Engineers, by Zay Jeffries, research director of the Aluminum Manufacturers, Inc., Cleveland, Ohio. With respect to the growth and aging of aluminum alloys, it was stated that no matter how the alloy is cooled in ordinary methods of production, a permanent change of volume takes place when it is reheated to a temperature of about 572 degrees F. This permanent change of volume was found in all the commercial alloys of aluminum studied by the writer, although it differed somewhat in magnitude.

The change in volume can be made permanent at the room temperature so that the casting will not grow any more. This change of volume first came to the attention of the writer in connection with racing automobile pistons, where the temperature had been so high that the pistons had actually increased in diameter. This is not an important factor in the ordinary water-cooled engine, because the temperature is seldom high enough to cause such a growth, except perhaps in the head where the clearance is ample to take care of it; but in air-cooled cylinders and in racing engines there is no question but that the pistons are susceptible to a certain amount of growth.

When aluminum alloys cool to room temperature they keep on changing in physical properties at that temperature. The standard No. 12 alloy when cast in sand, for example, has a certain tensile strength and elongation, but twenty-four hours after the casting, it has different properties. Its strength has increased slightly and its ductility has decreased slightly; after a few months the change is still more in the same direction. In one of the more ductile alloys a reduction in the elongation of from 8 per cent in the freshly cast alloy to 5 per cent after a month's aging, is sometimes found, while the tensile strength and elastic limit have increased. All the castings used in the last fifteen years have undergone this change, which is nearly complete in thirty days at ordinary room temperatures. No serious disadvantages have arisen, so that knowledge of the fact that these changes take place should not cause alarm. It may later lead to a more intelligent use of the material.

Effect of Alloying on the Physical Properties

When zinc is added to an aluminum alloy, the tensile strength increases gradually until 12 per cent zinc has been added, when it is about 25,000 pounds per square inch; however, the strength increases up to 35 per cent zinc. The average tensile strength of test bars taken from an aluminum-zinc alloy containing a little iron was over 50,000 pounds per square inch. This is not considered a good alloy, because it is brittle and its specific gravity is over 3.3; thus a high zinc alloy is generally unsuitable for engineering uses. The addition of copper to aluminum raises the tensile strength of the alloy until it is over 20,000 pounds per square inch when 14 per cent copper has been added. The maximum tensile strength obtained by adding iron is about 16,000 pounds per square inch when the percentage of iron is about 2.5, and the maximum tensile strength obtained by adding nickel, is slightly more than 18,000 pounds per square inch when approximately 5 per cent nickel has been added.

When the effect of these same elements on ductility is measured by the percentage of elongation, it is found that copper reduces the ductility faster than any of the other elements. The addition of iron is not desirable above 2 per cent, while nickel produces about the same result as copper. The addition of zinc also decreases the ductility of the castings, but not nearly so rapidly as the other elements. Experiments were made to determine the effects of temperature on two different alloys, one of which was a strong alloy known as Lynite No. 145 which contains about 2.75 per cent copper, 7 to 8 per cent zinc, and over 1 per cent iron. The sample tested had a tensile strength of 28,000 pounds per square inch and an elongation of 8 per cent at 32 degrees F. In testing it with a rise in temperature, it was found that its strength decreased regularly up to 572 degrees F., at which it was slightly under 9500 pounds per square inch. On the other hand, its elongation increased rapidly with an increase in temperature.

The other alloy contained about 12 per cent copper and 0.75 per cent manganese. The addition of the latter element made this alloy stronger at temperatures above room temperature; the elongation increased slightly, but its change was not marked. The tensile strength, however, increased from about 20,000 up to almost 22,000 pounds per square inch which was reached at 392 degrees F. At 572 degrees F. the first alloy had a tensile strength of 9500 pounds per square inch, while that of the second was more than 18,000 pounds per square inch. Thus, the second alloy was twice as strong as the first at this temperature with sufficient ductility, over 2 per cent, to make this advantage a decided factor in its use. This alloy is used to some extent at present in experimental cylinders, in cylinder heads, and any other parts requiring considerable strength at high temperatures.

Comparing Aluminum with Other Metals

A comparison of aluminum with machine steel is interesting, especially in connection with fatigue values. The modulus of elasticity of machine steel is 30,000,000 pounds per square inch and that of aluminum, 10,000,000 pounds per square inch. Machine steel breaks sharply after its elastic limit has been reached, and a slight increase in the load produces a large permanent set, whereas in forged aluminum, a slight permanent set is obtained and the metal has the ability to check its deformation after passing the yield point. Although cast aluminum alloys have the same modulus of elasticity as forged alloys, the proportional limit is usually low, being about 7500 pounds per square inch, as opposed to 22,000 pounds per square inch.

The fatigue values obtained in tests made on a White-Souther machine are unique. An aluminum casting stressed to 14,000 pounds per square inch, which was well above its proportional limit, broke after about 500,000 reversals. When a similar casting was stressed to 8500 pounds per square inch it required 16,000,000 reversals to break it. Mild steel having a tensile strength of 65,000 pounds per square inch, an elongation of 30 per cent, and a yield point of 30,000 pounds per square inch will break at 16,000,000 reversals when stressed to only 12,000 pounds per square inch. The point to be explained is why mild steel, either annealed or cold-worked, will break at 12,000 pounds per square inch, which is below the proportional limit, while aluminum will stand the same number of reversals when stressed a little above its proportional limit.

Aluminum Forging Alloys

The forging alloys are mixed like other aluminum alloys and poured into ingot form; the ingots are either rolled or pressed out into billets, which are then forged into various shapes. It has been the experience that forgings give very uniform results. Heat-treatment improves the qualities; an untreated alloy having a tensile strength of about 40,000 pounds per square inch and an elongation of about 15 per cent, if properly heat-treated, will have a tensile strength of about 55,000 pounds per square inch, an elongation of 20 per cent, and an elastic limit of 20,000 pounds per square inch. Thus, a material is obtained having the properties of mild steel with one-third its specific gravity.

The stiffness or rigidity of a material is an important factor in engineering; stiffness depends directly on the modulus of elasticity of the material and varies as the cube of the thickness of any section. Here again, aluminum alloys possess advantages as structural members. An aluminum plate of the same weight as a steel plate would be about three times as thick and, having one-third the modulus of elasticity, its stiffness would be only one-third in so far as this factor enters; but being three times as thick as the steel plate, it would be twenty-seven times more rigid if it had the same modulus of elasticity. Dividing this figure by 3, a ratio of 9 to 1 in favor of aluminum is obtained. For alloys slightly heavier than aluminum, that ratio is 7½ and 8 to 1 instead of 9 to 1. Figured the other way, with one-half the weight in plate section, aluminum would be equally as stiff as steel; this factor is quite important when designing parts for rigidity.

Aluminum forgings have applications for different purposes due to different requirements. One factor is lightness; where this is desired in reciprocating parts of automobiles, aluminum connecting-rods would probably be valuable chiefly because of this factor. Forged aluminum seems to be a very good bearing material against hard steel and possibly against medium steel. Accordingly, two advantages can be gained by using aluminum connecting-rods—improved bearing qualities and a reduction in weight. Moreover, if the aluminum bears directly on steel, ideal conditions for cooling the bearing result; as aluminum has a high heat conductivity, it should rapidly dissipate the heat from the bearing.

Another important advantage aluminum alloys have in certain cases, arises from the absence of corrosion. It is true that a coating or oxide forms on the surface of aluminum, but as all the salts of aluminum are white, the oxide is inconspicuous. This is true of zinc also; zinc oxide is white and consequently when a piece of iron is galvanized and a coating of zinc oxide is formed on the outside, it is not thought of as rust. However, in its way it has been rusted, but the rust is white or colorless. Even though all aluminum products have oxide on the outside, it is colorless and also thin. Another characteristic of aluminum is its coefficient of expansion. In an ordinary timing-gear system the gears might be rigidly attached to one aluminum casting, and as aluminum expands about twice as much as iron per degree, it might be found that the iron gears have too great a clearance when the engine is warm. Aluminum gears, or even one of them, would reduce that clearance on account of the greater coefficient of expansion.

* * *

The elimination of hauling coal in a tender for each locomotive by electrifying its lines, has resulted in various economies for the Chicago, Milwaukee & St. Paul Railway. This has not only tremendously reduced the coal consumption of the railroad, but has increased the ton-mileage approximately 8 per cent on the mountain divisions. The greater power of the electric locomotives, as demonstrated daily in actual service as well as in the more spectacular tests of strength with steam locomotives in which the latter have come out second best, has practically doubled the ton-mileage of the three electrified divisions with no increase in trackage beyond that incident to the normal development of the railroad, and with a great reduction in the number of locomotives, instead of the increase which would have been necessary under steam operation.

NEW BOOK ON PATTERNMAKING

Patternmaking. By Joseph A. Shelly. 341 pages, 6 by 9 inches; 259 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $3.

This treatise on patternmaking deals, in its sixteen chapters, with two general subjects which include, first, the principles governing the production of castings by forming suitable molds from patterns, and, second, the actual construction of patterns and core-boxes of different types. As patternmakers must understand the principles of molding, the application of various types of patterns and their relation to the work of the molder have been explained before considering the building of patterns. The types of patterns that illustrate different problems in the pattern shop and foundry have been carefully selected, in order to demonstrate every important variation likely to arise in practice. Since the construction of wooden patterns involves considerable skill, especially in the art of joinery, the use of hand- and power-operated woodworking tools and the particular classes of work for which they are adapted are fully described and illustrated.

In dealing with the general subject of pattern construction, the idea has been to explain very thoroughly the elements or fundamental features of this work. For instance, much attention has been paid to the exact procedure in the fitting or joining of different parts, and to the building up and formation of various shapes common to pattern construction, because it was considered more important to explain fully how parts are sawed, chiseled, planed, turned, and fastened together, than to fill the book with miscellaneous and unrelated examples of pattern work. The numerous examples included have been selected either to illustrate different well-known methods of construction, or the various types of patterns in common use and their application.

While this treatise is intended primarily for those interested in patternmaking as a vocation, it should also prove of value to draftsmen, for the reason that the origination of designs which are practicable from the viewpoint of the patternmaker and molder requires a knowledge of the fundamental principles of patternmaking. The various subjects treated have been so arranged and divided throughout the book that the student interested more in general principles than in the actual work of construction may readily select whatever sections are considered essential.

The scope of the book and the practical nature of the subjects treated are indicated by the following list of chapter headings: Types of Patterns and their Relation to Molding Problems; Hand or Bench Tools used in Patternmaking; Pattern Shop Machinery and its Operation; Pattern Joinery; Staved, Stepped, and Segment Work; The Laying out of Patterns; Typical Examples of Pattern Work; Core-box Construction; Pattern Turning; Pattern Work on Cylinders; Wheel and Propeller Patterns; Gear Patterns; Special Pattern Work; Finishing Pattern Work; Pattern Lumber; and Filing and Setting Jaws.

* * *

MEETING OF THE BROOKLYN ENGINEERS' CLUB

On Thursday evening, November 18, the second of a series of papers on "Industrial Brooklyn" was read at the Brooklyn Engineers Club by O. P. Hatton, advertising manager of the E. W. Bliss Co., Brooklyn, N. Y. Following a historical sketch of the development of the press working of metals, Mr. Hatton told of the entrance of the E. W. Bliss Co. into this field in 1857 and showed a large number of interesting lantern slides, illustrating progress made by his firm in the development of the various types of power presses, and a number of manufacturing operations on which such equipments are successfully employed at the present time. The Thursday evening meeting at the club was followed by a Saturday afternoon excursion to the E. W. Bliss Co.'s plant in South Brooklyn.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application

Kingsbury Automatic Drilling Machine. Kingsbury Mfg. Co., Keene, N. H. 385
Automatic Multiple-spindle Profile Milling Machine. Automatic Machine Co., Bridgeport, Conn 387
Newton Continuous Milling Machine. Newton Machine Tool Works, Inc., Philadelphia, Pa 387
Dawsearl Finger Abrasive Wheels. Dawsearl Tool & Machine Co., 390 Forest St., Arlington, N. J. 389
"Wilkes" Tool-holder. Dawson Tool Corporation, 51st St. and Lancaster Ave., Philadelphia, Pa 389
Brewster Electric Demagnetizing Machine. William Brewster Co., 30 Church St., New York City 390
Coats Piston Ring Gage. Coats Machine Tool Co., Inc., 110-112 W. 40th St., New York City 390
Electric Arc Welding Apparatus. Electric Arc Cutting & Welding Co., Newark, N. J. 390
Taylor Electric Rivet Heater. Taylor Welder Co., Warren, Ohio 391
Kempsmith No. 2 "Maximiller." Kempsmith Mfg. Co., Milwaukee, Wis. 391
Motor Base on Wood Turret Lathes. Wood Turret Machine Co., Brazil, Ind. 392
American Broaching Machine. American Broach & Machine Co., Ann Arbor, Mich 392
Taper Attachment for Cincinnati Boring Mills. Cincinnati Planer Co., Cincinnati, Ohio 393
Oliver No. 80 Saw Bench. Oliver Machinery Co., Grand Rapids, Mich. 393
"Buhr" Multiple-spindle Drill Head. Nelson Blanck Mfg. Co., Dubois and Clay Sts., Detroit, Mich 394
Sheffield Snap Gages. Sheffield Machine & Tool Co., Dayton, Ohio 394
H. A. Hopkins Expanding Boring-bar. H. A. Hopkins & Co., Inc., South Bend, Ind 395
Jackson Vertical Automatic Chucking Machine. Long-Henkel Mfg. Co., 3rd and Buttonwood Sts., Reading, Pa 395

Kingsbury Automatic Drilling Machine

In working out the design of this machine, the force of gravity has been employed to provide for feeding the drills through the work. This gravity feed becomes effective when the drill starts cutting, and remains operative until the hole is drilled. A mechanical device provides for rapidly lowering the drill to the work and for returning it to the starting point after the operation has been completed. Another noteworthy feature of the design is the incorporation of an automatic mechanism which stops the machine if the drilling time exceeds a specified limit, due either to dullness or improper grinding of the drills.

An automatic sensitive ball bearing drilling machine equipped with a gravity feed and an automatic stop, which provides for keeping the drilling time within a specified limit, has recently been placed on the market by the Kingsbury Mfg. Co., Keene, N. H. This machine was originally developed and used in the Kingsbury plant, and the results obtained from its operation proved so successful that a decision was reached to place it on the market. Front and rear views are illustrated in Figs. 1 and 2 from which it will be seen that drilling machines of this type may be equipped for operation either with electric motor drive or with belt drive.

Where an individual motor is employed, power is transmitted to the main shaft *A* by means of a noiseless chain; and for belt drive, it will be seen that tight and loose pulleys are mounted directly on

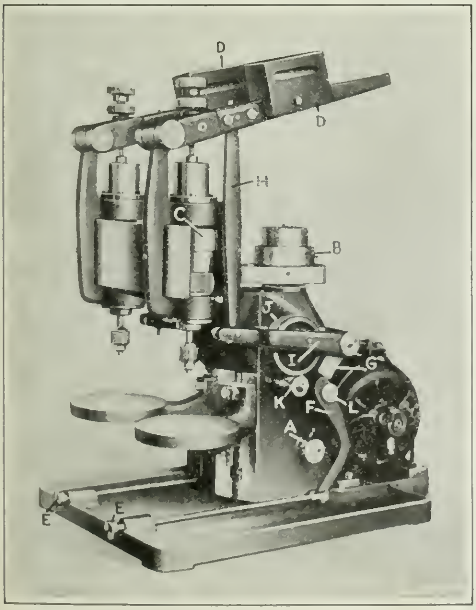


Fig. 1. Automatic Sensitive Drilling Machine built by the Kingsbury Mfg. Co. A Timing Mechanism is not provided on this Machine

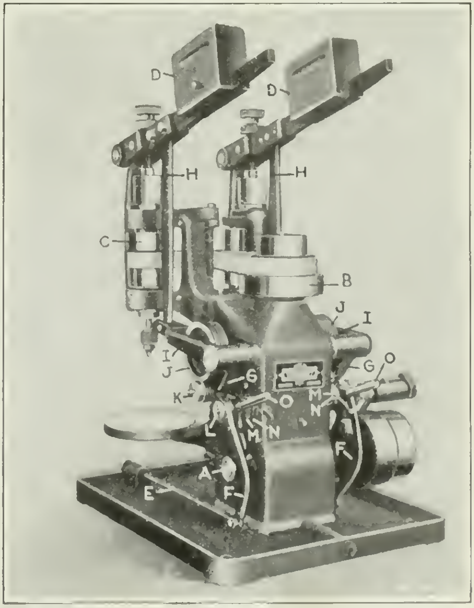


Fig. 2. Rear View of Automatic Sensitive Drilling Machine equipped with Automatic Timing Mechanism

shaft *A*; otherwise, the machines are identical in construction. Bevel gears transmit power from shaft *A* to a vertical shaft inside the column, at the upper end of which cone pulley *B* is mounted. A belt runs over this cone and idler pulleys which are so positioned that the belt has an adequate surface of contact with the cone pulley *C* on each of the spindles. One of the idler pulleys can be seen in the rear view of the machine, Fig. 2.

Arrangement of the Gravity Feed Mechanism

On these machines, each of the two spindles operates independently, and the feeding of the drill into the work is accomplished by a weight *D* which exerts a constant feeding pressure from the moment that the drill engages the work until it has completed its operation. The spindle is carried down to bring the drill to the work, and returned after the drilling operation has been completed by means of a combination of levers and a friction-driven crank disk, which operate in the following manner: When a piece of work has been placed under either of the spindles, the operator pushes rod *E* inward, which results in throwing latch *F* out of engagement with the end of arm *G* of a bellcrank lever *I*, thus allowing weight *D* to push downward on link *H* and lever *I*, with the result that a friction-driven crank disk *J*, the crankpin of which is pivoted in lever *I* comes into contact with a driving member *K*.

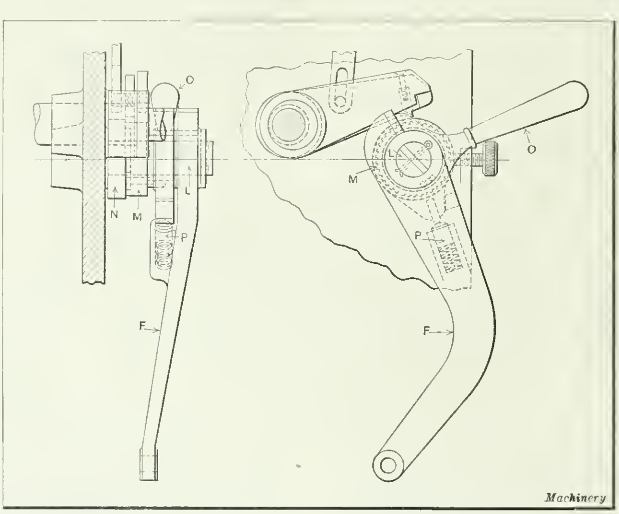


Fig. 3. Design of Timing Mechanism provided on Machine illustrated in Fig. 2

Near the middle of the vertical shaft which carries pulley *B* at its upper end, there is a worm that meshes with a worm-wheel carried at the center of the shaft on which the two grooved friction driving members *K* are mounted; and when the crank disk *J* at each side of the machine is carried down into engagement with the driving member *K*, the disk is rotated through the frictional action of the grooved contact surfaces of these two members. As previously mentioned, the crankpin in disk *J* runs in a bearing in lever *I*, so that the revolution of the disk results in pulling downward on link *H* and lever *I*, thus rapidly drawing the spindle down to bring the drill into contact with the work.

Method of Operating the Machine

With a two-spindle machine of this kind, the method of procedure is to load the jig under one spindle and start the operation by pushing inward on rod *E*, and then to start the second spindle to work. By operating the spindles alternately in this way, non-productive time of the workman is reduced to a minimum, thus effecting a substantial improvement in the rate of production. For this reason it will be apparent that it was an important matter to provide for the independent functioning of the mechanisms controlling the feed of the two spindles.

How the Gravity Feed Becomes Effective

When the point of the drill comes into contact with the work, the resistance offered to its penetration is sufficient to lift friction disk *J* out of engagement with the driving member *K*, thus disengaging the friction drive and placing dependence on the action of gravity on weight *D* to feed the drill through the work; but when the drilling operation has been completed and there is no longer any resistance to the advance of the drill, weight *D* once more establishes contact between crank disk *J* and driving member *K*, and through the link mechanism provides for rapidly raising the spindle to the starting point. The design has been worked out in such a way that when the spindle has been raised to the top of its stroke, latch *F* may snap in under the end of the bellcrank arm *G*, thus stopping the operation until rod *E* is once more pushed in.

This machine may also be arranged to operate continuously by securing latch *F* in such a position that it will not come into contact with bellcrank arm *G*. It is claimed for this machine, that owing to the uniform gravity feeding pressure, the breakage of drills will be reduced to a minimum. The arrangement of crank disk *J*, which provides for rapidly bringing the drill down into contact with the work, is such that there is a slowing up of the downward movement before contact is actually established, so that there is no danger of the impact being sufficient to break the drill. Evidently each of the weights *D* can be moved along the arm by which it is carried in order to adjust the feeding pressure according to the size of drill that is being used.

In setting up one of these machines for the performance of a specified drilling operation, the first step is to ascertain the most desirable rate of speed and feed for handling the job. With these data available, the drilling time is easily calculated and the automatic efficiency device is then set to provide for stopping the machine if the use of a dull or improperly ground drill is causing the drilling time to extend over more than the proper period. Referring to Fig. 3, the arrangement of this device is as follows: Secured to stud *L* on which link *F* is pivoted, there is a ratchet wheel *M* which is engaged by two pawls. One of these is actuated by an eccentric connected to the feed mechanism, while the other is a retaining pawl that holds the ratchet wheel in position against the tension of a spring, as it is turned by the first pawl.

If the drilling operation is completed within the specified length of time, the returning of the drill to its starting position causes lever *I*, Figs. 1 and 2, to lift both of the pawls out of engagement with ratchet *M*, so that the spring may return this ratchet to the starting position, which is determined by means of an adjustable graduated disk *N* carried on stud *L* between the ratchet wheel and the frame of the machine. As the ratchet snaps back to its starting position, a pin on the side of the ratchet comes into contact with a pin on the side of disk *N* which arrests the backward movement of the ratchet.

How the Machine is Stopped if the Time Limit is Exceeded

Should it happen that the drill has become dull, thus preventing it from accomplishing the drilling operation within a specified time limit, forward rotation of the ratchet *M* is continued, and a pin on the opposite side of this ratchet comes into contact with a corresponding pin carried by lever *O* and swings this lever over into such a position that, as the drilling spindle rises toward its starting position, a lug on lever *O* comes into contact with the end *G* of bellcrank lever *I* and arrests the movement before the cycle of operations has been completed, thus preventing further operation of the machine and notifying the operator that satisfactory working conditions are not being secured. Lever *F* carries a spring plunger *P* that runs over a pin mounted on the hub of lever *O*, to provide for holding this lever in either of its two positions. In order to restart the machine, the operator has to pull up on handle *O*, thus causing plunger *P* to first move inward and then latch the lever in the operating position. With an arrangement of this kind, it will be apparent that a constant safeguard is placed upon the efficiency of the operation.

AUTOMATIC MULTIPLE-SPINDLE PROFILE MILLING MACHINE

A recent modification of the Coulter automatic multiple-spindle profile milling machine has been brought out by the Automatic Machine Co., Bridgeport, Conn. In Fig. 1 one of the machines is shown equipped with three spindles, while in Fig. 2 there is illustrated another machine having four spindles. Each of these machines is provided with a transfer table on which two work-holding fixtures are mounted, so that while one fixture is in the proper position for milling the work, the other is in a suitable position for unloading and loading. By this arrangement a practically continuous milling operation is obtained. In addition, a further saving in production time is secured by having several spindles cutting simultaneously.

The machine in Fig. 1 is engaged in milling the faces of manifold bosses, while in Fig. 2 the under sides of these bosses are being machined. A cam-actuated mechanism automatically feeds the work into the cutters and withdraws it when the required cut has been taken, this camming being arranged to give a rapid advance, a normal feed while cutting, and a quick return. An automatic stop is furnished, so that the minimum amount of time is consumed in nonproductive motions. Each spindle has an independent adjustment for depth. The spindle housing is raised and lowered by means of the inclined handwheel directly above it, and it is moved horizontally by rotating the handwheel at the right-hand end of the cross-slide. An adjustment is provided on the transverse position of the table, the latter being moved longitudinally from the cutting position for one fixture to the cutting position for the other, by one turn of the handwheel at the left of the base.

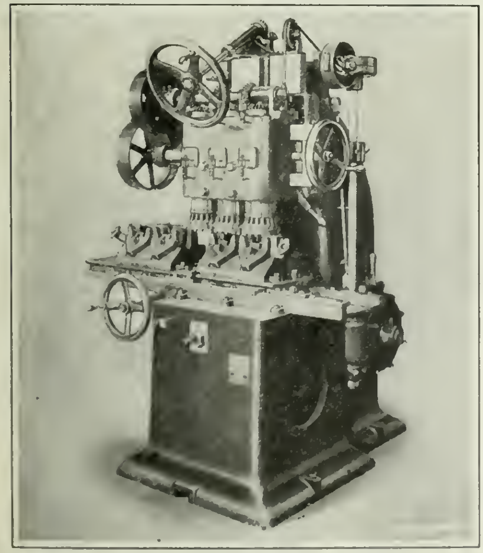


Fig. 1. Three-spindle Profile Milling Machine built by the Automatic Machine Co.

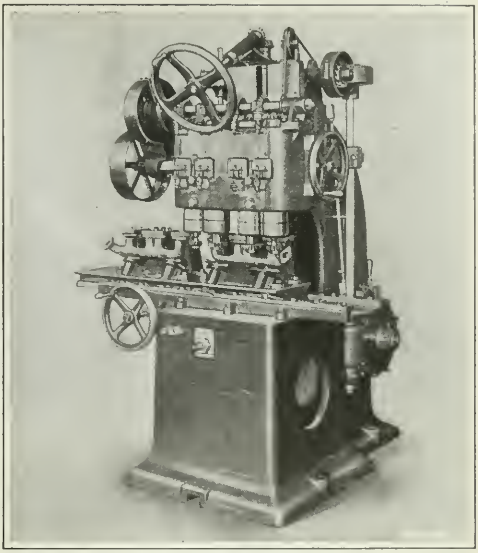


Fig. 2. Four-spindle Machine engaged in milling the Under Sides of Manifold Bosses

This is essentially a single-purpose production machine, but it is adaptable to a wide range of work, as the position and number of spindles and the arrangement of the cams can be made to suit the operation. Automatic stops can be provided, to be used or not, according to the nature of the work and the skill of the operator. The spindles are driven by either bevel or spiral gears, whichever type may be deemed best for each particular case. This type of machine reduces production time and cutter wear, in comparison with single-cutter types of continuous milling machines, and the vertical spindles present an opportunity of milling surfaces that could not be machined by slab milling.

NEWTON CONTINUOUS MILLING MACHINE

The Newton Machine Tool Works, Inc., Philadelphia, Pa., has recently brought out the Model 0-3 continuous milling machine shown in Fig. 1. This machine is designed for simultaneously performing face milling operations on opposite ends or faces of a large variety of machine parts, including forgings, castings, and shafts, which must be milled accurately to length. As will be seen by referring to the illustration, the machine has a heavy cast base on which are mounted the heads carrying the two cutter-spindles and the work-carrying spindles.

The head at the left end of the machine is stationary, and the one at the right is adjustable, so that work of varying lengths can be accommodated. Each cutter-spindle can be adjusted for depth of cut independently of the other. A worm and worm-wheel is employed to drive the cutter-spindles. The work-rotating spindles, or the drum-spindles on which the work-holding fixtures are mounted, are revolved by gearing. The pinions that transmit motion to the two drum-spindles are located on the same shaft, so that the two drums will always register properly with each other. The machine

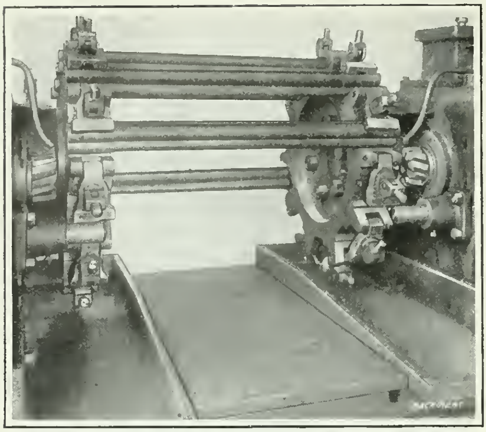


Fig. 2. Close-up View of Fixture shown in Fig. 1

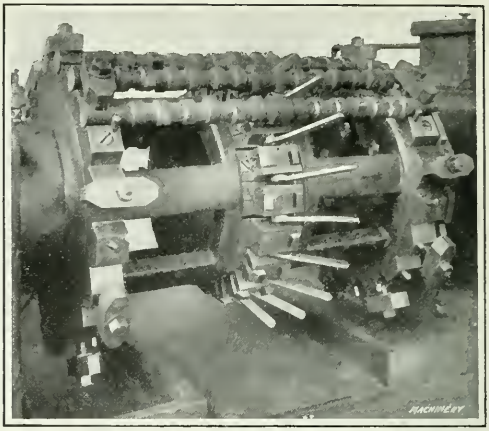


Fig. 3. Fixture used for holding Camshafts

is equipped with an oiling system which provides adequate lubrication for all bearings. The attention of a skilled workman is not required, and it is only necessary to employ an operator who has been taught the simple operation of inserting the pieces in the jig and removing them when completed.

Fig. 2 is a close-up view of the fixture shown in position on the machine in Fig. 1. This fixture is used in milling 1⅜-inch diameter shafts to length, with a production rate of 250 pieces per hour. For this operation the intermittent feed and rapid traverse mechanism is used, which permits the pockets carrying the work to be revolved past the milling cutters at the proper speed for milling, and then at an increased speed until the next pocket has been brought into position for milling the work which it carries. This change in speed is controlled automatically in the following manner: As the pocket containing the pieces revolves past the milling cutters, the feed is automatically tripped and the rapid traverse engaged, which advances the work-holding drums at a ratio of 10 to 1, and just before the next pocket reaches the milling cutters, the rapid traverse is tripped and the feed mechanism re-engaged.

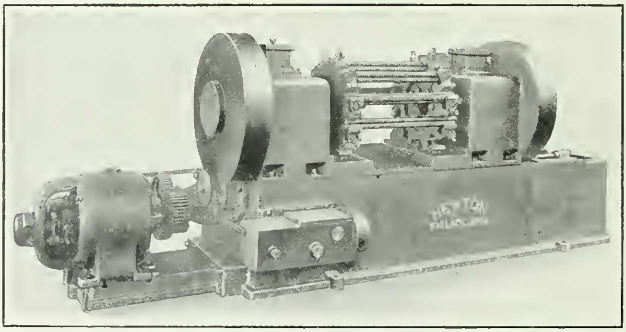


Fig. 1. Newton Model 0-3 Continuous Milling Machine

Three shafts are clamped in each pocket by the operator, who stands at the front of the machine, which is the side shown in Fig. 1. There are ten pockets in the fixture, and referring to Fig. 2, it will be observed that a toggle clamping lever is provided at the ends of each pocket, to provide for clamping the work in place. These toggle levers are so arranged that the rotation of the drum brings them into contact with pins bolted to the housings at the rear of the machine. When the levers come into contact with these pins, the clamps are released and the work rolls out on the inclined edges of the

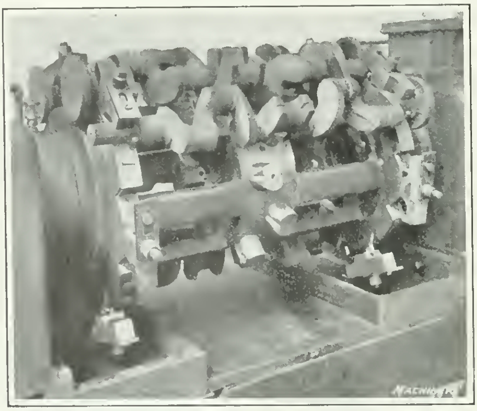


Fig. 4. Fixture used for milling Ends of Six-throw Crankshafts

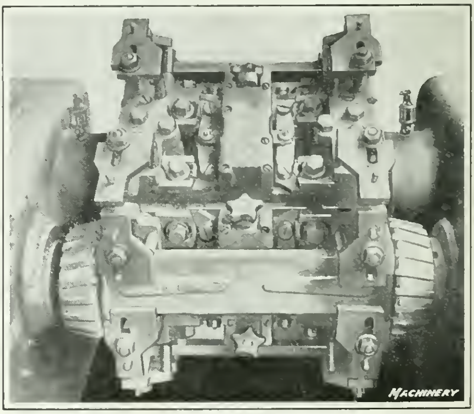


Fig. 5. Fixture used in milling Ends of Casting shown in Fig. 6

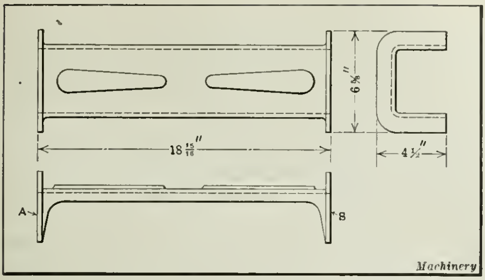


Fig. 6. Casting held in Fixture shown in Fig. 5 when milling Ends A and B

pans and from there into a tote box or on a roller conveyor. In Fig. 3 is shown a fixture designed for milling both ends of camshafts. It will be observed that a universal chuck grips the central bearing of the camshaft, and thus locates the work in the fixture. The intermittent rapid traverse feed is not used in this instance, as the work is placed close together. With this fixture the production rate is 180 milled shafts per hour.

In Fig. 4 the machine is shown set up for milling the ends of a six-throw crankshaft. In this case the work is located by plungers at the center of the fixture. By placing the crankshafts in the fixture so that the flanged end of one comes next to the small end of the succeeding one, it is possible to bring them close together. The flange on this particular crankshaft is 5 1/64 inches in diameter, the small end is ¾ inch in diameter, and the distance between the faced ends is 33 31/32 inches. The production rate on this work is 90 pieces per hour.

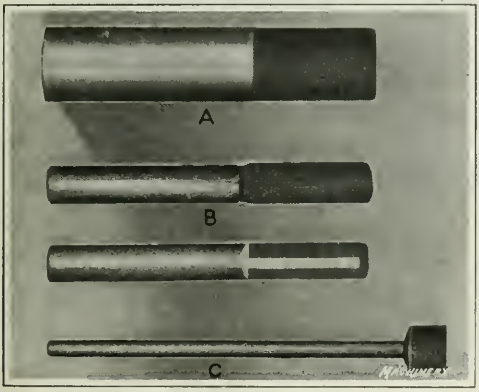


Fig. 1. Several Types of Abrasive Wheels manufactured by the Dawsearl Tool & Machine Co.

In Fig. 5 there is shown a fixture used in milling the ends of a cast-iron frame, the principal dimensions of which are given in Fig. 6. The light section of this casting necessitates the use of a fixture which is designed to prevent distortion of the work. When the frailness of the casting is taken into consideration the production of forty-five pieces per hour, which is attained when using the fixture as shown in Fig. 5, would be regarded as satisfactory by most experienced milling machine operators.

DAWSEARL FINGER ABRASIVE WHEELS

The Dawsearl Tool & Machine Co., 390 Forest St., Arlington, N. J., has recently developed a line of small abrasive "finger" wheels, which are especially adapted for resharpening button dies and for grinding small-diameter bushings, drawing dies, etc. Several types of these wheels are illustrated in Fig. 1. The wheel shown at *A* is intended for grinding large button dies, although it can be used for other work. The two wheels shown at *B* are also intended for grinding button dies, the only difference between them and the one shown at *A*, being in the diameter. One of these wheels is shown with part of the abrasive removed, thus exposing the supporting rod with which all these wheels are provided to insure against breakage. It is claimed that this reinforcement makes the wheels sufficiently rigid to insure a perfect cutting action, and yet permits enough flexibility to prevent the wheels from being broken when pressure is put upon them.

The wheel shown at *C* is especially designed for grinding bushings, drawing dies, gages, and other work of a precision nature. Wheels of this type are made to less than 1/16 inch in diameter at the cutting end, and so grinding operations can be substituted for lapping operations in many instances. Similarly, the use of these wheels in regrinding button dies, eliminates the old and slow method of performing the operation through the use of oilstones turned to the necessary size. The manufacturer of these wheels recommends their use in connection with "Dumore" grinders which are manufactured by the Wisconsin Electric Co. Fig. 2 shows one of these machines equipped with a finger wheel in use grinding a button die.

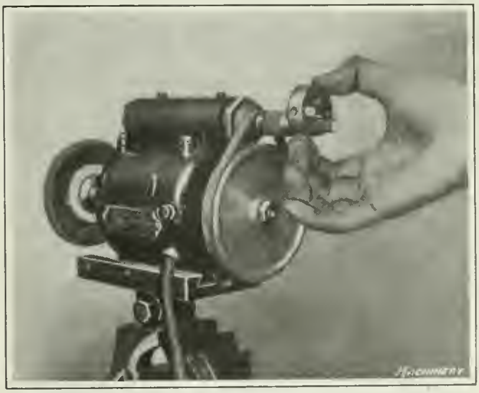


Fig. 2. "Dumore" Grinder equipped with a Dawsearl Wheel for Use in grinding a Button Die

"WILKES" TOOL-HOLDER

The Dawson Tool Corporation, 51st St. and Lancaster Ave., Philadelphia, Pa., has placed on the market the "Wilkes" tool-holder shown in the accompanying illustration. It will be seen that the tool bit is inserted in a square hole machined at an angle relative to the bottom surface of the tool-holder in order to give the proper amount of top rake. A binding screw runs the length of the tool-holder, the front end of the screw being beveled on the bottom to provide a good contact surface with the tool bit. The opposite end of this screw is threaded to suit a nut contained in a slot in the tool-holder. By this arrangement, the bit can be clamped securely or loosened by simply rotating the nut.

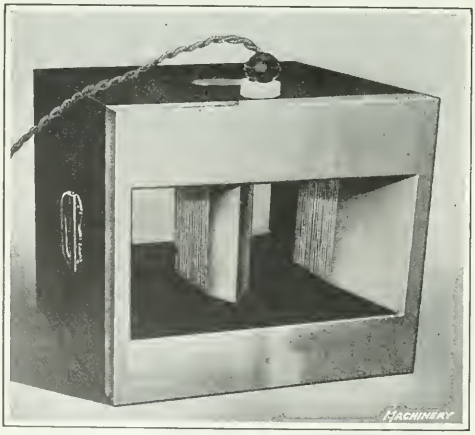
"Wilkes" Tool-holder manufactured by the Dawson Tool Corporation

The latter is a snug fit in the slot of the tool-holder, so that it cannot move in a longitudinal direction. It will be seen that the clamping action of the binding screw is close to the cutting edge of the bit.

An advantage claimed for this type of tool-holder is that its construction at the front end gives an unusual amount of support to the bit directly beneath the cutting edge. As there is no set-screw along the top surface of the holder for clamping the bit in place, as on many other types, the tool-holder can be slipped from the toolpost toward the operator, instead of toward the work. It is stated that this tool-holder is given a special heat-treatment to render it capable of withstanding severe usage. It is made in ten sizes to accommodate bits ranging from 3/16 to 1 inch square.

BREWSTER ELECTRIC DEMAGNETIZING MACHINE

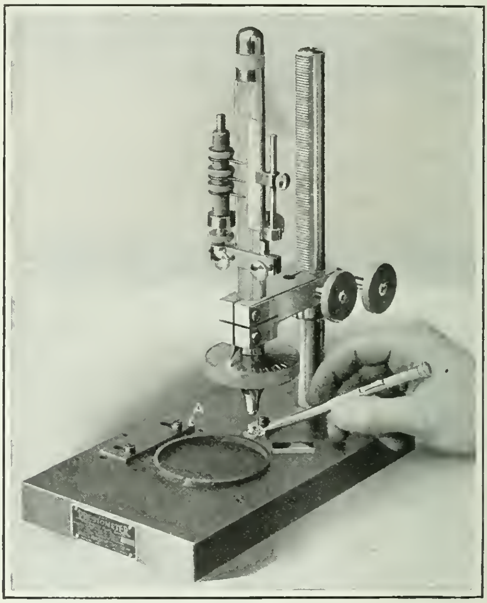
The residual magnetism left in the work after holding it on magnetic chucks for a machining operation is usually undesirable, as it causes chips, etc., to adhere to the parts. In order to eliminate such a condition, it is necessary to subject such parts to a demagnetizing operation, and for this purpose the William Brewster Co., 30 Church St., New York City, has recently placed on the market a demagnetizing machine known as the "Demagnetool No. 2," which is here illustrated. This machine is especially designed to cause the rapid removal of magnetism left in parts produced in large quantities and which have been held on magnetic chucks. While the illustration shows the demagnetizer with the opening in a horizontal position, it is usually mounted on a bench in a vertical position with a receptacle placed beneath the opening. In using this machine, the work is poured through the opening, the parts becoming entirely demagnetized as they drop through and into the receptacle beneath. Where there is an occasional cutter or delicate part to be demagnetized, it can be passed through by hand instead of dropping. The opening of the machine illustrated is 10 by 6 inches, but the manufacturer is prepared to build machines of any desired size.



Machine built by the William Brewster Co. for removing the Residual Magnetism in Parts held on Magnetic Chucks

COATS PISTON RING GAGE

It is a matter of general knowledge among automotive engineers and users of motor cars that numerous undesirable operating conditions will result from having piston rings which do not fit properly in the grooves of the piston. For use in gaging rings to assure that their widths come within specified limits, the Coats Machine Tool Co., Inc., 110-112 W. 40th St., New York City, has worked out a special adaptation of the Prestometer fluid micrometer gage for this purpose. It will be seen from the accompanying illustration that this gage is of the standard design with the exception that hardened steel balls are used for the gaging points, and an adjustable guide is provided that enables the gage to be set for testing the accuracy of various sizes of piston rings. There are two diagonal rows of holes in the base of the gage to receive the two screws that hold the locating block *A* in place. These holes provide for securing the block in different positions for holding various sizes of piston rings between the gaging points with one point of the ring periphery in contact with the block.



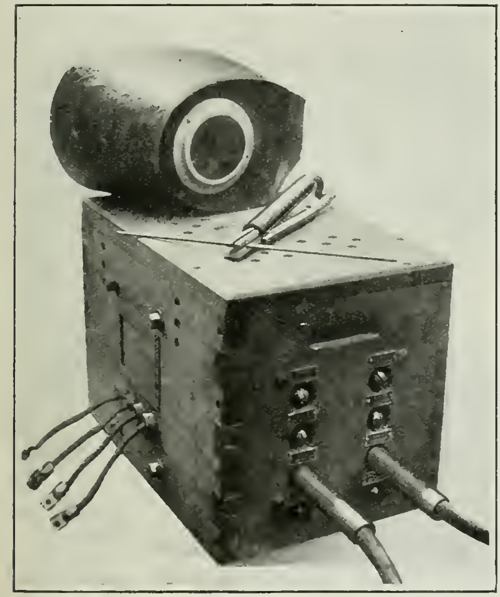
Modification of Prestometer Fluid Gage to permit the Inspection of Piston Rings

In the base of the gage there is a cup-pointed set-screw which supports a ⅜-inch hardened steel ball in such a position that the top of the ball projects slightly above the surface of the base; and carried by the plunger there is a 3/16-inch ball that engages the top of the work. This ball is held on the plunger by means of a cup that is threaded on the plunger and has an opening at the bottom through which the ball projects slightly. The use of the regular contact points on a Prestometer gage used for testing piston rings was found unsatisfactory, because the metal was so hard that the points were rapidly worn. Also, it was necessary to provide means for holding the lower contact point above the surface of the gage base, as any slight "wind" in a forged ring, or the presence of a burr, would hold the piece out of uniform contact with the base and thus give an erroneous reading. So far as the use of the Prestometer fluid gage is concerned, this application in testing piston rings is exactly the same as for other classes of service, the gage being set to standard gage-blocks and used as a comparator.

ELECTRIC ARC WELDING APPARATUS

An electric arc welding equipment weighing 100 pounds complete and especially suitable for use by automobile repair men, plumbers, sheet-metal workers, electricians, etc., has been developed by the Electric Arc Cutting & Welding Co., Newark, N. J. This equipment uses electrodes from 1/16 to 5/32 inch in diameter, operating continuously with the medium and smaller sizes, and intermittently with the larger sizes. While it has been designed to operate on either 110 or 220 volts and at any frequency specified by the purchaser, it can also be furnished for other voltages. The power supply must be of at least five kilovolt amperes and within the underwriter's regulations. While the equipment will operate from lamp sockets with the smaller electrodes, it is not advisable to do so. However, if a current of five kilovolt amperes is available, the equipment can be operated by being connected with the panel board from which the lights are supplied.

The connections of the apparatus are very simple; two wires run from the machine to the power supply, and two wires are attached to a regulating unit on the equipment. It is stated that the uses to which this apparatus may be put cover every field of arc welding, with the possible exception of the rapid handling of very heavy work. However, it will also do heavy work, but at a reduced rate, which, while perhaps not economical for use in production, is entirely economical for emergency repairs.



Portable Electric Arc Welding Equipment built by the Electric Arc Cutting & Welding Co.

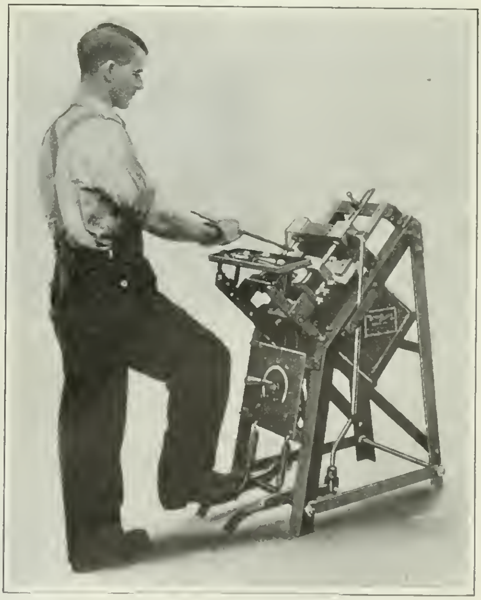
Some of the work to which the apparatus is applied in garages and automobile repair shops is as follows: Repairing scored cylinders, mud guards, mud guard brackets, cracked cylinder water jackets, frames, lamp brackets, bumper brackets, step braces, etc. Lead burning can also be done very successfully, and spot-, butt-, or tack-welding of small thin pieces can also be rapidly accomplished.

TAYLOR ELECTRIC RIVET HEATER

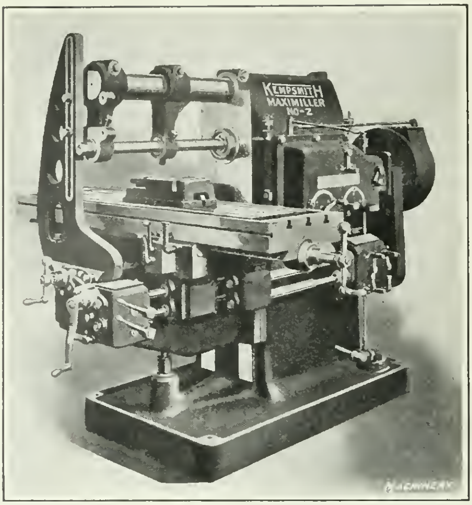
A new type of electric rivet heating machine has been developed by the Taylor Welder Co., Warren, Ohio, as shown in the accompanying illustration. This outfit can be permanently installed on a floor or a platform, or provided with a bail so that it can be picked up by a crane and moved from place to place as required. A simple plug connection is used to transmit electricity to the machine, and plugs can be located at various points about the shop. The machine illustrated is designed to heat two rivets simultaneously, but a machine can be built for heating any number of rivets in multiples of two. In most instances, however, a machine of the type shown will heat rivets sufficiently fast to keep one boy busy removing hot rivets and inserting cold ones. The time required for heating a rivet ¾ inch in diameter and 4 inches long is about thirty seconds. Of course, smaller rivets become hot in a correspondingly shorter period. Experiments have shown that 100 pounds of rivets can be heated with a current consumption of approximately 18 kilowatt hours.

In operating this machine, the top electrode is elevated by depressing one of the foot-treadles which are connected to the electrode by means of connecting-rods. The rivets are then inserted and the pressure on the treadle is released so that the electrode is lowered on the rivet heads and holds them in an upright position. The current immediately begins to flow from the terminals of the transformer through the rivet itself to the upper conductor, and then through the other rivet into the other terminal of the transformer, thus completing the circuit. In heating rivets in this manner, the heat is generated through the center of the rivet, whence it radiates toward the outside surface. Since the heat is under the absolute control of the operator, there is little tendency for the rivets to become burned, as the heat can be shut off when the best upsetting conditions have been attained.

Electrically heated rivets are not scaly when they are removed from the machine, as is commonly the case when rivets are heated in forges of the ordinary type. Therefore, they are more easily inserted in the riveting machine and also more readily headed, as their temperatures are more uniform. Some of the other advantages of this rivet heating machine are that the work is always in plain view of the operator; there are no fumes or gases delivered from the heater; there is no disagreeable heat in hot weather; there is no necessity for carrying coal or coke to the machine nor removing ashes; there is no expense when rivets are not being heated; and the machine is ready for operation at a moment's notice.



Machine built by the Taylor Welder Co. for heating Rivets electrically



Milling Machine recently introduced by the Kempsmith Mfg. Co.

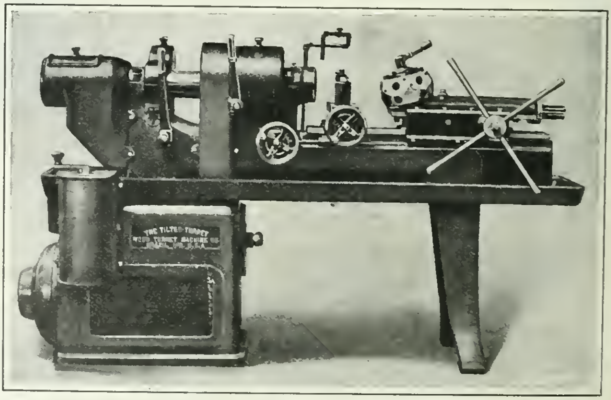
KEMPSMITH NO. 2 "MAXIMILLER"

In the November, 1918, number of MACHINERY, reference was made to the first of a line of "maximillers" to be placed on the market by the Kempsmith Mfg. Co., Milwaukee, Wis., this machine being known as a No. 4 size. The accompanying illustration shows another maximiller of recent development, which is known as a No. 2 size, and which is of the same general design as the No. 4. The principal dimensions of the new machine are as follows: Working surface of table, 56 by 12 inches; T-slots in table, three, ⅝ inch in width; longitudinal power traverse of table, 28 inches; transverse power traverse of table, 10 inches; vertical power movement of table, 19 inches; distance from face of column to over-arm brace, 24¾ inches; taper hole in spindle, B. & S. No. 12; diameter of hole through spindle, 1⅛ inches; number of spindle speeds, 18; range of spindle speeds, from 16 to 400 revolutions per minute; number of feeds, 18; range of feeds, from ⅝ to 25 inches per minute; rate of quick longitudinal traverse of table, 100 inches per minute; rate of quick transverse or vertical movements of table, 36 inches per minute; and floor space required, 85 inches in direction of spindle, and 105 inches in direction of longitudinal movement of table. The net weight of the machine is 4200 pounds.

MOTOR BASE ON WOOD TURRET LATHES

A new design of motor base and single belt drive which has recently been brought out by the Wood Turret Machine Co., Brazil, Ind., is shown in the accompanying illustration applied to one of the machines of this company's manufacture. This motor base, or cabinet leg, is so arranged that the motor can be easily removed for cleaning, or when repairs are necessary, by unloosening three machine screws which hold the circular cover to the left end of the base. Power is transmitted from the motor to the driving pulley on the spindle of the machine by means of a belt which passes through the pan and around the pulley, the tension of this belt being controlled by a double-acting idler which is operated by the hand-lever shown at the right-hand end of the base. The belt is fully guarded by means of a cast-iron cover.

This type of motor drive arrangement is being supplied on the Nos. 2, 3, and 4 friction back-geared machines, direct-current variable-speed motors being used. The controller-box crank and all other operating levers on these machines are so grouped that they are within easy reach of the operator, without requiring him to change his position in front of the machine.

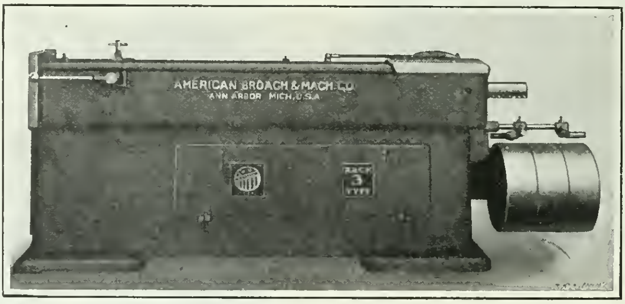


Motor Base furnished on Machines built by the Wood Turret Machine Co.

AMERICAN BROACHING MACHINE

The American Broach & Machine Co., Ann Arbor, Mich., has recently placed on the market a No. 3 broaching machine which is of the rack-operated type. This machine has a capacity for broaching round or square holes up to 3½ inches, using broaches up to 58 inches in length. The face of the machine is finished within 6 inches of the floor and is provided with two T-slots for use in holding special fixtures. As will be seen by referring to the accompanying illustration, the base is of the cabinet type. Shelves for holding broaches and a compartment which serves as an oil reservoir are located in the base. The starting head of the machine is made from a solid steel billet, fitted with hardened and ground steel shoes which slide in box-shaped ways.

The sliding head is fitted with a central broach-block that permits bringing the vertical head into accurate alignment for central broaching. The rack is 4¼ inches in diameter and has one flat side on which the teeth are cut. The rack teeth mesh with a hardened steel pinion carried on a hardened and ground shaft. A worm-gear of special phosphor-bronze, driven by a hardened steel worm,

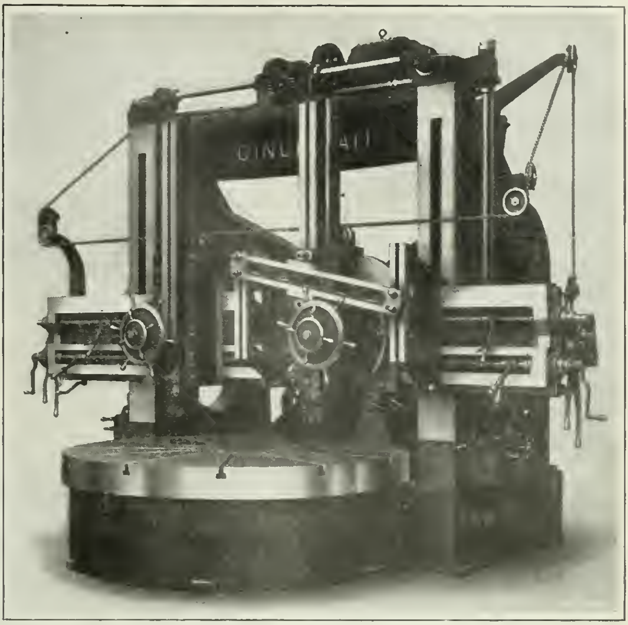


American No. 3 Rack-operated Broaching Machine is keyed to the pinion-shaft. The worm is provided with two roller thrust bearings to receive the end thrusts.

The machine is fitted with an automatic brake which absorbs the momentum of the moving parts when the operating head has reached the end of the stroke. Automatic stops which can be adjusted to give different lengths of stroke are provided. The reverse stroke has twice the speed of the cutting stroke. The loose pulleys are mounted on Hyatt roller bearings, and an oil pump and oil trough are furnished as part of the regular equipment.

TAPER ATTACHMENT FOR CINCINNATI BORING MILLS

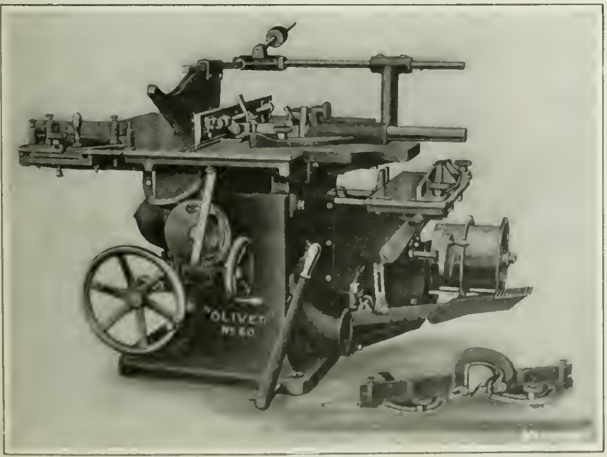
For use in turning and boring tapers which approach the horizontal so closely that swiveling of the head is not practicable, the Cincinnati Planer Co., Cincinnati, Ohio, has developed a taper turning and boring attachment for use on all sizes of boring mills of its manufacture from 42 inches up to 12 feet. The accompanying illustration shows the attachment on an 8-foot mill, and component parts such as the sine bar supports, sine bar, and sine bar guide are all clearly shown. To provide up and down adjustment of the ram, without loosening the sine bar and thereby changing its position, the faces of the ram are especially machined and fitted with a T-slot equal in length to the up and down travel. In mounting, the sine bar supports, sine bar guide, and sine bar are placed loosely in position and clamped securely in place after the proper angle has been determined. Power feed to the ram is then disengaged by means of the small handwheel, after which the attachment is ready for operation. Its use is recommended for angles up to and including 18 degrees.



Taper Attachment for Use on Boring Mills built by the Cincinnati Planer Co.

OLIVER NO. 80 SAW BENCH

A variety saw bench known as the No. 80 has been added to the line of equipment built by the Oliver Machinery Co., Grand Rapids, Mich. This machine, which is shown in the accompanying illustration, was designed to meet modern demands in the production of wooden patterns, furniture, automobile bodies, agricultural implements, talking machine cabinets, etc. It will rip work to a width of 23 inches, and cut off to a length of 32 inches, when a universal ripping table is provided; and will rip to a width of 27 inches, and cut off to a length of 15 inches with a plain table. Stock up to 3 inches thick can be cut with a 14-inch diameter saw, or to 4 inches thick with a 16-inch diameter saw. By using a mortising and boring attachment, holes up to 2 inches in diameter and 6 inches deep can be bored, and holes up to ¾ inch square and 4 inches deep can be mortised.



Belt-driven Saw Bench with Mortising and Boring Attachment, built by the Oliver Machinery Co.

The table has a surface 36 inches wide and 44 inches long; it can be tilted to an angle of 45 degrees, and has a vertical adjustment of 4 inches. The universal table has a sliding section 15 inches wide to the left of the saw, which rolls on ball bearing ways provided with a vertical adjustment for alignment and wear. This rolling table may be moved 4 inches from the saw to permit the use of dado saws and special heads. The rolling table permits accurate cross-cutting, mitering, and grooving operations to be done. A universal ripping fence, which can be tilted to an angle of 45 degrees, may be used on either side of the saw, or secured at any angle not in line with the saw, on either the stationary or sliding table. It has a quick adjustment of 12 inches, and a micrometer device is supplied for permitting accurate adjustments to be made. A metal block is provided for attachment to the fence to serve as a stop and give clearance when cross-cutting.

A miter cut-off gage, having a capacity for cutting at angles ranging from 30 to 135 degrees, is furnished for use on the sliding table when cutting off very wide stock. The machine may be driven by either a belt or motor drive, two types of motor drives being applicable. Where two- or three-phase, sixty-cycle, alternating current is obtainable, a compact driving arrangement can be provided by mounting the motor directly on the saw arbor in place of the ordinary pulley. The more usual type of motor drive consists of a five-horsepower motor running at about 1800 revolutions per minute, mounted on a sub-base, with adjustment for taking up belt stretch.

"BUHR" MULTIPLE-SPINDLE DRILL HEAD

Multiple-spindle drill heads of the type shown in Fig. 1 are manufactured by the Nelson Blanck Mfg. Co., Dubois and Clay Sts., Detroit, Mich., for the purpose of adapting single-spindle drilling machines for the drilling of a number of holes at one time. A detachable adapter and driver are provided for transmitting power to a square shaft of the attachment, which is mounted on a thrust bearing having a load capacity equal to the combined thrust of all the spindles. Radial ball bearings and spur gears are used throughout the entire construction, the head is self-contained and dustproof, and all moving parts are made from heat-treated chrome-nickel steel and run in grease. Special arms can be furnished for drilling to close center distances, each spindle unit having been designed to withstand three times the stress produced by using the maximum size of drill, so that each spindle will drive several drills placed on such special arms.

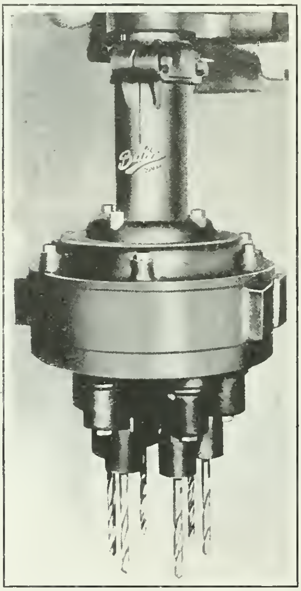


Fig. 1. Multiple-spindle Drill Head made by Nelson Blanck Mfg. Co.

The spindles of this multiple drill head can be set in various positions within certain limits to suit the holes to be drilled in the work. In Fig. 2 the spindles are arranged for drilling holes spaced about a circle of the minimum diameter that can be accommodated, while in Fig. 3, the spindles are set at their maximum distance from the center of the head. Fig. 4 shows how the different spindles can be placed, regardless of the position of the others.

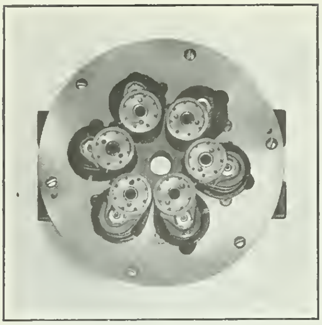


Fig. 2. Spindles set at the Minimum Distance from the Center

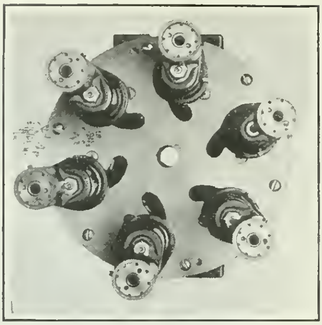


Fig. 3. Maximum Setting of Spindles from Center of Attachment

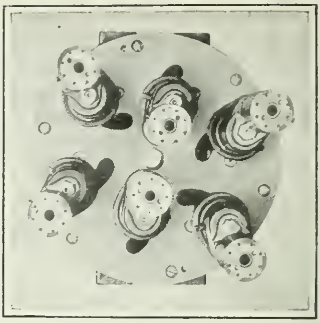


Fig. 4. Spindles set for drilling Another Combination of Holes

These tools are known as "Buhr" multiple-spindle drill heads, and they are made in many standard sizes, the smallest head having three spindles which will drill to a minimum sized circle of 1½ inches in diameter, and to a maximum circle of 6¼ inches in diameter, the maximum size of drill that can be used being ¼ inch in diameter. The largest drill head has four spindles which can be spaced for drilling to a minimum sized circle of 4½ inches in diameter and to a maximum sized circle of 18 inches in diameter. A number of standard heads are provided with 8, 10, and 12 spindles.

SHEFFIELD SNAP GAGES

The Sheffield Machine & Tool Co., Dayton, Ohio, has recently developed a new method of constructing snap gages, which enables various styles to be quickly made up from standard parts. These parts consist of head- and foot-blocks, shown in Fig. 1, which are manufactured in quantities and provided with either adjustable or solid renewable anvils as required. In addition to these parts, castings for C-shaped cylindrical snap gages, of the type illustrated in Fig. 2, are made in sizes from ¼ inch upward. In making up a gage of this type, it is only necessary to assemble the foot- and head-blocks on a casting of the required size. Internal and

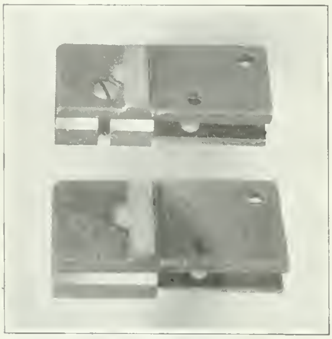


Fig. 1. Sheffield Gage Heads with Renewable Solid and Adjustable Anvils

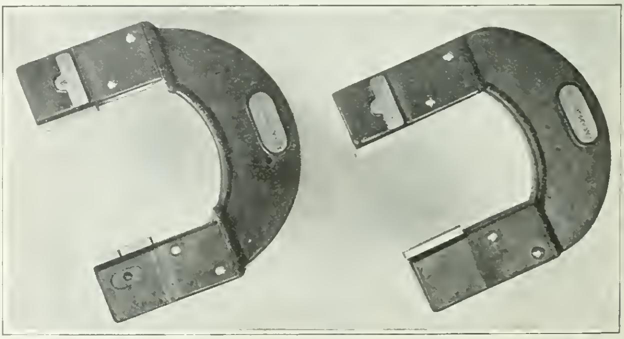


Fig. 2. Snap Gages for measuring Cylindrical Work, which are equipped with Sheffield Heads having Adjustable and Solid Renewable Anvils

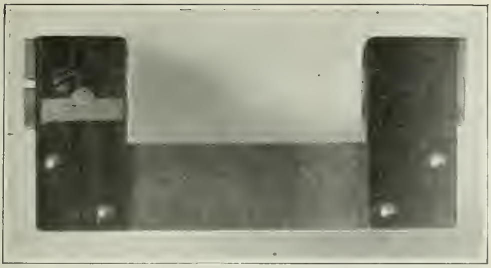


Fig. 3. Internal "Go" and "Not Go" Gage, equipped with Sheffield Heads having Renewable Solid and Adjustable Anvils

external gages such as shown in Figs. 3 and 4 are made by simply cutting a beam of strip steel to the proper length and then attaching the foot- and head-blocks as shown. Referring to Fig. 1, it will be seen that the "Go" and "Not Go" gaging points or anvils are so assembled that they form a snap gage of the two-step type for gaging the distance between two surfaces. The gage in Fig. 5 is so assembled that the solid anvils of the "Go" gage are on one side of the beam, and the solid anvils of the "Not Go" gage on the other.

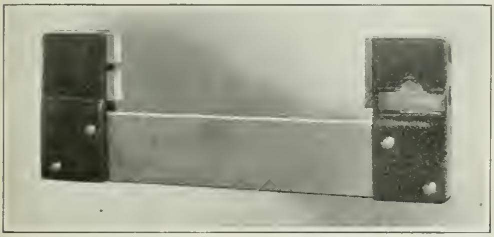


Fig. 4. External "Go" and "Not Go" Gage, equipped with Sheffield Heads having Renewable Solid and Adjustable Anvils

By the use of these Sheffield heads it is possible to quickly make any style of gage for measuring lengths, widths and thicknesses, either externally or internally, and also cylindrical work in lathes and grinders. The anvils are easily and cheaply replaced when worn, which makes the gage practically indestructible; and if the gage becomes obsolete, it is only necessary to remove the pins which hold the head- and tail-blocks to the beam or casting, and they can be used in making some other size of gage, the only scrap being the piece of strip steel which serves as a beam.

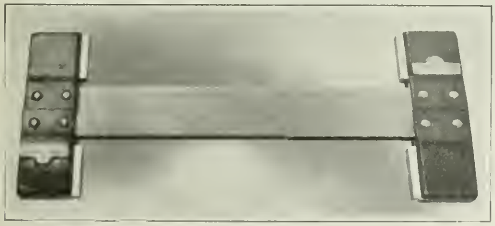
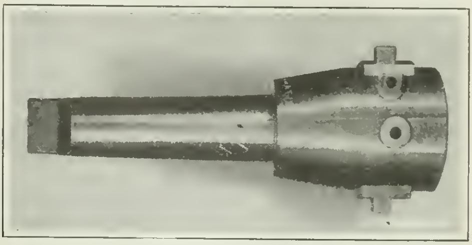


Fig. 5. Two-sided External "Go" and "Not Go" Gage equipped with Sheffield Heads having Solid Renewable Anvils

H. A. HOPKINS EXPANDING BORING-BAR

A type of expanding boring-bar which has proved satisfactory during a number of years of rough and heavy usage in railroad shops, being employed mainly in such operations as boring car wheels and journal boxes, has recently been placed on the market by H. A. Hopkins & Co., Inc., South Bend, Ind. This tool is known as the VV expanding boring-bar, being so called from its construction. The square type of cutters used gives ample strength for taking heavy cuts and an opportunity to grind a good clearance angle and rake on the cutters to facilitate the removal of metal. The cutters are adjusted radially for cutting to a specified diameter by means of a conical-pointed screw on one side of the bar, and they are locked securely in place by means of another screw having a suitable V-groove, on the opposite side.

On one job on which this type of boring-bar was employed, the operation consisted of boring automobile connecting-rods to the finished size in one cut. From 3/16 to ¼ inch of stock was removed on a side, and 371 rods were bored before the cutters required resharpening or readjustment.



Hopkins Expanding Boring-bar

This boring-bar can be supplied in any diameter or length required for holes from 1 to 12 inches in diameter, and it can be made with single or multiple sets of cutters. On the larger bars, regular commercial tool bits can be used, this feature being considered a valuable one, as broken or worn cutters can easily be replaced from any supply house. The bars have sufficient expansion to insure long cutter life.

JACKSON VERTICAL AUTOMATIC CHUCKING MACHINE

A vertical automatic chucking machine known as the Jackson is being manufactured by the Long-Henkel Mfg. Co., 3rd and Buttonwood Sts., Reading, Pa., for the rapid quan-

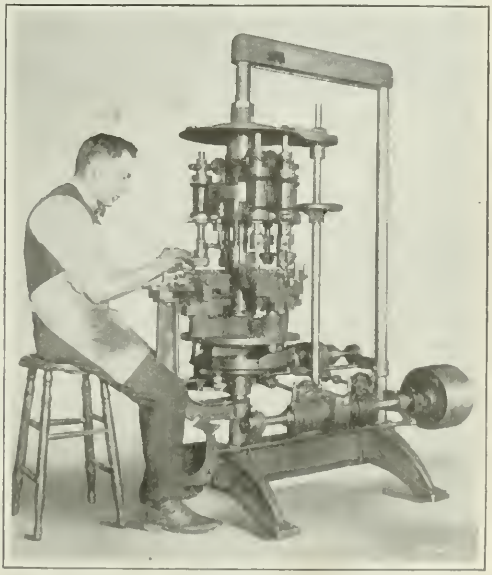


Fig. 1. Vertical Automatic Chucking Machine built by the Long-Henkel Mfg. Co.

tity production of small parts such as standard nuts, electrical fixtures, battery terminals, sash pulleys, etc. This machine is built in three different types. Fig. 1 shows a machine of the reciprocating type equipped with four duplex automatic chucking vises and three pairs of working spindles. It is mainly adapted to classes of work requiring turning, drilling, boring, tapping, or threading.

The chucking vises automatically eject the finished parts and clamp unfinished ones after they are inserted in the vises. This relieves the operator of everything but the mere handling and observation of the work. The machine has a positive drive throughout, and is fully equipped with ball bearings. Handy and quick-acting tool adjustments are provided to render the machine easy to set up. All work is constantly in full view of the operator, thus providing a safeguard against mischucking.

It is obvious that this machine permits multiple operations to be performed on the same piece of work as, for instance, drilling different sizes of holes, threading with different sizes of taps, and performing various other operations limited only by the number of spindles provided on the machine. When the machine is employed for threading or tapping standard bolts or nuts, a magazine feed appliance may be employed.

Fig. 2 shows a large variety of work which has been economically produced on machines of the type described. The operation performed on each part and the number of pieces finished per ten-hour day is given in the following, in order that an idea may be obtained of the rates of production secured: Piece *A* is a lock-bar in which four holes are drilled and tapped in two operations, the output being 10,000 pieces drilled or tapped per day. Standard nuts of the type shown at *B* are tapped at the rate of 20,000 per day. Two operations are performed on pump nipple *C*, the first of these consisting of turning, threading, and drilling, while the second consists of turning, facing, and threading the part. The number of either of these operations which can be performed per day is 5000. Electrical fixtures of the type shown at *D* are drilled, turned, faced, and threaded at the rate of 8000 per day. Identical operations are performed on the part shown at *E* and the rate of production is the same.

In the electrical fixture shown at *F*, two holes of different diameters are drilled, faced, and tapped, the production being 8000 pieces per day. Turning, pointing, drilling, and threading operations are performed on gage fixture *G*, and the output is 5000 pieces. The spiral wing-nut *H* is drilled, faced, and tapped at the rate of 5000 per day. A tapping operation is performed on the iron wing-nut *I*, 20,000 nuts being the output. Battery terminal *J* is drilled at a production rate of 20,000 pieces per day. Two holes are drilled in the cast-iron part *K* and one hole is tapped, the output being 5000 parts. The part shown at *L* is a sash pulley housing, of which 30,000 are drilled during the specified time, the same rate of production being obtained on the sash pulley *M*. The middle hole of the cast-iron part shown at *N* is drilled at the rate of 15,000 holes per day. The production secured on the pump part shown at *O* is 4000 pieces, drilling, facing, and tapping operations being performed. Door handle *P* is turned, drilled, threaded, and tapped at the rate of 5000 pieces per day. In the operations performed on pump handle *Q*, two tap holes are drilled, two holes are counterbored, and two holes are tapped, the number of parts produced per day being 5000.

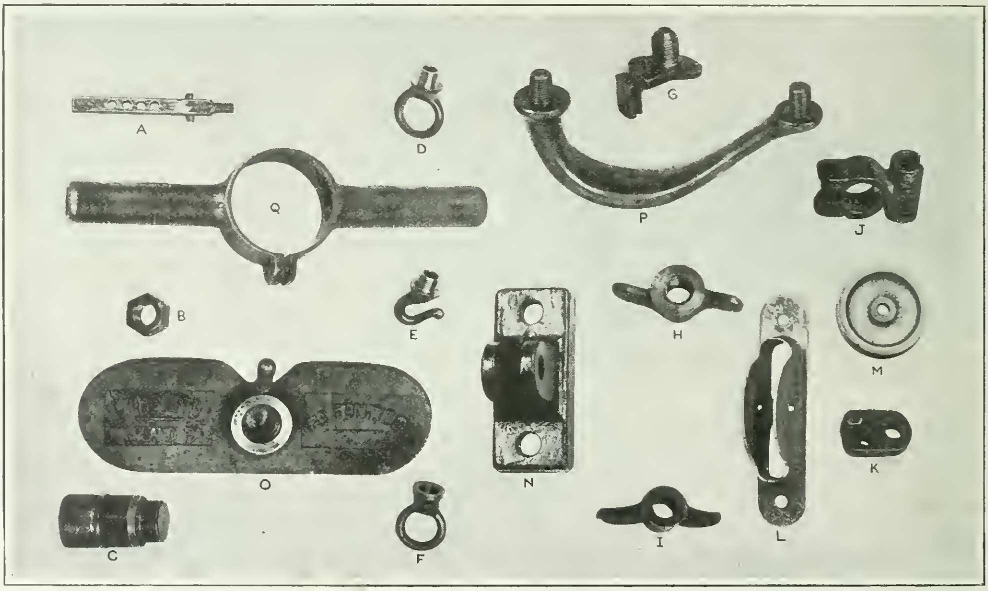


Fig. 2. Various Parts produced on the Machine illustrated in Fig. 1

NEW MACHINERY AND TOOLS NOTES

Plate Bending Brake: Dreis & Krump Mfg. Co., 2909 S. Halstead St., Chicago, Ill. A plate bending brake which weighs 30 tons and is capable of bending steel plates 12 feet long by ¾ inch thick with the metal cold.

Pouring Device: E. J. Woodison Co., 1621 St. Aubin Ave., Detroit, Mich. A mechanical pouring device provided with adjustable levers and a counterweight which enables ladles with capacities of over 400 pounds to be lifted 18 inches.

Revolving Knife Wood Trimmer: A. E. Bauer & Son, 7021 S. Racine Ave., Chicago, Ill. A revolving knife wood trimmer having a maximum length of cut of 7½ inches and a maximum height of cut of 2½ inches. Guides are provided which can be set at any angle up to 45 degrees.

Headstock: S. A. Potter Tool & Machine Works, 79 E. 130th St., New York City. A headstock which is essentially the same as that used on the bench lathes of this company's manufacture, but which is especially designed for mounting on a bench for use in filing, polishing, and lapping.

Multiple-spindle Drill Heads: Roberts Mfg. Co., 152 Brewery St., New Haven, Conn. A line of multiple-spindle drill heads of the fixed-center type which may be furnished with either cast-iron or aluminum cases. These heads can be furnished with any number of spindles to hold drills up to 1 inch in diameter.

Bench Shear: Bartlett Mfg. Co., 40 E. Lafayette Ave., Detroit, Mich. A bench shear known as the No. 25, which is of the same style as the No. 20 shear of this company's manufacture, except that the cut of the new shear is 4½ inches, whereas the No. 20 has a cut of only 3 inches. This machine will cut steel bars or sheet iron up to ⅛ inch.

Riveter for Boiler Flanges: Baird Pneumatic Tool Co., Kansas City, Mo. A pneumatic riveter for marine boiler flanges, which is intended for driving rivets between the flanges of either two- or three-furnace Scotch marine boilers and similar work. The riveter is hung in a circular frame and is so balanced that it can be readily placed in any position.

Electric Welding Machine: Electric Welding Machine Co., 500 E. Larned St., Detroit, Mich. The "Weldrite" electric welding machine designed for the electric welding of cast iron and repair work in machine shops and foundries. The machines operate on 110, 220, or 440-volt alternating current where access can be had to an electric circuit delivering 75 amperes.

Scale Remover: George Oldham Son & Co., Baltimore, Md. A pneumatic tool for removing scale from boiler tubes and crown sheets, as well as paint and rust from all metal surfaces. The light, rapid strokes delivered by this device will remove scale without injury to the surface. The device measures only 3½ inches over all and weighs approximately 2½ pounds.

Pouring Ladle Heater: Wayne Oil Tank & Pump Co., Fort Wayne, Ind. A ladle heater, consisting of a frame upon which the ladle may be supported at various heights, and an inverted burner mounted on the top plate of the frame, which has a cone-shaped hood designed to blow the flame into the ladle. The burner uses oil at 5 pounds or more pressure and air at 1½ pounds.

Threading Tool: Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill. A spring threading tool provided with means for quickly obtaining rigidity, so that the tool can be used for roughing or ordinary turning. The cutting tool can be swung to either side of its central position. This holder is made in sizes ranging from ⅜ by ⅞ by 5½ inches up to ¾ by 1⅝ by 8½ inches.

Coil-winding Machine: Charles Eisler, 159 Clifton Ave., Newark, N. J. A coil-winding machine intended for winding the filament coils for gas-filled, incandescent lamps, which is claimed to be capable of winding coils from 25 to 900 turns per inch for lamps of 15 to 1000 watts. The mandrels used are from 0.003 to 0.035 inch in diameter, and can be dissolved in acid after the coil is completed.

Band Saw: West Side Iron Works, Grand Rapids, Mich. A 14-inch bench band saw known as the "West Side Junior," which is intended for use in pattern shops, furniture factories, manual training schools, etc. The machine is furnished with either belt or motor drive, and has a table measuring 16½ by 19 inches. Provision is made for tilting the table to any angle up to 45 degrees.

Multiple-spindle Drill Heads: United States Drill Head Co., Cincinnati, Ohio. A line of fixed-center, multiple-spindle drill heads, each head being especially designed for the work on which it is to be used. Light weight heads are usually driven by a standard taper shank, while those intended for heavy work are clamped to the quill and driven by a key inserted in the drift slot of the spindle.

Electric Contactor Controller: Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. A Type S contactor controller, intended for starting and regulating the speed of shunt-series, and compound-wound direct-current motors used on cranes, hoists, crushers, roll and transfer tables, etc. This controller will operate in any position, as the contactors are spring-actuated, and therefore not affected by gravity.

Slotting Machine: Racine Tool & Machine Co., Racine, Wis. A No. 25 slotting machine which has a table measuring 12 by 27 inches. The machine makes 60 strokes per minute, with a length of stroke of 7 inches. The main working parts of the mechanism and the reservoir for the coolant are contained in the base. The feed is governed by a spring-controlled lever which can be regulated from the front of the table.

Nut and Screw Driving Machine: Spencer K. Brown, Syracuse, N. Y. A nut and screw driving machine designed to turn at the rate of 1000 revolutions per minute, which is now used in the assembling department of the H. H. Franklin Mfg. Co., of Syracuse. This machine is the invention of Mr. Brown who is associated with the above company. However, plans for the manufacture of this machine have not been decided upon.

Magnetic Testing Apparatus: A device for the magnetic testing of steel, known as the "Defectoscope" and invented by Dr. Charles W. Burrows, magnetic research engineer, Grasmere, N. Y. This device is especially adapted for use in determining defects in steel wire, rods, rails, cables, and strips. It is also useful in determining whether or not the piece under test is of the same magnetic characteristics as the original sample.

Portable Electric Drill: Arnold Electric Tool Co., Inc., 902 Chapel St., New London, Conn. The Arnold Type C portable electric drill, which is provided with a 1/3-horsepower motor having an idle speed of 480 revolutions per minute. This tool will drill ½-inch holes in steel and ¾-inch holes in wood or brass. The motor operates on both alternating and direct current of 110 to 120 volts, although machines can be furnished for other voltage.

Tier-lift Truck: Lakewood Engineering Co., Cleveland, Ohio. In the February number of Machinery mention was made of a tier-left truck made by this company. An improved model No. 703-A built along the same general lines has recently been brought out. It has a lifting range of 96 inches and has double the lifting speed of the truck previously described. This truck is designed especially for handling light bulky packs having a total weight of not over 2000 pounds.

Arbor Press: P. A. Geier Co., Cleveland, Ohio. A general utility arbor press designed for use in garages, repair shops, and machine shops. This press has a hardened steel pinion which meshes with an 8/10 pitch stub tooth steel rack. The height of throat over the plate is 13¾ inches, the largest arbor opening 2 inches, and the maximum diameter of the work which can be accommodated is 33 inches. The operating lever is 22½ inches long, and with the compound mechanism gives a leverage of 160 to 1; with the compound mechanism out the leverage is 40 to 1.

Electric Chain Riveting Machine: Kobert Machine Co., Buffalo, N. Y. A machine for automatically riveting sprocket chain links. The links are fed from a rotating hopper, having a screw and worm rail within the hopper body which feeds the links directly into the welding fixture. The jaws then close on the work, the electrode makes contact in a manner which permits no sparking or arcing, and when the desired heat is obtained, the electrode is raised and a heading set delivers a heavy blow, thus forcing the metal into the desired shape.

Magnetic Separator: Dings Magnetic Separator Co., 672 Smith St., Milwaukee, Wis. A Type B magnetic separator intended for extracting iron from brass and aluminum chips, abrasive materials, rubber buffings, etc. The machine has an electromagnet with poles located above two cross-belts, which travel above a wide belt containing the material to be separated. The cross-belts carry the particles which are raised by the magnetic poles to the side of the machine, whence they drop into receptacles placed to receive them. The machines are built in five sizes with conveyor belts from 18 to 60 inches in width.

Metal-spinning Lathe: P. Pryibil Machine Co., 512-524 W. 41st St., New York City. A metal-spinning lathe of the extension-bed type, which is intended for the spinning of articles of large dimensions, such as utensils for restaurant kitchens. The headstock is provided with a cone pulley and back-gears. With the gap closed, the swing is 27 inches, and with the bed extended, 60 inches. A compound slide-rest is provided, which can be set to any position. The longitudinal feed is 16 inches and the cross feed 9 inches. Faceplates measuring 20 inches and 12 inches are provided. The net weight of the machine is 4500 pounds.

Grinding Machine: B. L. Schmidt Co., Davenport, Iowa. A "Micro" semi-automatic 19- by 24-inch internal grinding machine, having provision for wet grinding. It grinds holes from 2½ to 10 inches in diameter and up to 13 inches long. There are two wheel-spindle speeds of 5500 and 3652 revolutions per minute; and the planetary speeds are 48 and 25 revolutions per minute, with table speeds 11, 6½, 5¾, 4⅝, 3⅝, and 2½ inches per minute. The headstock is mounted on the bed, and the table travels under it. The spindle has an eccentric motion, variable from 0 to 1⅛ inches, and it is possible to feed in units of 0.0001 inch by means of push-buttons on the headstock.

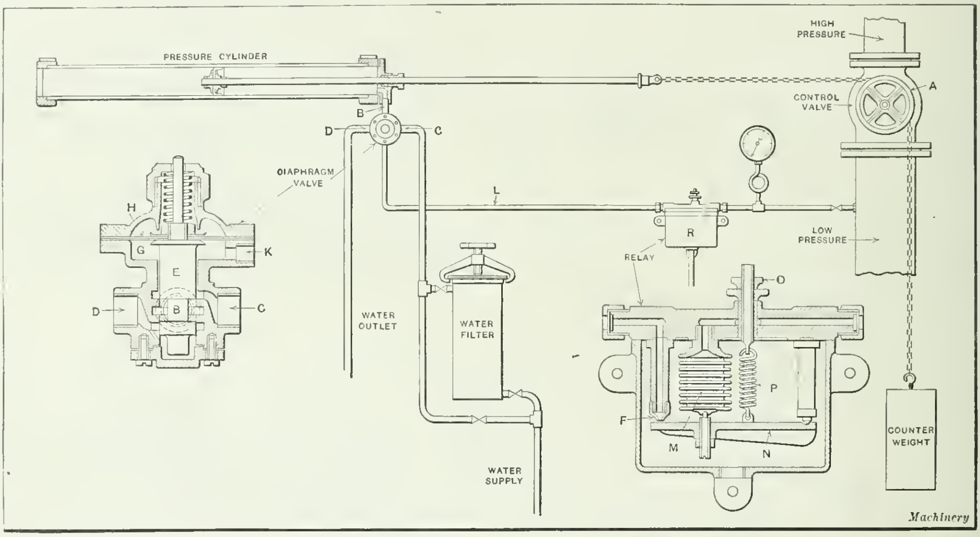
Oil-burning Furnaces: Wayne Oil Tank & Pump Co., Fort Wayne, Ind. A line of tilting non-crucible type oil-burning furnaces for melting brass, copper, aluminum and other non-ferrous metals. These furnaces are built in two sizes having capacities of 350 to 550 and 550 to 800 pounds, respectively. Air at a pressure of about 1½ pounds and oil at 5 pounds or more pressure is required to operate the burners. This company has also brought out a tilting crucible-type oil-burning furnace made in three sizes, having capacities of 200, 350, and 750 pounds, respectively. A worm-gear drive is provided for tilting, and its action serves to lock the furnace in any position. The burner is designed for air pressure of from 1 to 2 pounds, and an oil pressure of 5 pounds or more.

ARCA AUTOMATIC REGULATING APPARATUS

An ingenious regulating apparatus which is especially designed for maintaining constant pressure of steam, air, gas, water or other fluids, or for obtaining a constant temperature or a constant electromotive power has been developed by a Swedish inventor by the name of Ragnar Carlstedt. The regulating device is based upon a well-known hydrostatic law. The simplest method of explaining how the regulating apparatus functions will be to take an actual example as shown diagrammatically in the illustration. Here the apparatus is used for controlling the flow of steam, and actuates through a sprocket wheel *A*, the control valve on the steam line. The sprocket wheel is substituted for the handwheel on an ordinary globe valve, and a chain passes over the sprocket wheel to a counterweight as shown at its lower end, while the other end of the chain is connected to a piston-rod, the piston of which is moved by hydraulic pressure in the cylinder. It is evident that a movement of the piston in the pressure cylinder caused by the operation of the regulating mechanism will open or close the globe valve, because if the pressure in the cylinder is reduced, the counterweight will pull the piston toward the right and open the valve, while if the pressure on the piston is increased, it will close the valve against the action of the counterweight.

The pressure of the water in the pressure cylinder is controlled by a diaphragm valve, this valve being shown in section on an enlarged scale. The valve is connected at *C* with a water supply line, and at *D* with a water outlet. It is connected to the pressure cylinder by port *B* and to the relay *R* by piping *L* which enters the valve at port *K*. The relay *R* is connected, in turn, with the low-pressure side of the steam system to be regulated, and controls the pressure of the water in chamber *G*. The manner of operation will be described later. If there is a variation in the pressure of the water in chamber *G* a movement of valve piston *E* will be produced due to the action against diaphragm *H*, and thereby either the port *C* or *D* may be closed. The spring on the opposite side of this diaphragm makes it possible to adjust to the exact amount of pressure that is wanted to cause a given movement, this adjustment being made through suitable nuts. The pressure in chamber *G* causes water to be constantly forced to the relay, where it escapes through an orifice.

A section through the relay is shown on an enlarged scale in the lower right-hand corner of the illustration. The construction of the relays used in different installations of this regulating system varies, but the basic principle whether for pressure, heat-controlled electric current regulation, etc., is the same. The relay regulates the amount of water that escapes from pipe *L* through orifice *F*, and thus controls the pressure in chamber *G*. Close to the mouth of orifice *F* is the end of the pivot lever *N* which may be drawn by varying force against the metal bellows *M*, by coil spring *P*, which is adjusted by the nut *O*. The variations of the pressure in the low-pressure side of the steam line cause the bellows to expand and contract, thus causing slight movements of the lever. When the end of the lever is moved away from orifice *F*, the pressure behind the jet is automatically decreased, and when the lever is moved closer to the orifice, there is an increase in the hydrostatic pressure behind the jet. Hence, the pressure in chamber *G* is automatically increased or decreased with the variations in the low-pressure steam line, and suitable movements of valve piston *E* are obtained as previously described.



Automatic Regulating Apparatus for controlling Pressure of Fluids and Gases

The action of the entire apparatus is as follows: When the pressure in the steam line increases, the bellows expand and force lever *N* downward, permitting an increased flow of water through the orifice *F*, and thereby reducing the pressure in chamber *G* of the diaphragm valve and causing a movement of piston *E* so that port *C* is closed and port *D* opened. This allows water to be discharged from the pressure cylinder, thus reducing the pressure in the cylinder and allowing the counterweight to close the globe valve sufficiently to compensate for the rise in pressure of the steam. In like manner, a decrease on the low-pressure side of the steam line causes the bellows in the relay to contract, thereby bringing end of lever *N* closer to the orifice. This increases the hydrostatic pressure behind the orifice, increases the pressure in chamber *G*, opens the supply port *C* and closes port *D*, and thereby increases the pressure on the piston in the pressure cylinder, pushing it to the left and opening the globe valve against the action of the counterweight.

The characteristic of the relay employed in electric installations is the utilization of the law of expansion. This relay is used in connection with a rheostat for obtaining the proper current supply, and operates on the same basic principle as the relay previously referred to. It consists of an outer brass tube in which a glass or porcelain tube is contained, and the impulse for actuating the water jet is derived from the difference in the coefficient of expansion of the two materials from which the tubes are made. These relays are suitable for temperatures up to about 390 degrees F. For higher temperatures up to 1100 degrees F., the outer tube is made of nickel. The electric relays are capable of handling any amperage or flow of electric current.

There are two types of relays for pressure regulations, one for high pressures from 2 to 300 pounds per square inch, and one for low pressures. The high-pressure relay is the one described in the preceding paragraphs, and the design of the low-pressure relay makes use of a canvas diaphragm in place of the bellows mentioned in connection with the high-pressure relay. In addition to the usages referred to, this regulating system may be employed for a diversity of purposes, such as regulating furnace drafts, for dryer installation in automatically controlling the moisture, for heat-treating furnaces, and numerous other commercial purposes.

Only a very slight impulse is required to actuate the movement of the pressure cylinder piston, it being stated that the regulator will operate with a very slight variation in the water jet. For example, it is pointed out that often a movement of only a few thousandths of an inch of the lever which controls the water jet will operate the pressure cylinder piston. The apparatus is handled in this country by the American Galco, Inc., Grand Central Palace, New York City.

* * *

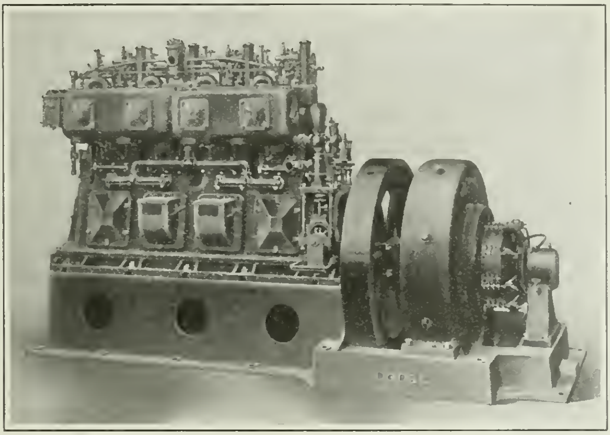
FORTIETH ANNIVERSARY OF A. S. M. E.

On November 5, 1880, a meeting of engineers was held at the Union League Club in New York City for the purpose of organizing an association of mechanical men which was given a name that is now well known in engineering circles —the American Society of Mechanical Engineers. To commemorate the fortieth anniversary, a meeting was held in the Engineering Societies Auditorium at 29 W. 39th St., New York City. Meetings were also held simultaneously by all of the local sections of the society. One of the features of these meetings consisted of the demonstration of a contribution to applied science made by W. H. Bristol, president of the Bristol Co., Waterbury, Conn. Mr. Bristol has been successful in developing a practical means for synchronizing the operation of a moving picture machine and a phonograph, making it possible for a speaker to be shown continuously on the screen while the phonograph reproduces his words in time with corresponding gestures. Fred J. Miller, president of the American Society of Mechanical Engineers, and Ira N. Hollis, past president, went to Waterbury for the purpose of having records made that could be distributed to all of the sectional meetings to convey the greetings of these two distinguished members of the society, and to show them while making their speeches. Unfortunately, time did not permit of sending out the required moving picture equipments for the purpose, but the phonograph records were used. At the New York meeting the chief speakers of the evening were Fred J. Miller, president of the American Society of Mechanical Engineers; J. Herbert Case, acting governor of the Federal Reserve Bank, New York City; Samuel Gompers, president of the American Federation of Labor; and William B. Dickson, vice-president of the Midvale Steel & Ordnance Co. Representatives were in attendance from the Institution of Mechanical Engineers of Great Britain, the American Society of Civil Engineers, and the American Society of Mining Engineers.

* * *

DODGE ELECTRIC GENERATING APPARATUS

One of the latest developments of the Dodge Sales & Engineering Co., Mishawaka, Ind., is shown in the accompanying illustration. It consists of an electric generator driven by a Dodge heavy oil engine. The units may be furnished with the engine connected directly to the generator as shown, or may be equipped for belt drive. The sizes at present manufactured range from 12½ up to and including 75 horsepower. The Dodge engine is sold under a standard guarantee which specifies a consumption of fuel oil of 0.5 pound per brake horsepower hour, using fuel as low as 0.28 degree Baumé test, containing not less than 18,500 British thermal units per pound. The engine here illustrated has a brake output of 50 horsepower, and is direct-connected to a 30-kilowatt, 220-volt, direct-current generator, running at a normal speed of 425 revolutions per minute. The cost of producing current with this equipment is said to be five mills per kilowatt hour, basing the cost of fuel at five cents per gallon.



Dodge 50-horsepower Electric Generating Unit

The generator was developed especially for this particular service by the Engberg Electrical & Mechanical Works, St. Joseph, Mich. The armature is of the iron-clad ventilating type with a laminated core, being built of electrical sheet steel, thoroughly japanned before being assembled. The drum and core are provided with air ducts which permit a thorough circulation of air. In the type shown, the crankshaft coupling is connected directly to the armature drum, so that the engine drives through the armature and not through the armature shaft. This construction enables the armature to be removed without disturbing the engine.

The commutator is made of copper bars insulated with a high-grade mica plate and it is of heavy construction, thus insuring continuous operation without need of renewal. It is built up on a separate sleeve, and bolted to the armature drum, so that the shaft can be removed without disturbing the windings. The bars are collected in a steel chuck, which is provided with large steel screws. In assembling, the chuck is heated and allowed to expand, at which time the screws are tightened so that when the chuck cools and shrinks, the commutator is held tightly in place.

* * *

The monthly statements of the Interstate Commerce Commission show that from March 1 to September 1 of this year the railroads expended approximately $175,000,000 more on maintenance of roadway and structures than during the corresponding period last year.

STRENGTH OF SPUR GEARS

A chart developed in the engineering department of the Foote Bros. Gear & Machine Co., Chicago, Ill., to simplify the calculations involved in figuring the strength of spur gears is shown in the illustration. This chart is based upon the well-known Lewis formula that is given on page 595 in MACHINERY'S HANDBOOK, and gives the safe working load in pounds per inch of face at the pitch line of cast-iron gears when the velocity at this line is zero. The safe working load at any velocity can then by determined by the method described in the following. A tensile strength of 8000 pounds per square inch is used in constructing the chart, this being suitable for cast-iron gears with cut teeth. In order to find the safe working load of unhardened steel gears, the values obtained by the chart should be multiplied by 2.5, and to find the safe working load of hardened steel gears the values should be multiplied by 4.

In using the chart, the safe working load of the gear, in pounds per inch of face, when the velocity equals zero is determined by following the vertical line corresponding to the number of teeth in the gear to its intersection with the curved line representing the pitch of the gear teeth, and then following the nearest horizontal line at the point of intersection to the left side of the chart. The value obtained should next be multiplied by the face width of the gear in inches. This last value is multiplied by a certain factor, which is dependent upon the velocity of the gear, to find the safe working load of the gear when the velocity in feet per minute is known. This velocity V can be readily found by multiplying the product of the pitch diameter in inches times the number of revolutions per minute by the constant 0.262. The factors referred to in the foregoing corresponding to various velocities are given in the accompanying table. When the safe working load W of a given velocity is known, the horsepower can be calculated as follows:

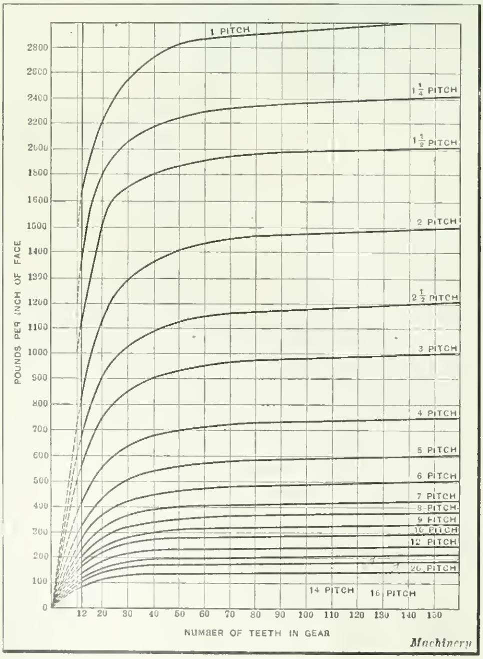


Chart giving Safe Working Load of Spur Gears in Pounds per Inch of Face when the Velocity equals Zero

$$\text{H.P.} = \frac{V \times W}{33{,}000}$$

As an example, assume that it is desired to find the horsepower of a 20-tooth hardened steel spur gear of 2½ diametral pitch, having a face 4 inches in width and rotating at the rate of 600 revolutions per minute. By following the vertical line of the chart corresponding to 20 teeth until it intersects with the 2½-pitch curved line, and then following the horizontal line passing through this point of intersection to the left side of the chart, the safe working load per inch of face width will be found to be 900 pounds. Multiplying this value by 4 gives a safe working load of 3600 pounds for the entire face width, provided the gear is made of cast iron. However, as the gear is made of steel and hardened, this value must also be multiplied by 4, so that 14,400 pounds equals the safe working load of the gear, assuming that the velocity at the pitch line equals zero. The velocity of the gear is equal to 8 × 600 × 0.262, or 1257 feet per minute. The factor in the table corresponding to the nearest velocity, which is 1200 feet per minute, is 0.333. The safe working load of the gear at the given velocity therefore equals 0.333 times 14,400 or 4800 pounds. By substituting the proper values in the horsepower formula:

TABLE OF STRENGTH FACTORS

Velocity, Feet per Minute	Factor	Velocity, Feet per Minute	Factor
50	0.928	600	0.500
100	0.857	900	0.400
200	0.750	1200	0.333
300	0.666	1800	0.250
450	0.571	2400	0.200

Machinery

$$\text{H.P.} = \frac{1200 \times 4800}{33{,}000} = 175$$

* * *

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for October 1, 1920.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Matthew J. O'Neill, who, having been duly sworn according to law, deposes and says that he is the treasurer and general manager of The Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Industrial Press 140-148 Lafayette St., New York
Editor, Erik Oberg " " " " "
Managing Editor, None " " " " "
Business Managers:
  Alexander Luchars, President " " " " "
  Matthew J. O'Neill, Treasurer
    and General Manager " " " " "

2. That the owners of 1 per cent or more of the total amount of stock are:

The Industrial Press 140-148 Lafayette St., New York
Alexander Luchars " " " " "
Matthew J. O'Neill " " " " "
Louis Pelletier " " " " "
Erik Oberg " " " " "
H. L. Ketchum " " " " "
E. Y. Urban " " " " "

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MATTHEW J. O'NEILL, General Manager.

Sworn to and subscribed before me this 29th day of September, 1920.

WILLIAM E. BACON.
(SEAL) Notary Public, Kings County, No. 522.
Kings Register, No. 1279.
New York County No. 747
New York Register No. 1673
(My commission expires March 30, 1921.)

PERSONALS

D. B. Carson has been appointed Cleveland district sales manager for the Tacony Steel Co., Philadelphia, Pa.

D. J. Crowley has been appointed Michigan sales agent of the Tacony Steel Co., Philadelphia, Pa., and will be located in the Dime Bank Bldg., Detroit, Mich.

C. W. Angerman, for six years chief draftsman for the Griscom-Russell Co., Massillon, Ohio, has entered the employ of the Lucius Mfg. Co., Canton, Ohio, as chief mechanical engineer.

W. B. Currier, Jr., has been appointed general manager of the Cleveland Planer Co. and the Cleveland Machine Tool Co., Cleveland, Ohio. Mr. Currier replaces D. B. Clark who is no longer connected with either concern.

W. H. De Wolfe has recently been appointed district manager of the New Britain Machine Co., New Britain, Conn. Mr. De Wolfe's headquarters will be in Boston, Mass., at Room 638, Old South Bldg., 294 Washington St.

William Hartman, superintendent of the National Cash Register Co., Dayton, Ohio, has been elected a member of the board of directors of that company. Mr. Hartman has been in the employ of the company for thirty years.

A. H. Ackerman has been appointed district sales representative of the Tacony Steel Co., Philadelphia, Pa., succeeding F. B. Hillwick. The offices have been removed from the Marquette Building to 427 Reaper Block, Chicago.

G. E. Anderson, formerly assistant eastern sales manager of the Duff Mfg. Co., Pittsburg, Pa., has been promoted to the position of southwestern sales manager, and placed in charge of the new branch office of the company located in the Railway Exchange Bldg., St. Louis, Mo.

Frederick T. Davis is now connected with the New York branch office of the Becker Milling Machine Co, Reed-Prentice Co., and Whitcomb-Blaisdell Machine Tool Co., located at Grand Central Palace, New York City. Mr. Davis was formerly with the Davidson Tool & Mfg. Corporation.

C. F. Meyer, assistant secretary of the Landis Machine Co., Waynesboro, Pa., will leave shortly for an extended trip to the Orient in the interests of the company. Mr. Meyer will visit England, India, The Dutch East Indies, Australia, Philippine Islands, China, Japan, and Hawaii.

Ralph K. Rowell, formerly equipment engineer at the International Motors Corporation, has become a director and vice-president of Hubbard & Harris, Inc., Bridgeport, Conn., consulting engineers. His attention will be given particularly to the work of the machine and equipment designing department.

R. H. Bowyer, formerly factory manager of the Dittmer Gear & Mfg. Corporation, Lockport, N. Y., has been appointed sales engineer. George E. Wilkinson, formerly chief inspector, will take Mr. Bowyer's place as factory manager. E. L. Sherman has been promoted to the position of supervisor of inspection.

J. F. Boyd, formerly with the Cyclops Steel Co., has been placed in charge of sales of the Wetmore expanding reamers in the Chicago district, which includes Illinois, Missouri, and northern Indiana. Mr. Boyd's office is at 846 Marquette Bldg., Chicago, Ill. The Scully-Jones Co. will continue to handle Wetmore products as heretofore.

L. C. Wilson, for the last two years general sales manager of the Chain Belt Co., Milwaukee, Wis., has been elected secretary of the Federal Malleable Co., West Allis, Wis., manufacturer of malleable castings, malleable chain, and the "Rapid" molding machine. He will be succeeded as sales manager of the Chain Belt Co. by Clifford F. Messinger.

George H. Morgan has been elected treasurer of E. F. Houghton & Co., Philadelphia, Pa., manufacturers of oils and leathers. The position of secretary, formerly held by Mr. Morgan, will be filled by George W. Pressell, chief of the Houghton Research Staff. Mr. Morgan will retain the position of managing director of the leather manufacturing department of the company.

Albert H. Hopkins has resigned from the presidency of the Engineering Advertisers' Association of Chicago and from the managership of the advertising and sales promotion departments of the C. F. Pease Co. to become Chicago manager for the J. Roland Kay Co., 161 E. Erie St., Chicago, Ill., international advertising agent. He will have charge of the domestic division of the company.

E. P. Williams, formerly director of field work, Bureau of Market Analysis, Inc., has become associated with the Independent Pneumatic Tool Co., Chicago, Ill., manufacturer of "Thor" air and electric tools. Mr. Williams will have charge of the Direct by Mail Advertising and Sales Promotion Department of the company and will be located in the general offices at 600 W. Jackson Blvd., Chicago.

J. J. Arnsfield, advertising manager of Fairbanks, Morse & Co., was elected president of the Engineering Advertisers' Association of Chicago, to fill the vacancy made by the resignation of A. H. Hopkins; Keith J. Evans, advertising manager of Joseph T. Ryerson & Son, was elected vice-president; and Julius Holl, advertising manager of the Link-Belt Co. was elected a member of the board of directors.

Walter Watson, who has been in the continuous employ of the Watson-Stillman Co. for fifty years, was presented on November 1, by the directors of the company, with a check for $1000 as an expression of appreciation of his long and faithful services as a highly skilled machinist. In addition, the company agreed to pay Mr. Watson, upon his voluntary retirement from employment, the sum of $65 a month during his life, and on his death to pay to his wife $50 a month throughout her life.

Albert A. Dowd, formerly president of the Service Engineering Co., 25 Church St., New York City, is no longer connected with that company. Mr. Dowd has formed another company, which will operate under the name of Albert A. Dowd Engineering Co. Offices and drafting-rooms will be maintained at 131 W. 39th St., New York City. The new organization is prepared to handle work in the following lines: Planning, consulting, factory investigations, industrial engineering, design of tools, design of automatic machinery, and building of tools and automatic machinery.

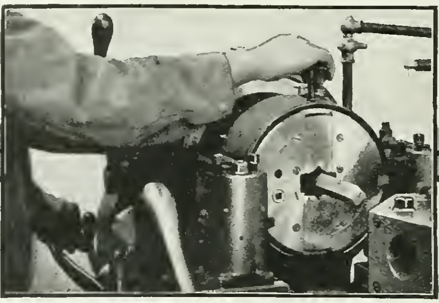
Fritz J. Frank has been elected president of the Iron Age Publishing Co. to succeed W. B. Taylor who recently retired on account of ill health, aften ten years able and vigorous administration. Mr. Frank was born in Pennsylvania in 1872, and in 1898 became western business manager of the *Colliery Engineer*, a publication well known at that time in the coal mining field. In 1906 he left the *Colliery Engineer* and became connected with the *Mining & Scientific Press*, continuing there until 1910 when he came to the *Iron Age* as advertising manager in the New York territory, being made secretary in 1911 and since 1918 vice-president of the Iron Age Publishing Co. Mr. Frank's twenty two years' experience in technical journalism, and particularly in the iron, steel, and machinery industries, qualifies him unusually well for his present position at the head of the Iron Age organization. He has many friends in those industries as well as in the publishing field who join in wishing him success as the responsible head of a great journal with sixty-five years of history behind it.

Fritz J. Frank

* * *

SOCIETY OF INDUSTRIAL ENGINEERS' MEETING

The Society of Industrial Engineers held its annual fall convention in Pittsburg, November 10 to 12. The keynote subject of the convention was Industrial Education. Among the speakers at the convention were Frank B. Gilbreth, of Frank B. Gilbreth, Inc., Montclair, N. J., who spoke on "Some New Factors in Industrial Education"; M. O. Leighton, chairman National Public Works Department Association, Washington, D. C., who spoke on "The Need for the Application of Industrial Engineering Principles in National Affairs"; H. H. Merrick, president Great Lakes Trust Co., Chicago, who spoke on "Training Managers to Apply Business Principles"; Dwight T. Farnham, St. Louis, who spoke on "European Industrial Conditions"; E. L. Ryerson, Jr., vice-president and works manager Joseph T. Ryerson & Son, Chicago, who spoke on "Training Industrial Engineers within the Organization"; and William O. Lichtner, Thompson & Lichtner, Boston, who spoke on "Methods of Training Time Study Men." The business manager of the society is George C. Dent, 327 S. La Salle St., Chicago, Ill.



Two distinctive features that give

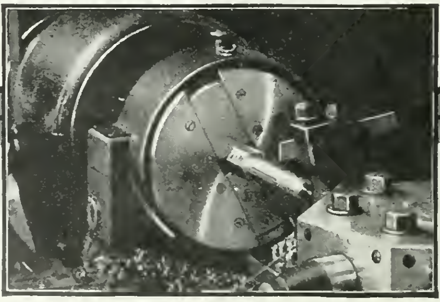
BROWN & SHARPE

Wire Feed Screw Machines

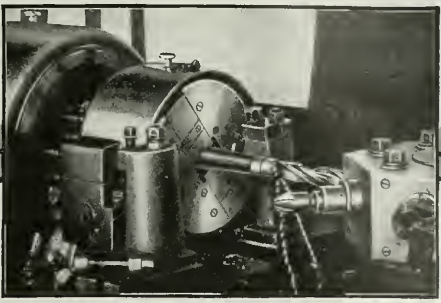
such great flexibility are the Roller Feed and the Automatic Chuck.

The **Roller Feed** is located near the front spindle bearing. This construction brings the feed rolls very close to the chuck, so that each bar is used practically to the end.

The rollers will feed any length without adjustment, and will accommodate any size stock within the capacity of the machine.



Brown &
Mfg.
Providence,

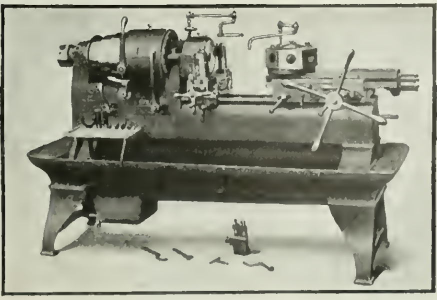


The **Automatic Chuck** is adjustable to all sizes of stock. A few turns with a wrench adjusts the chuck to any desired size within the capacity of the machine, a feature which is readily appreciated, as it obviates the necessity of a large stock of expensive collets for various sizes of stock.

Another feature which increases the efficiency of the chuck is that it will accommodate either round, square or hexagonal stock without changing the jaws or any other adjustment than that for size.

Special attention is called to the fact that the chuck automatically compensates for any ordinary variation in the size of the bar.

For further details send for Catalog 22 G.



**Sharpe
Co.**
R. I., U. S. A.

EDWIN S. CARMAN NEW PRESIDENT OF THE A. S. M. E.

Edwin S. Carman, works manager of the Osborn Mfg. Co., Cleveland, Ohio, has been elected president of the American Society of Mechanical Engineers for the coming year, taking office at the annual meeting, December 8. Mr. Carman was born in Prairie Depot, Ohio, in 1878, and his high-school education was supplemented by engineering studies at the Central Manual Training School of Cleveland. He gained his early training in industrial mechanical work in the shop of the Sun Oil Co., Toledo, Ohio, and four years later came to the American Machine & Mfg. Co., Cleveland, where, after two years in the engineering department, he was appointed chief engineer. While with this company he designed a complete line of electric traveling and forge shop cranes, hoists, and rolling mill equipment. In 1908 this company was consolidated with the Johnston & Jennings Co., of Cleveland, and Mr. Carman was appointed chief engineer and manager of the engineering and machine department.

Edwin S. Carman

The Osborn Mfg. Co. of Cleveland early recognized the possibilities of making foundry molding machinery, and decided to enter this field. In 1908, Mr. Carman was engaged by this company to design, manufacture and build a complete line of foundry molding machines. In 1913 Mr. Carman became directly associated with the Osborn Mfg. Co. as chief engineer in charge of engineering and manufacture of the machine division, and in 1916 he was elected a director and secretary. In 1917 he was appointed works manager of both the machine and brush divisions of the company. He is the author of a treatise on "Foundry Molding Machines and Pattern Equipment," and a contributor of papers on the art of machine molding.

For a number of years Mr. Carman has been prominent in the activities of engineering societies. He has been president of the Cleveland Engineering Society. He was the first chairman of the Cleveland Section of the American Society of Mechanical Engineers, and was a member of the A. S. M. E. Committee on Aims and Organization and chairman of Sub-committee C, which dealt with relations of the mechanical engineer to other engineers. He is a member of the A. S. M. E. Committee on Constitution and By-laws. Last December he was appointed chairman of the A. S. M. E. Committee on Local Sections, with a seat on the council.

* * *

OBITUARIES

James W. Bell, vice-president of the Wagner Electric Mfg. Co., St. Louis, Mo., died at his home in St. Louis, November 4, aged ninety-four years. He had been a director and stockholder of the company since its incorporation. Mr. Bell had many other interests, and is given credit for having introduced the first comprehensive cost system in the stove industry.

A. J. Babcock, president of Manning, Maxwell & Moore, Inc., died in London, England, on October 30 after a short illness. Mr. Babcock was born in Brookfield, N. Y., in 1850, served in the regular army from 1867 to 1871, then studied and practiced law until 1884, when he entered the machinery business in Chicago with the Fay & Egan Co. Later he became connected with Manning, Maxwell & Moore as manager of their Chicago branch, and about seven years ago came to New York as assistant to the president. He later became president himself, retiring in May, 1920, on account of ill health.

Arthur E. Hauck, president of the Hauck Mfg. Co., Brooklyn, N. Y., died at his home in Flatbush, October 30, aged 41 years. Mr. Hauck began his career by learning coppersmithing in Germany, but subsequently left Germany to follow his trade in the Navy and shipyards of Belgium, France, and England. When he was twenty years old he came to this country and obtained employment in the Philadelphia Navy Yard. After working for three years in the Navy coppersmithing shops in Philadelphia, Norfolk, Baltimore, and Brooklyn, he started in the oil burner business in 1902 with a small shop in Brooklyn. This business has consistently grown and developed until it includes more than a score of basic patents in burning oil, kerosene, etc., as well as numerous minor inventions and improvements which deal with applications of burning oil for a great many uses.

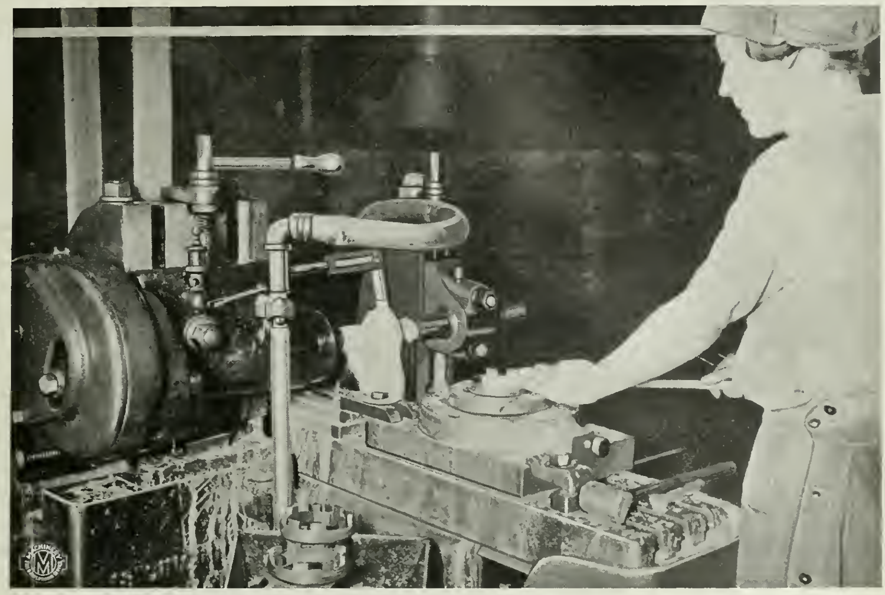
Joseph H. Baird, founder of the Baird Machine Co., Bridgeport, Conn., died November 14 in Cheshire, Conn., aged ninety-two years. Mr. Baird was born in Oakville, Conn., in 1827. He started working at the age of ten and was first employed in the shop of the Scovill & Buckingham Co. of Oakville (now the Scovill Mfg. Co. of Waterbury), which was then manufacturing butt hinges and hardware. He remained with the firm for nine years, after which he opened a small shop of his own in Huntington, Conn., for the manufacture of tools, presses, and special machinery. As Mr. Baird was primarily an inventor and regarded profit as a secondary consideration, the shop was not a financial success. He later became connected with the Oakville Co. in the capacity of designer, and while there did important work in designing tools and machines for manufacturing pins. Mr. Baird remained with this company for seven years. About 1878 he formed the Baird Pin Co., and subsequently acquired an interest in several other concerns. Eventually he brought his interests under one head and organized the Baird & Warner Co., which later changed its name to the Baird Machine Co. He was president of the company up to 1913, when, at his own request, he retired in favor of a younger man, but he acted in an advisory capacity until the last.

Mr. Baird was the inventor of many automatic machines and improvements used for making everyday products in large quantities. Among his most important inventions were machines for making pins. He invented the pin sticking machine which puts the pins in paper, and which revolutionized the whole pin business from the sales and handling standpoint. He also invented a machine for making safety pins, which takes the wire from a coil and ejects complete pins ready for the cleaning or plating operation.

DANIEL M. WRIGHT

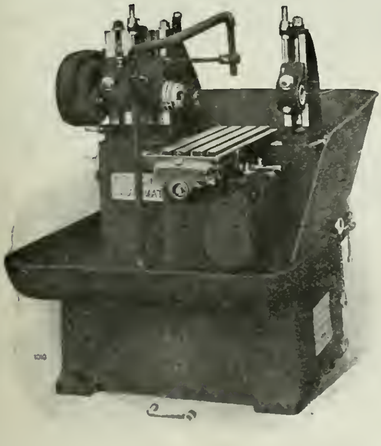
Daniel M. Wright, secretary-treasurer and general manager of the Henry & Wright Mfg. Co., Hartford, Conn., died in Hartford October 27, following an operation for meningitis. Mr. Wright was born in Philadelphia in 1870, but was educated in Hartford, Conn., and began his business career there. He became well known as a business man in Hartford and as a progressive machine tool manufacturer. He made several inventions, the most recent one being the new type of power press known as a "dieing" machine. Besides being general manager of the Henry & Wright Mfg. Co., he was president of the Universal Chain Co., and of the Claflin Oil Derrick Co. — corporations recently formed. He was also a director in various other enterprises and at one time was president of the Hartford Board of Trade, which was later merged with the Hartford Chamber of Commerce, of which Mr. Wright was at first vice-president and later president. In politics he was a Progressive, and was a delegate in 1912 to the convention which nominated Theodore Roosevelt for president. He was also a delegate to the national progressive convention in 1916, and a member of the progressive state central committee. He is survived by his wife, who was Mary Dedenar of Chicago; by two sisters, Miss Mary Wright and Miss Elizabeth Wright of New London; and by a brother, Marcus A. Wright of Tarrance, Cal.

Daniel M. Wright



Cincinnati Automatic Millers

Will Help Solve Your Production Problems



Quantity production of duplicate parts is very much simplified by using Cincinnati Automatic Millers. The time-saving automatic features enable one operator to attend to a battery of machines.

The photograph, taken by courtesy of the Autocar Company, Ardmore, Pa., illustrates the 24″ Plain Machine milling eight slots in the edge of malleable iron bearing retainers. Each slot is 3/4″ wide, 7/16″ deep, the wall of the casting being 5/16″ thick.

We also make this same machine Plain and Duplex in the 48″ size.

Write for production figures on your milling work.

THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI **OHIO, U. S. A.**

COMING EVENTS

December 2-4—Annual meeting of the Taylor Society at the Engineering Societies' Building, 29 W. 39th St., New York City. Secretary's address: Room 611, 29 W. 39th St., New York City.

December 7-10—Annual meeting of the American Society of Mechanical Engineers at 29 W. 39th St., New York City.

January 11-13—Annual meeting of the Society of Automotive Engineers in New York City. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

January 24-29—Third National Marine Exposition held at Grand Central Palace, New York City, under the auspices of the National Marine League of the United States of America, 268 Pearl St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Nebraska, Lincoln, Neb. Fiftieth annual general catalogue, containing the complete record for 1919-1920 and announcements for 1920-1921.

William Hood Dunwoody Industrial Institute, Minneapolis, Minn. Bulletins containing information concerning the institute and outlining the courses offered in the metal-working trades in both the day and evening schools.

Wentworth Institute, Huntington Ave. and Ruggles St., Boston, Mass. Circular containing an outline of the day and evening courses offered in the mechanical trades and in the manufacturing and architectural industries. There are two day courses covering a period of one and two years, respectively.

NEW BOOKS AND PAMPHLETS

Enamels for Sheet Iron and Steel. By J. B. Shaw. 88 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 165, of the Bureau of Standards. Price, 15 cents.

Cast Iron for Locomotive Cylinder Parts. By C. H. Strand. 25 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 172 of the Bureau of Standards. Price, 10 cents.

Modern Welding Methods. By Victor W. Page. 292 pages, 6 by 9 inches; 200 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

This book treats in detail of oxy-acetylene welding, thermit welding, and all classes of electric arc and resistance welding. The material is written in a simple, non-technical manner for the student and practical mechanic rather than the engineer. The purpose is to help those who are interested more in the practical applications than in the theory. The book shows the apparatus needed and its use. It describes the production of welding gases, and the construction and operation of all kinds of welding and cutting torches. Details are given concerning the methods of preparing work for welding. Gas and electric welding machines of different forms are described, and instructions are given for installing electric spot and butt welders. Cost data are also included. Soldering and brazing processes are described, and an outline of forge welding is given. The book contains instructions on the heat-treatment of steel as well as tabular data on tempering various forms of tools, melting points, and temperature determinations. The material is divided into nine chapters, headed as follows: Introduction to Methods of Joining Metals; Properties of the Common Metals; Welding Gases and their Production; Oxy-acetylene Welding Appliances; Oxy-acetylene Welding and Cutting; Electric Resistance and Arc Welding; Thermit and its Practical Applications; Soldering and Brazing Processes; and Forge Welding and Heat-treatment of Steel.

Hendrick's Commercial Register of the United States for Buyers and Sellers. Twenty-ninth annual edition, 1921. 2572 pages, 7½ by 9½ inches. Published by S. E. Hendricks Co., Inc., 2 W. 13th St., New York City. Price, $12.50.

The twenty-ninth annual edition of this comprehensive directory for buyers and sellers in the electrical, engineering, hardware, iron, mechanical, mill, mining, quarrying, chemical, railroad, steel, architectural, contracting, and kindred industries has just been published. The book has been thoroughly revised, the arrangement being the same as in previous editions. Following the index to trade classifications, which covers 163 pages and contains many cross-references, comes the classified trades section covering 1844 pages, an increase of 31 pages over the 1920 edition. This section contains over 18,000 classifications of different products, listed alphabetically, under each of which are given the names and addresses of the manufacturers, as well as detail matter, trade names, etc. The trade name section of the directory, which gives an alphabetical list of the important trade names and brands of products that are shown under the various classifications, contains 222 pages. This list of trade names furnishes a ready reference for purchasing agents and prospective buyers. The list of automobile trade names is given separately under the automobile classification in the classified trades section. The alphabetical section of the register, which follows the trade name section, covers 483 pages and contains a complete list of all the manufacturers whose products are included in the book, together with particulars of their main industry. In this section the address of the main office or works only is given, branch office and works addresses being given among the various classified lists. An alphabetical list of advertisers is also included. This list covers twenty-three pages, and gives the main office of each advertiser, as well as the domestic and the foreign branches. The same method of exterior indexing is employed as in the previous editions, the front edges of the pages being colored red, white, and blue to facilitate reference to any section.

Condensed Catalogues of Mechanical Equipment (1920 edition). 1004 pages, 6 by 9 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $4.

This is the 1920 edition of a yearly publication comprising condensed and illustrated catalogue information covering the products of manufacturers of various classes of mechanical equipment and containing a general classified directory of mechanical equipment and a consulting engineers' directory. More firms than ever before are represented by the publication of catalogue data. The total number is 572, and among these are a large proportion of the leading manufacturers in their respective lines. The number of catalogue pages in this edition has also been increased to 745. The catalogue section is divided into seven main parts, as follows: Power Plant Equipment; Testing, Measuring and Recording Apparatus; Power Transmission Machinery; Conveying, Hoisting and Transporting Machinery; Metals, Alloys and Other Materials; Metal Work Machinery, Machine Tools and Accessories; and Compressors, Blowers, Pumps, Hydraulic Machinery, Industrial Machinery, Steel Plate Work. On the title page of each of the seven main divisions of the catalogue section is an alphabetical list of the products catalogued in that section, thus enabling the engineer to quickly find information concerning the equipment in question. For convenience, these separate lists are also combined in the main table of contents, which gives a general survey of the material in the volume. The products shown in the catalogue section are listed according to the names of the manufacturers, arranged alphabetically. The general mechanical equipment directory and the consulting engineers' directory which is compiled from the membership of the society, have been extended and improved, and it is believed that these reference features will prove of even greater value than heretofore. The mechanical equipment directory in this edition contains the names and addresses of more than 4000 firms listed under about 3000 classifications of equipment, and the consulting engineers' directory contains the names and addresses of 800 engineers listed under about 500 classifications.

NEW CATALOGUES AND CIRCULARS

Hobart Bros. Co., Troy, Ohio. Bulletin 52d, treating of HB ball-bearing electric motors, for operation on either alternating or direct current.

Lakewood Engineering Co., Cleveland, Ohio. Booklet illustrating the application of industrial transportation systems for different classes of work.

General Electric Co., Schenectady, N. Y. Bulletin 40017A, illustrating and describing small belted direct-current generators and exciters known as Type ML.

Dwight P. Robinson & Co., Inc., 125 E. 46th St., New York City. Circular illustrating power plants in different parts of the country that were designed and constructed by this company.

Metal Saw & Machine Co., Inc., Springfield, Mass. Circular illustrating and describing the "Horizontal Junior" metal-cutting machine of the band-saw type, which has a capacity for cutting metals up to 4 by 4 inches.

Baldwin Locomotive Works, 500 N. Broad St., Philadelphia, Pa. Records 98 and 99, illustrating and giving specifications for locomotives for heavy passenger service, and eight-coupled locomotives for freight service, respectively.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City. Stock list for November, 1920, of Shelby cold-drawn seamless steel tubing. Circular of "Meno" rust remover and cleanser for machines, tools, and all metal surfaces.

C. H. Boulin, 82 Duane St., New York City. Circular descriptive of the Hasler speed indicator, which indicates speeds of rotation from 1 to 10,000 revolutions per minute, as well as linear and circumferential speeds from 1 to 1000 yards per minute.

Esterline Co., Indianapolis, Ind. Circular reproducing power survey charts made by Esterline wattmeters, which revealed a defective condition of the reversing mechanism of a planer; waste of power by an air compressor; and defective condition of a circular saw.

Landis Machine Co., Inc., Waynesboro, Pa. Leaflet printed in Spanish illustrating and describing Landis pipe and bolt threading machines. The circular shows a number of different installations of these machines in various industrial plants and gives data regarding the work done in each case.

R. G. Smith Tool & Mfg. Co., Newark, N. J. Circular of the Smith standard radius lathe and planer tool, showing its application for cutting convex and concave radii. Prices are given for the different sets of tools furnished, which consist of various sizes of concave and convex cutters and a holder.

Karge-Baker Corporation, Phoenix, N. Y. Catalogue describing the principle of construction and details of design of the Karge cushion coupling. The five different types of Karge couplings are illustrated, and applications to various classes of drives are shown. The book is fully illustrated with both halftone and line engravings.

Metalwood Mfg. Co., Detroit, Mich. Circular B-63, illustrating and describing the Metalwood No. 597 shaft straightening press, which has a rated work pressure of from 50 to 60 tons. Circular B-67, describing the Metalwood No. 360 hydro-pneumatic swaging press, adapted to work requiring considerable pressure but a short stroke.

Milwaukee Electric Crane & Mfg. Co., Inc., Milwaukee, Wis. Catalogue of the Milwaukee crane, pointing out some of the principal features, describing the construction in detail, and illustrating the various types of trolleys produced. A large number of illustrations are included, showing installations of Milwaukee cranes in manufacturing plants.

Holz & Co., Inc., 17 Madison Ave., New York City. Bulletin 9, descriptive of Amsler standardizing boxes for checking tensile and compressive loads of testing machines of the lever or hydraulic types. Bulletin 10, describing in detail the operation of the Humfrey static notched-bar testing machine for measuring the brittleness and ductility of steel and other metals.

John Steptoe Co., Cincinnati, Ohio. Catalogue illustrating the Steptoe line of crank shapers, and milling machines of the hand and power type. The shapers are made in 14-, 16-, 20-, and 24-inch sizes, and the entire line has been strengthened to take exceptionally heavy cuts with high-speed steel. Applications of motor drive and single-pulley drive to Steptoe shapers are also shown.

Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn. Catalogue covering the line of "Red-E" tools, which includes high-speed lathe centers, lathe dogs, grinding machine dogs, milling machine dogs, lathe tools, planer tools, hold-downs, and belt sticks. Tools of the "Red-E" line are made with removable high-speed steel cutters. The catalogue gives price lists of the various tools.

Norton Co., Worcester, Mass. Cloth-bound book containing articles by Howard W. Dunbar, dealing with the development and application of steadyrests in grinding operations; principles underlying form-grinding, and description of form grinding attachments; grinding of plane surfaces, including types of machines, selection of wheels, methods of handling work, and kinds of materials ground.

Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Catalogue 10, illustrating and describing the different styles of Mumford foundry molding machines made by this company. The various parts and the details of construction are clearly shown by a large number of line illustrations. Leaflets descriptive of the Hanna auction oiler, and the Mumford unbalanced type vibrator, respectively.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Catalogue 860, treating of C-H motor control apparatus for pumps, compressors, and similar service. A condensed chart is given to aid in the selection of the proper control equipment for each particular class of service. The booklet is illustrated with views showing installations of pumping and compressing machinery, and applications of control apparatus.

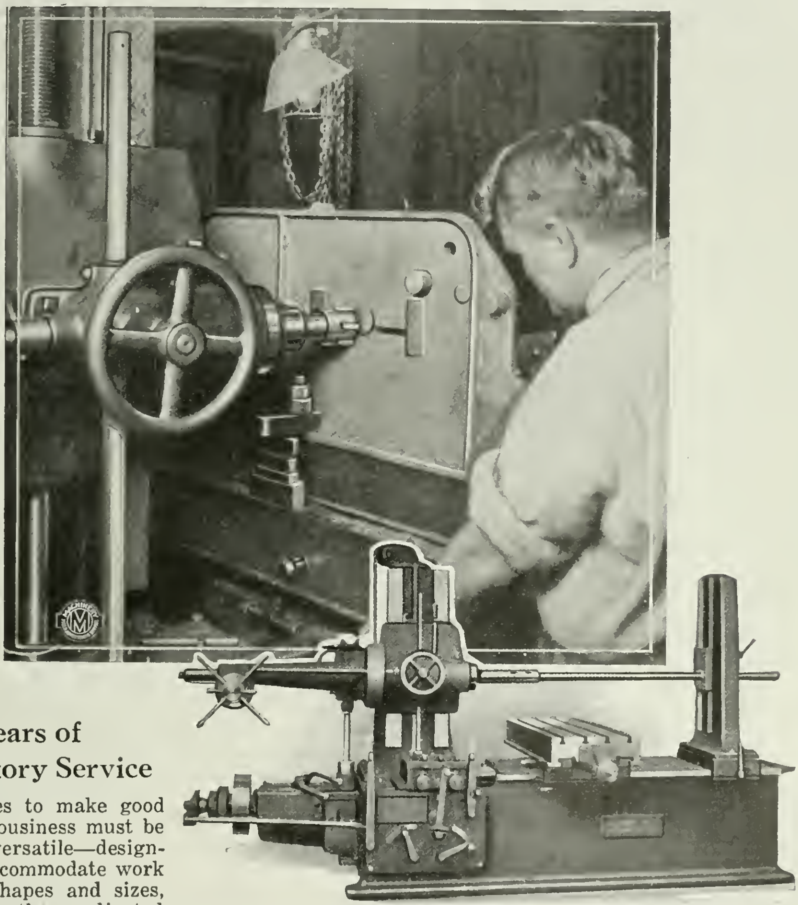
Joseph T. Ryerson & Son, Chicago, Ill. Folder entitled "Do You Know How to Make a Chisel?" describing in detail the making of a chisel from ¾-inch octagon tool steel, including the forging, grinding, hardening, and tempering. Illustrations are reproduced to show the correct form of the cutting edge of a chisel. The pamphlet also gives data relating to "Ryolite" 4-point chisel steel produced by this company.

Sawyer-Weber Tool Mfg. Co., Los Angeles, Cal. Booklet entitled "Proof," containing information regarding the Weber re-turning method for refinishing crankshafts, and letters of recommendation from users of the Weber crankpin re-turning tool. The catalogue contains illustrations showing the tool at work re-turning crankshafts, a set of cutters for use with the Weber tool, chips indicative of the smooth cutting action of the tool, etc.

Ajax Metal Co., Inc., Philadelphia, Pa. Catalogue listing the complete line of Ajax metal products, which includes white metal alloys, bronze and brass ingots, and bearings and castings. This catalogue is published in two editions, one printed in English and one in Spanish, the growing export trade of the company having made necessary the publication in two languages. Copies of the booklet will be sent to all interested.

LUCAS "PRECISION"

Boring, Milling and Drilling Machines in the "Special Machinery" Business



Seven Years of Satisfactory Service

Machines to make good in this business must be highly versatile—designed to accommodate work of all shapes and sizes, conveniently adjusted and capable of working within close limits.

According to the Package Machinery Company, Springfield, Mass., Lucas "Precision" Boring, Milling and Drilling Machines have fully met all these requirements for the past seven years.

There are three in this shop. One of them is shown machining a cast-iron table for a soap wrapping machine—the operations involved being to drill and bore holes and face bosses on both sides of the piece. Let us describe them in detail.

Lucas Machine Tool Co. NOW AND ALWAYS OF **Cleveland, Ohio, U. S. A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne, V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y., is publishing "The Ettco Magazine," devoted to the interests of the company, which contains general articles, and material relating to the "Ettco" drill chuck, self-gripping mandrel, and high-speed insert center.

Western Machine Tool Works, Holland, Mich. Catalogue 21, illustrating and describing in detail Western low-hung drive plain radial drilling machines made in three styles known as the heavy, manufacturing, and leader types. The catalogue also illustrates and describes Western low-hung drive full universal radial drilling machines.

Fitchburg Machine Works, Fitchburg, Mass. Catalogue describing the construction and operation of the 4-inch "Lo-swing" lathe, which employs the principle of multiple tool turning for the rapid production of duplicate parts. The special equipment and attachments for use in connection with this machine are illustrated. A number of typical tool set-ups are shown diagrammatically, which indicate the wide field of work covered.

Davis-Bournonville Co., Jersey City, N. J. Bulletin descriptive of the No. 1A and No. 2 oxygraph for cutting steel up to 20 inches thick with oxy-acetylene or oxy-hydrogen, dies and shapes being cut accurately to drawing, pattern, or templet, with cutting speeds up to 18 inches per minute. The booklet contains examples showing a variety of shapes cut in electrical works, shipyards, navy yards, tool shops, and manufacturing plants.

Cincinnati Planer Co., Cincinnati, Ohio. Catalogue illustrating and describing the Cincinnati line of rapid-production boring mills, which are made in 42-, 48-, 60-, 72-, and 84-inch sizes, and massive boring mills made in 8-, 10-, 12-, and 10- by 16-foot sizes. Detailed views of the various parts of the machines are shown, and complete specifications, covering dimensions, capacity, weight, feeds, speeds, etc., are given for the different sizes.

Winter Bros. Co., Wrentham, Mass. Catalogue 14, containing dimensions, prices, and other data relating to the carbon and high-speed steel taps and dies made by the company. The leaves are provided with a thumb-index, so that any section can be readily referred to. The high-speed steel section of the catalogue is printed on colored paper. Tables of tap drill sizes, standard pitches for threads, decimal equivalents, and other useful information are included.

National Acme Co., Cleveland, Ohio. Circular showing the plants of the company at Cleveland, Ohio, Montreal, Canada, and Windsor, Vt., where Acme multiple-spindle automatic screw machines, bolt-threading machines, stud-threading machines, screw slotters, bar pointers, Gridley automatic screw machines, screw products, etc., are produced. Calendar for 1921, containing on each sheet an illustration of one of the company's automatic machines, and calendar for the current month as well as the past and following months.

L. S. Starrett Co., Athol, Mass. Catalogue 22, covering the line of mechanical tools made by the company, including steel rules, straightedges, section liners and protractors, steel measuring tapes, combination squares, bevel protractors, steel squares, calipers, vernier height gages, depth gages, micrometers, toolmakers' buttons, screw pitch gages, thickness gages, clamps, hacksaws, hacksaw frames, pliers, scribers, speed indicators, dividers, trammels, center-punches, screwdrivers, wire gages, bench levels, etc.

Landis Machine Co., Inc., Waynesboro, Pa. Handbook compiled for users and operators of Landis threading machinery, containing instructions relating to the grinding of Landis chasers and the care and operation of Landis die-heads and threading machines. The book also treats briefly of the application of the Landis die for cutting special threads. Tables of helix angles for different diameters and pitches, in inches and millimeters, are included, as well as tables giving maximum and minimum pitches for special threads, and widths of special chasers for special threads.

Ingersoll Milling Machine Co., Rockford, Ill. Catalogue entitled "Installations of Ingersoll Milling Equipment," illustrating the typical milling machines made by the company, and showing actual operations performed on these machines, which indicate the wide range of work for which they are adapted. The types of machines illustrated are the adjustable-rail milling machines, single-faced fixed-rail milling machines, double-faced fixed-rail milling machines, horizontal-spindle milling machines, and continuous milling machines of the rotary and circular table type, differential and drum types, and reciprocating type.

Brown & Sharpe Mfg. Co., Providence, R. I., has prepared a memorial booklet in recognition of the services of Brown & Sharpe employes during the war. The book is being distributed to the families of those who lost their lives, and to all the employes who could be reached of the 911 who were in service, as well as to several thousand employes now with the company who were also employed at the factory during the period of the war. The booklet contains portraits of the boys who lost their lives, an account of the service they rendered, as well as an honor roll of all the men in service, giving their length and branch of service, arranged by departments. Citations of distinguished service are included. A portion of the book is devoted to the service of the employes remaining in the factory who also made a worthy war record. The important work performed by the women who replaced the men entering the service is also given attention.

Joseph T. Ryerson & Son, Chicago, Ill. Bulletin entitled "How Safety Methods are Applied in the Ryerson Steel Service Plants," describing in detail the organization formed for the purpose of carrying on safety work in the Ryerson plants. The bulletin shows a safety organization chart which gives an idea of the extensive application of the work in these plants. It describes in detail the duties of the organization and the methods employed for awakening interest in safety work. A number of safeguards employed in the plants are shown. Bulletin boards are placed in prominent positions about the plants, on which are posted safety bulletins which are changed every day in order to maintain the workmen's interest. Safety meetings are held from time to time which the employes are invited to attend. The company realizes that the backbone of accident prevention is regular and frequent inspection, and hence every stock-room and piece of equipment is inspected once each week by members of the plant committee. The various plants of the company maintained at Chicago, New York, St. Louis, Detroit, and Buffalo compete with one another in the safety work. At the end of six months the plant which has the highest percentage standard is considered the prize winner, and every man in the plant who is eligible through length of service receives a reward in cash. Although it is difficult to determine the exact decrease in accidents in the Ryerson plants due to their rapid growth, a conservative estimate based on the yearly accident statistics places the reduction in the accident rate at 80 per cent.

TRADE NOTES

Dawson-Rouillard Tool Corporation, 51st St. and Lancaster Ave., Philadelphia, Pa., has changed its name to the **Dawson Tool Corporation**. The company has recently added the Wilkes tool-holder to its line of small tools, rivet sets, etc.

American Broach & Machine Co., Ann Arbor, Mich., has recently given out a contract for the erection of a new building, 50 by 120 feet, to be used for machine assembly. The building will be of one-story construction, similar to the present plant.

William Hamilton & Sons Car Co. has taken over the plant of the Jewett Car Co., at Newark, Ohio, where it will build and repair all classes of railroad and street cars. New equipment is being installed, and extensive alterations and additions are being made.

Chung Mei Trading Corporation, 2 Hongkong Road, Shanghai, China, would like to receive catalogues of all kinds of metal-working and wood-working machinery and tools. This firm is interested in introducing American machines and methods in China.

James Maher Pipe-Tongs & Wrench Co. has been incorporated in Delaware, Ohio, and is now engaged in the manufacture of Maher pipe tongs. The president of the company is James Maher; secretary and treasurer, M. G. Williamson; and general manager, G. A. Yocke.

Sun Machinery Co., Inc., formerly of 278 Washington St., Newark, N. J., has recently moved to larger quarters at 103 Commerce St., Newark. The new location affords adequate floor space to show the large stock of new and used machine tools and motors carried by the company.

Chicago Pneumatic Tool Co. announces the removal of its rock drill plant from 864 E. 72nd St., Cleveland, Ohio, to the company's Boyer pneumatic hammer plant at 1301 Second Blvd., Detroit, Mich. The location of the "Little Giant" air drill plant at 1241 E. 49th St., Cleveland, remains unchanged.

Lafayette Tool & Equipment Co., Inc., Lafayette, Ind., manufacturer of the Lafayette universal grinder, has appointed Russell, Holbrook & Henderson, Inc., sole agent for the company in the United States. Sales offices are maintained at 30 Church St., New York City, and 548 Leader News Bldg., Cleveland, Ohio.

Steel Products Engineering Co., Springfield, Ohio, has recently taken over the manufacture of the shaper formerly made by the H. J. Averbeck Shaper Co. It is the intention of the Steel Products Engineering Co. to continue the manufacture of the 17- and 21-inch sizes, and later to develop a 16-inch shaper for tool-room use, and a 25-inch shaper to take in a larger range.

Hubbard & Harris, Inc., Bridgeport, Conn., consulting and manufacturing engineers, at a recent meeting of the stockholders decided to change the firm name to **Hubbard, Harris & Rowell, Inc.** The officers of the concern are Harry E. Harris, president and treasurer; Ralph K. Rowell, vice-president; and H. B. Harris, secretary.

Bradford Sales Co., has been organized with offices in the Leader-News Bldg., Cleveland, Ohio, to represent in Cleveland and the surrounding territory manufacturers of mechanical or electrical products. C. C. Bradford, for a number of years sales manager of the U. S. Light & Heat Corporation, and more recently sales manager of the Marlin Rockwell Corporation, is manager.

Simonds Mfg. Co., of Fitchburg, Mass., and Chicago, Ill., has established a new company in Great Britain which will be known as **Simonds Saws, Ltd.** An office and shop has been opened at 53 Bayham, Camdentown, London, N. W., where a full line of Simonds saws steel products will be carried. Guy A. Eaves, formerly connected with the Fitchburg plant of the company, will be office manager, and Leon E. Wilbur, who has previously covered the Great Britain territory, will be associated with him.

Dillon Electric Co., Canton, Ohio, has completed a new plant at New Philadelphia, Ohio, 60 by 150 feet. This plant will enable the company to take care of their increasing business in the maintenance and repair work of electrical machinery and apparatus in the district adjoining New Philadelphia, and will also permit an expansion of the company's electrical grinder business. The plant in Canton will be operated as heretofore, but by having the two plants, a better service to customers in electrical maintenance and repair work becomes possible.

Wetmore Reamer Co., Milwaukee, Wis., announces that the Detroit branch office of the company has formed a new company to handle the sale of Wetmore expanding reamers in the state of Michigan, exclusive of the northern peninsula. James J. Ward, previously assistant sales manager, has become one of the three members of the new firm, which will be known as the **Wayman-Taylor-Ward Co.** Mr. Wayman and Mr. Taylor have previously handled this work. The location of the offices has been changed to **403 Real Estate Exchange Bldg., Detroit, Mich.**

Kelly Reamer Co., Cleveland, Ohio, announces the following changes in its organization, coincident with moving into its new plant: A. H. Howard, who formerly operated an independent office as the A. H. Howard Sales Engineering Co., will represent the Kelly Reamer Co. in the Cleveland, Toledo, and northern Ohio territory; R. W. Martindale, formerly with the E. A. Harper Tool & Supply Co., of New York and Philadelphia, will handle the Pittsburg territory; W. B. Leonard, formerly of the Standard Tool Co., will have charge of the Buffalo territory; A. J. Wadsworth, formerly connected with the New Process Gear Corporation, has become associated with the service department.

Morse Chain Co., Ithaca, N. Y., manufacturer of the Morse rocker joint silent chain used on automobiles for power transmission, has established a branch factory in Detroit at Eighth and Abbott Sts., which will be given over exclusively to the manufacture of silent chain sprockets and the Morse adjustment. The Detroit branch will be under the general management of F. C. Thompson. F. M. Hawley will be chief engineer, and C. B. Mitchell, factory manager. The main plant at Ithaca will continue to manufacture chains and power transmission. The company would be glad to receive catalogues, booklets, and circulars of improved machines and equipment relating to the line of manufacture in which it is engaged.

Electric Furnace Co., Alliance, Ohio, reports an increasing demand for electric furnaces on the part of foreign users. The company has recently shipped two 105-kilowatt Bailey electric furnaces to Norway, where they will be used to melt zinc at the Jossingfyord plant in Stavanger, and to melt aluminum at the Norsk Aluminum Works at Christiania. Brass melting furnaces have also been shipped to the Amsinck Corporation of Mexico, Mitsui & Co. of Japan, and Allen Everett, Ltd., of England. In addition, Bailey electric furnaces have been installed in the following three Canadian plants: the Dominion Steel Products Co. of Brantford, Ontario; the Monarch Metals Co. of Hamilton, Ontario, and the Union Screen Plate Co. of Lennoxville, Quebec.

Watson-Stillman Co., 192 Fulton St., New York City, manufacturer of hydraulic machinery, recently conferred expressions of appreciation upon a number of employes who have been with the company for many years: Walter Watson, who has been in the continuous employ of the company for fifty years, was presented with a check for $1000, and provision was made for paying him a pension upon his voluntary retirement. William Graudorf, T. W. Hammond, A. D. Carnes, J. Hardy, William Koshwitz, William Meily, and C. J. Wessels, who have all been in the continuous employ of the company for more than twenty-five years, were each presented with a gold watch suitably inscribed. Carl Wigtel, who has also been with the company for many years, was presented with a watch fob.

Landis Machine Co., Inc., Waynesboro, Pa., manufacturer of bolt and pipe threading machines, has recently completed an addition to its shop which will be used as the main machine shop of the company. The new building is 808 feet long and 146 feet wide, of fireproof construction. The walls and ceilings are constructed mainly of glass, which affords an abundance of light. In connection with the completion of the building, the company gave a housewarming party in the shop to its employes and their families, which was attended by nearly 1400 people. Speeches were made by J. G. Benedict, general manager, and S. F. Newman, assistant general manager. A vaudeville entertainment and a male chorus were features of the evening. After refreshments were served, an orchestra furnished music for dancing.

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The Editor's Monthly Talk

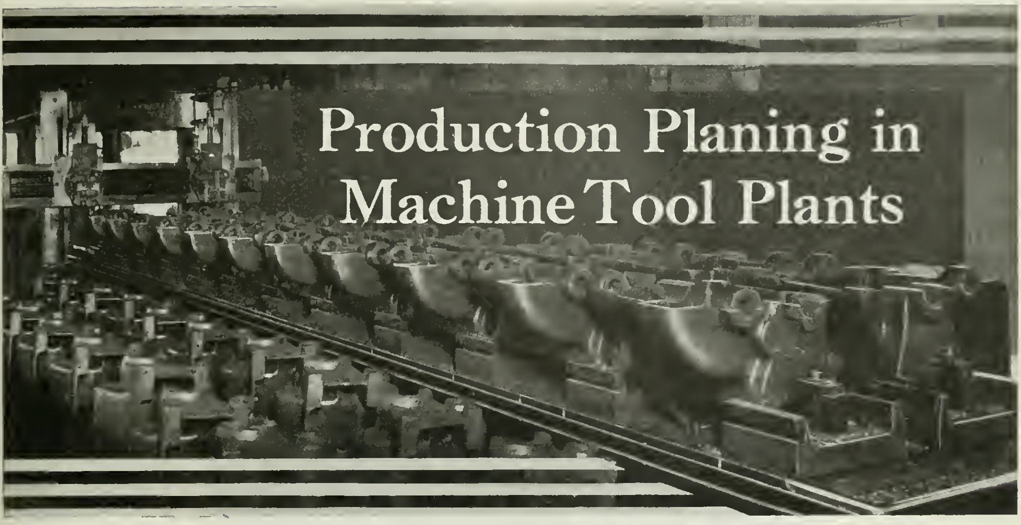
AT the threshold of a new year we instinctively review the past and forecast the future. MACHINERY looks back upon twelve months filled with endeavor to give its readers the best service possible, during which there were published 1188 pages of editorial and contributed matter, comprising 979 separate articles and items of information, not counting the regular news features such as personals, manufacturers' notes, etc. Of the articles published, 107 were devoted to general machine shop practice and methods used in up-to-date manufacturing plants—in all 481 pages. The design of machinery and machine details was dealt with in 62 articles, of 178 pages; shop and drafting-room systems and management in 38 articles of 72 pages; and foreign and domestic trade in 43 articles of 65 pages. In the New Machinery and Tools Section, 259 new or improved machine tools and devices were illustrated and described. There were 115 Practical Letters from MACHINERY'S readers—one of the most valuable features, and 17 pages of How and Why questions and answers dealing with practical problems arising in shop and drafting-room, mostly involving shop mathematics. There were 2023 illustrations using 1111 halftones and 912 line engravings.

Statistics may be dry reading, but often they enable us to see things adequately. The mine of practical information MACHINERY collects and publishes in a year involves an enormous amount of work and an outlay which few readers can appraise.

During the past year developments in automotive shop practice have been more rapid than in any other field. These have been recorded by MACHINERY in many recent articles. The very live subject of industrial relations has received adequate attention in the definite manner characteristic of MACHINERY—neither too conservative nor too radical—the aim being always to present facts rather than theories, results rather than expectations. The whole field of machine shop practice has been closely and systematically searched for new and improved methods and practices, for MACHINERY knows where to look and is always on the job. The same is true of foreign and domestic trade in machine tools—our correspondents cover all important markets.

During 1921 MACHINERY will still further extend its service to readers and advertisers. In this, the January number, begins an important series on production planing, and on shaper and slotter practice. Early issues of the year will contain important articles relating to applied interchangeable manufacturing practice, production control, piece work and bonus systems, grinding practice, sand-blasting, drafting-room methods, and scores of other subjects equally important to managers and superintendents, engineers and designers, foremen and others responsible for results in machine-building shops. Every phase of shop practice and management will receive adequate attention.

Important developments are taking place in the machine shop field as we enter upon the new year. Some machines and devices have recently been brought out that will prove almost revolutionary in their effect upon productive capacity and accuracy in machine work. Production especially was striven for in the developments of the past twelve months. These advances in practice and design are not confined to any one line of machine tools, although they have been more pronounced probably in the automatic, the milling machine, and the grinding machine field; but none of the other fields should really be omitted, for marked advance has been made in all. For example, in rapid production drilling, records have been made during the past year that completely eclipse previous performances. Great progress has been made in the development of recording and controlling apparatus for the heat-treatment of steel. A considerable advance has been made in the art of cutting and testing gears—in fact there has been marked progress in many different lines. Should each succeeding year mark advances in machine shop practice as important and valuable as those recorded at the end of 1920, the next decade will see so great a development in the productivity of machine tools that even the most optimistic could hardly visualize the vast economies and benefits to be realized. In the general field of applied science, also, remarkable advances have been made, and the new decade beginning on January 1, 1921, devoted as we hope it will be to peace and reconstruction, is likely to be a period of great forward steps in the fields of engineering and science.



Production Planing in Machine Tool Plants

Planer Practice in a Number of Plants Building Milling Machines—First of a Series of Articles

By EDWARD K. HAMMOND

TEN years ago, one frequently heard men of experience in machine shop practice express the belief that planers were destined to be superseded by other types of machines; but that this opinion was unjustified is evidenced by the fact that planers still retain their position as an indispensable part of the equipment of machine shops engaged in handling many classes of work. As their name implies, planers are used chiefly for machining flat surfaces on small, medium, or large sized pieces of work. Although it is impracticable to lay down any general rule governing the order in which machining operations should be performed, it is quite a general practice to send rough castings or forgings to the planer department for the first operation, and the surface so finished is then utilized as a locating surface in setting up the work for subsequent operations that are handled on planers or on other types of machines. Planing is successfully employed for finishing horizontal, vertical, or inclined flat surfaces; and where suitable provision has been made, it is possible to machine convex or concave curved surfaces of cylindrical or irregular form.

General statements may prove misleading; however, it is fairly safe to say that, judging from average practice, planers are operated at a lower rate of efficiency than many other types of machine shop equipment. This condition is due to the failure of many planer-hands to understand the best methods of performing planing operations. A survey of the fields in which planers are used reveals the fact that probably there is no other industry where machines of this type are producing more efficient results than in the building of machine tools. Recognizing this fact, a careful study has been made of the most approved methods of handling work on planers used in shops engaged in building the different standard types of machine tools. And as these methods involve the use of principles that are quite generally applicable, it will be evident that the information that has been selected for these articles should also prove of practical value to men in many lines of work other than the building of metal-working machinery.

A list of the customers of any builder of planers doing an extensive business will reveal the fact that machines of this type are used in a great variety of industries, and with this point in mind, it is not surprising that the requirements that must be fulfilled in planing operations also extend over widely divergent limits. At one extreme there is the case where a large bed casting for a machine is planed on its base in order to produce a satisfactory foundation. Obviously, such a job does not call for any considerable degree of accuracy, it being merely required to remove the excess metal and leave the bottom of the work practically flat. Frequently, such jobs are performed by simply taking a roughing cut, using as high a speed and heavy a feed as the cutting tools are capable of standing.

From this extreme, the range of the planer extends all of the way up to operations where a high degree of precision is required. On planed work, dimensions are often held within 0.0005 inch or even closer to the specified size. Examples of this kind are found in machine tool building plants in the finishing of flat bearing surfaces, etc., where it is required to have the planed surfaces perfectly flat and straight, and also to have them so located in relation to other fixed points on the work that the fits of such sliding members as milling machine knees and tables, or knees and columns, will enable them to run smoothly in contact with each other.

and without vibration or other undesirable conditions of operation present in a machine where there is any appreciable amount of lost motion between the surfaces of sliding bearings.

Valuable Features of Planers and of Planed Work

There are several important features of planed work which were not generally appreciated at the time when experienced efficiency engineers were predicting that the application of planers would become less extensive, although these points are probably of sufficient importance to have been responsible for the continuation of the use of machines of this type by men who plan the methods of machining that are used in many of the best known American metal-working establishments. Among them, the following are worthy of mention: In fitting sliding bearings, it is often regarded as necessary to perform a final scraping operation, and experience has shown that the planed surface of a good grade of cast iron can be worked more satisfactorily with a scraping tool than is the case with the surface of metal of the same grade, which has been finished by some other method.

In cases where there are a large number of sliding bearings that must be scraped, it will be evident that the finishing of surfaces in a way that enables them to be easily scraped is a matter of no small importance, because many of these planed surfaces are of very considerable size, and it is estimated that under average conditions a scraping tool does not remove more than 0.0002 inch of stock per stroke. This work must be done by hand, and usually calls for considerable judgment on the part of men employed for that purpose. Consequently, the saving effected by performing that part of the work which precedes scraping in a way that reduces the time and labor involved in scraping the surfaces down to a bearing is likely to be far from inconsiderable.

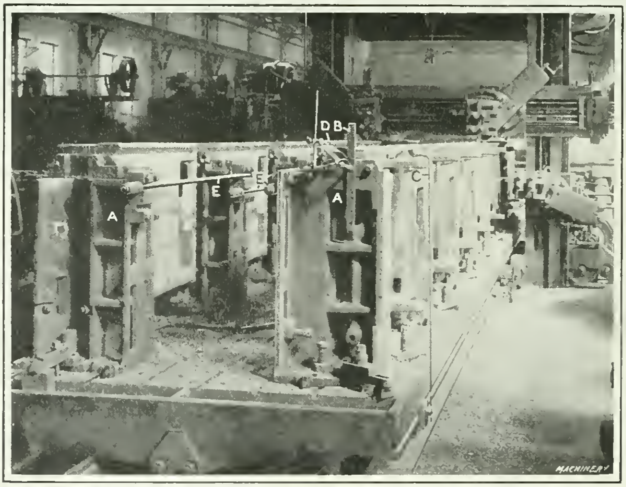


Fig. 1. Machining the Knee Bearing and All Finished Side Faces on Milling Machine Columns

Another important point in maintaining the planer's popularity in metal-working plants is the simple and inexpensive form of the cutting tools that are used. Not only are such tools procurable at a low first cost, but they are also simple to grind, so that the time which must be devoted to this work by skilled tool-room attendants is quite moderate. In this connection, it may be mentioned that the planer may be equipped with various forms of tool-holders or with cutting tools produced by welding high-speed steel or stellite cutter bits to machine steel shanks, and in this way a substantial economy is effected.

Application of Planers in Machine Tool Building Plants

Regardless of the class of work on which planers are used in machine tool building plants, it is probably safe to say that the average methods of planing used in such plants are likely to represent a close approximation of the maximum efficiency. It is for this reason that the major part of this series is devoted to the work of machine tool building plants. However, it must not be thought that the methods here illustrated and described are only applicable for the use of machine tool manufacturers. As a matter of fact, great care has been taken to select for discussion only those methods which have been developed through the employment of principles that are of general application. Consequently, the reader may start upon a study of information here presented for his consideration with the assurance that not only is he going to learn of methods that would be likely to prove useful in handling his work, but that such methods also represent the most advanced practice in this department of machine shop work.

Planing Cincinnati Milling Machine Columns

Where planers are used on repetition production work, rates of output are increased by setting up a number of pieces so that the required operations can be performed on all of them continuously. In a later section of this article, an analysis will be presented of the reasons why such a practice increases the efficiency and accuracy with which the work can be handled. Fig. 1 shows an example of such a planer set up at the plant of the Cincinnati Milling Machine Co., Cincinnati, Ohio, where a 72- by 72-inch planer built by William Sellers & Co., Philadelphia, Pa., has fourteen columns for No. 3 cone type Cincinnati millers set up in two parallel rows on the 40-foot table. This is the first cut taken on these castings, and the operation consists of planing the knee bearing and all finished surfaces on the side of the column to which the feed-box will be attached. Reference to the illustration will make it apparent that the two rows of castings are set up on the planer table with their positions reversed end for end, so that the two heads on the planer cross-rail may be employed for operation on the knee bearings, while the two side-heads can work simultaneously in planing the fit for the feed-box and the other surfaces that have to be machined on this side of the work.

This being the first operation on these castings, it will be evident that care must be taken to set up the work in such a way that the faces to be planed on each piece will be properly located in relation to the outside of the casting and to various other fixed points. The precautions taken to assure attainment of such a result are necessary, owing to both mechanical reasons and to the necessity of producing a good job. In Fig. 1 there are shown several of the tools used in setting up the work, and Fig. 2 illustrates a close-up view of one of the partially planed castings, together with the tools in the rail and side-heads and the gages that are employed for testing the work.

Method of Setting up the Castings for Planing

The method followed in setting up the castings ready for planing is as follows: It will be seen that each casting on the planer table is supported by a fixture *A*. The first step is to secure a wooden stick *B* to the fixture at each end of the row by means of a C-clamp, and then to stretch a string across the row of fixtures between two center marks provided on the fixtures for that purpose. This string is used as a reference point in setting up all of the castings in their respective fixtures. The purpose of using such a center line is to provide a reference point from which measurements may be made in locating each casting in its fixture, to be sure that the knee bearing on the column will not only be planed in such a manner that it "cleans up" satisfactorily, but to be sure of having this bearing centrally located with reference to the side walls of the casting and with such fixed points as the centers of bearing bosses, etc.

After centering the casting, its position must be adjusted vertically and this is done by the use of a plumb line *C*. It will be obvious that when in use, the plumb-bob will hang at the bottom of the string which is held close to the side wall of the casting, so that an estimate may be made of the amount which it is out of perpendicular and a suitable adjustment of the setting made to compensate for the existence of such an error. In making measurements of the amount of adjustment that is required in both the horizontal and perpendicular directions, use is made of various tools including the height gage shown at *D*.

For planing large castings, and more particularly for handling pieces of work such as those which are at present under discussion, it is necessary to both level up the casting and to provide means for its support when under the pressure of the cutting tools. In the present case, the casting rests on three jack-screws, on which it is centered by making measurements from the string stretched over the row of castings; and then these jack-screws are manipulated to provide for bringing the casting into a vertical position, as indicated by the plumb line *C*. Clamping of each casting in its fixture is accomplished by means of S-shaped straps which extend up from the planer table in such a manner that one end of each strap is resting on the table, while the other end extends through an opening in the work, so that tightening of the clamping bolt results in securing the casting in place.

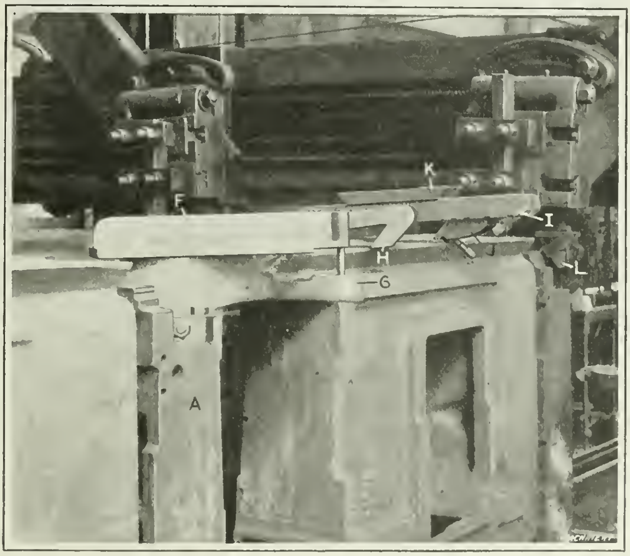


Fig. 2. Close-up View of One Casting. Cutting Tools and Gages for testing Work planed on the Machine illustrated in Fig. 1

Other straps of the forms shown in Fig. 1 are used to hold each casting back against its fixture, and jack-screws are placed between adjacent castings of each string to support the pressure of the cutting tools. A large jack-screw is placed inside of each casting to afford support between its walls, and there are small jack-screws located under the projections at the sides of the casting to prevent them from springing under the heavy cuts to be taken. As these pieces were set up on the machine, it was not feasible to take a photograph which would clearly show the method of clamping; but in Fig. 1 there are shown certain features of the arrangement, including some of the straps for clamping the fixtures and work down to the planer table, end stops placed behind the fixtures to support the thrust of the tools, and tie-rods *E* that extend between adjacent fixtures at the top to afford a means of support that will prove effective in eliminating vibration.

Order of Performing the Planing Operations

Mention has already been made of the fact that planing operations performed at this setting comprise the machining of the knee bearing, the seat for the feed-box, the guide for the dog, and the faces of the back-gear arms. Planing of the knee bearings is accomplished with the heads on the cross-rail, one head working on each row of milling machine columns, and the side-heads of the planer are employed for performing all other operations. For taking the roughing cuts, round-nosed tools are employed, and the so-called "straightening out" and finishing cuts are taken with square-nosed spring tools. An important point in connection with the setting of the work and the performing of successive operations is that after the roughing cuts have been completed, the clamps are all released and retightened, care being taken not to apply more pressure than is necessary to hold the work for taking the light straightening out and finishing cuts.

The clamping action provided in this way would not be sufficient to hold the work against the pressure of the heavy roughing cuts; but on the other hand, the clamping effect that is necessary for taking such cuts also produces a certain amount of distortion of the work, and if the finishing cuts were taken with the castings clamped in this manner, releasing of the clamps would allow the castings to spring back sufficiently to far exceed the close limits of tolerance that are allowed in finish-planing. For performing the roughing operation, a cutting speed of 42 feet per minute is employed with a feed of ⅛ inch per minute. For straightening out and finishing horizontal and vertical surfaces, a cutting speed of 27 feet per minute is employed, with a feed of ¾ inch; and on the angular faces of the dovetail bearings, the same speed is used for the straightening out and finishing cuts, with a feed of ⅜ inch.

Gages Used for Testing the Accuracy of the Work after it has been Planed

In Fig. 2 there are shown gages used for the following purposes: Gage *F* is employed for measuring from the planed face of the knee bearing to the planed face of the back-gear arm *G*. Gage *H* is used for testing the form of the dovetail, tissue paper feelers being employed in connection with this gage so that the form of the dovetail may be ascertained within 0.001 inch. At *I* there is shown a micrometer gage that is employed for testing the distance from face to face of the dovetail knee bearing. This gage is equipped with a micrometer head *J* that may be fitted into various slots in the body of the gage, to provide for using it on different sizes and types of Cincinnati milling machine columns. At the opposite end there is a dovetail bearing integral with the body of the gage, which is hooked over the dovetail; then, the adjustable head *J* is moved up to its slot and the final measurement taken with the micrometer.

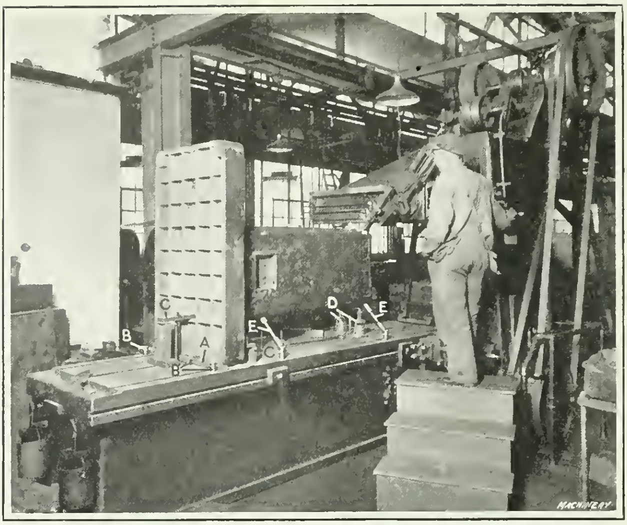


Fig. 3. Open-side Planer equipped for planing Knee Bearings on Columns of Milling Machines

Gage *K* is a master used for setting micrometer head *J* for a given size of milling machine column; and after this setting has been made, the micrometer must give the same reading with the gage placed on the planed knee bearing on the work. About 0.002 inch of metal is allowed on each face of the dovetail bearing to provide for scraping it to fit the bearing in the milling machine knee. At *L* there is shown what is known as a tool-setting gage, secured to the back of the work-holding fixture. Where there are a number of horizontal, vertical, and inclined surfaces to be planed on the same piece of work, gages of this type are frequently employed for setting planer tools. The horizontal and vertical faces of the gage constitute reference points against which the tools can be set to finish the work to the required dimensions; and where the planing of angular surfaces makes it necessary to swivel the planer head for that purpose, the tool may be run down the inclined face of the setting gage to make sure that the head has been properly set.

Planing Knee Bearings on Cleveland Milling Machine Columns

In machining the columns of Cleveland millers built by the Clark-Mesker Co. in Cleveland, Ohio, use is made of open-side planers built by the Cleveland Planer Co. Fig. 3 shows a machine set up for the performance of this operation, and the job is of interest because it illustrates the method of setting up and supporting a large casting of this kind. Great care must be taken to provide for resisting both the weight of the work and the pressure of the tools to prevent springing the casting out of shape, which would seriously affect the accuracy of the finished planed surfaces. As the castings come to this machine, they have been faced on the bottom, and this surface is used in locating the work for the performance of the present operation. It will be seen that a strip *A* is placed across the table, with stops *B* to hold it in place. The casting is abutted against this strip and held down by means of straps *C*.

It will be seen that the straps are held by the usual arrangement of bolts entering T-slots in the planer table; and supporting posts are placed under the outer ends of the straps, in a manner that is quite generally employed in planer set-ups. A noteworthy feature of this job is that the planing operation has to be performed on a part of the work that projects out from the base in such a way that it cannot be supported directly from the planer table. Therefore, to give the desired rigidity to the work and to prevent it from springing away from the pressure of the planing tool, it will be seen that two jacks *D* are placed under the forward end, and the supporting action obtained in this way is supplemented by four jacks at the sides of the casting, two of which are shown at *E*, there being two jacks similarly placed at the opposite side of the work. Before the casting is finally clamped for planing, care is taken to level and square it up in a manner similar to that employed in setting up the planer job shown in Figs. 1 and 2; and the knee bearing is then laid off on the column so that it will be properly located in relation to the side walls of the column and to other fixed points on the work.

Fig. 4 shows diagrammatically the sequence of operations performed in the planing of Cleveland miller columns, to bring the knee bearing to the desired form. The final outline of the work is illustrated to the right of this illustration, and each succeeding diagram shows the condition of the work as it progresses step by step toward completion. The pattern is made to cast the knee bearing as illustrated in the left-hand diagram, and the first operation consists of planing surface *A* with a round-nosed tool. After this

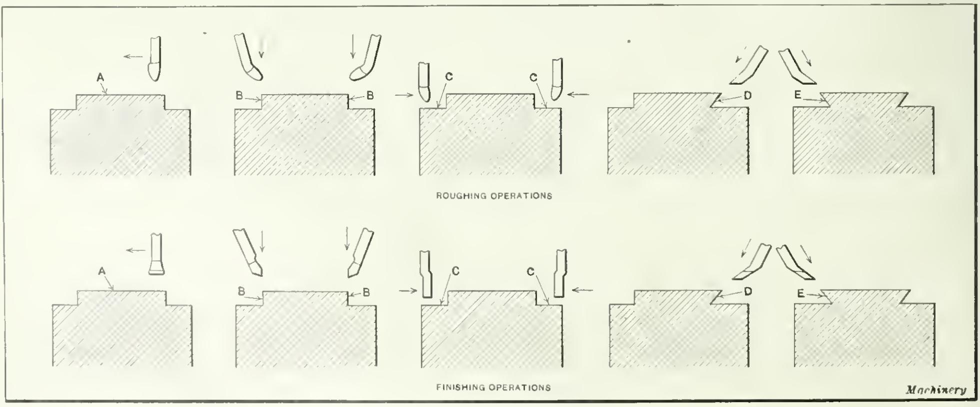


Fig. 4. Diagram showing Successive Steps in performing the Planing Operation illustrated in Fig. 3

cut has been taken, the next step is to plane down the side faces *B* to reduce the projection to the required width. Then faces *C* are planed with round-nosed tools. Faces *A*, *B*, and *C* are next finish-planed with tools of the form shown in the lower row of diagrams. Then the head of the planer is set over to an angle, as shown in Fig. 3, to provide for rough-planing side *D*, Fig. 4, of the dovetail bearing, after which the position of the head is reversed to give an angular setting to rough-plane surface *E*. These operations on faces *D* and *E* of the dovetail bearing are then repeated with finishing tools of the form shown in the lower diagrams. This diagram and those in Figs. 6 and 15 are for the purpose of showing the manner in which successive planing operations are performed in bringing a piece of work to the required form, and the methods of using different types of planer tools, rather than to give detailed data concerning the performance of any special planing operations. The production time on this job is six hours.

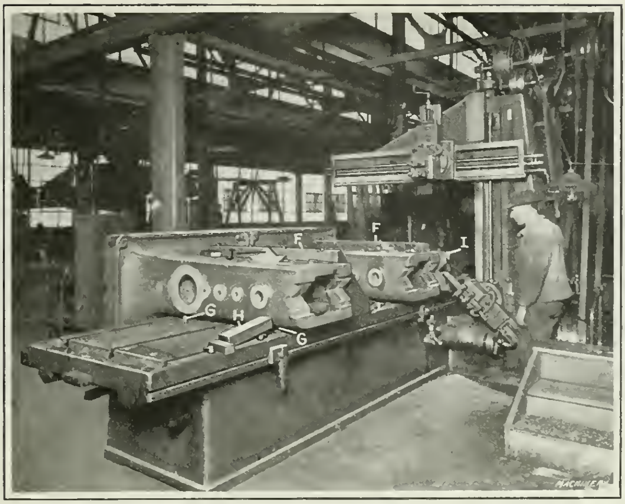


Fig. 5. Open-side Planer equipped for planing Over-arm Bearing in Two Milling Machines

Planing the Over-arm Bearing on Cleveland Milling Machine Columns

Readers of MACHINERY are familiar with the square over-arm that is used on Cleveland milling machines built by the Clark-Mesker Co. Open-side planers built by the Cleveland Planer Co. are used for machining the over-arm bearing in the column; and this operation shows a more typical use of a machine of this type, as the open-side feature affords sufficient capacity for handling these large castings. Fig. 5 shows one of the machines in operation, and Fig. 6 illustrates diagrammatically the way in which successive cuts are taken for the performance of this operation, and the form of tools that are used. Referring to the first of these illustrations, it will be seen that two work-holding fixtures *F* are provided on the planer table, against which the previously planed knee bearings on the columns are clamped. The weight of the castings is supported by jacks *G*, and end-stops *H* are employed to hold the work against possible movement resulting from the thrust of the tool.

With the work set up in this way, it is required to plane the top of the milling machine column to the form shown at the right-hand side of Fig. 6. The pattern is made to cast the top of the casting as shown in the left-hand diagram, and the first step is to rough-plane faces *A* with a round-nosed tool held in a horizontal position by the side-head. Next the offset tools are employed for planing opening *B* to size; and round-nosed tools held in the indicated positions are used for taking a roughing cut on faces *C*. Faces *A*, *B*, and *C* are then finish-planed with tools of the forms indicated. Next, the planer head is set to the required angle, and with a dovetailing tool mounted on the block, the face *D* is rough-planed. Keeping the tool-head in the same position, a tool of the form shown is set up for planing face *E*. Then, a similar setting of the tool-head is made, with the tool inclined in the opposite direction, to provide for planing the two surfaces *F* and *G*. After this sequence of operations has been completed on faces *D*, *E*, *F*, and *G*, the operations are all repeated for a finishing cut, using tools of the forms indicated. In Fig. 5 it will be seen that there is a tool-setting gage *I* at the back of the rear fixture *F*, that facil-

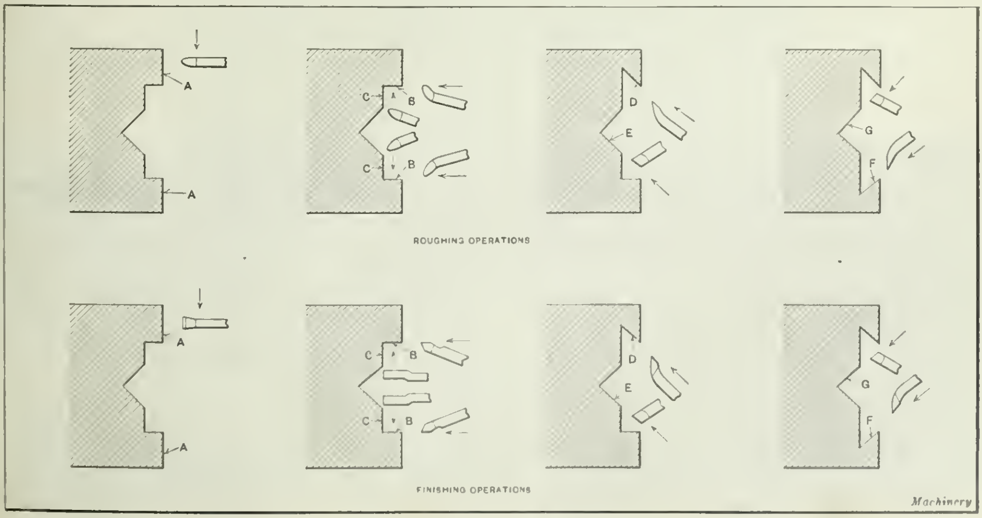


Fig. 6. Diagram illustrating Successive Steps in performing the Planing Operation shown on the Machine in Fig. 5

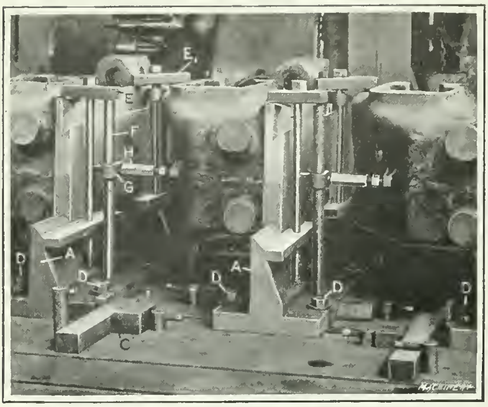


Fig. 7. Fixture for holding Milling Machine Knees while planing the Column Bearing

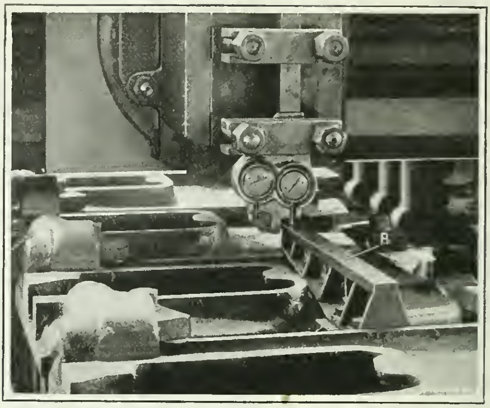


Fig. 8. Three-way Square and Duplex Dial Indicator for lining up Knees before planing

itates the work of setting the tools for planing the various surfaces on the work. At *J* there is shown a gage for testing the form of the planed work. The total time required for performing this sequence of operations on two milling machine columns is eighteen hours.

Planing Cincinnati Milling Machine Knees

Figs. 7 to 10, inclusive, illustrate another good example of production work done on a Cincinnati planer in the plant of the Cincinnati Milling Machine Co., in Cincinnati, Ohio. This operation consists of planing the column bearing on the knees for Type 2M machines, and prior to the performance of this operation, the knees have had the saddle bearing and the fit for the feed-box finish-planed, so that these surfaces may be utilized as locating points in setting up the work. Attention is first called to Fig. 7, where it will be seen that each casting is supported on a work-holding fixture *A* which is arranged with a V-bearing to engage the saddle bearing. In setting up this job, a string of twenty-two castings is mounted on the table, and great care has to be taken to so line up the work that the column bearing on each knee will be planed exactly at right angles to the saddle bearing and to the seat for the feed-box on the knee.

For accomplishing this result, use is made of a special form of square and a special indicator furnished with two dials, the use of these special setting-up tools being illustrated in Fig. 8. From this illustration, it will be apparent that the contactor points of the two dial indicators are arranged so that they engage the top and the side of bar *B*, which is one leg of the special square. This square has two other legs (not shown in the illustrations) which rest against the finish-planed top face of the saddle bearing that is best shown in Fig. 7. One of these legs stands in a vertical position and the other lies horizontally against the finished face of the work. A little thought will make it apparent that the use of a square of this kind, in conjunction with the two dial indicators, provides a convenient and accurate method of squaring up the castings ready for planing, because with the square in contact with the work as described, the finished saddle bearing on each knee must be at right angles to the line of travel of the planer table, in order for the two indicator points to be traversed back and forth along bar *B* without causing any deflection of the dial indicator needles. It will be evident that, used in this way, the square aligns the work to the line of travel of the planer table and provides for planing the column bearing on the knee at right angles to the previously planed saddle bearing.

Method of Setting up the Work and Fixtures

In connection with the following description of the method of setting up the fixtures and work for performing this planing operation, attention is directed to Fig. 7 which shows the arrangement to the best advantage. Bearing in mind that the previously planed bearing for the milling machine saddle is utilized as a locating point, the work being supported from the dovetail and located against the finished face of the fixture *A*, it will be evident that the fixtures may be conveniently squared up relative to the line of travel of the planer table by means of the special square *B* and dial test indicators shown in Fig. 8. The fixtures are put in place

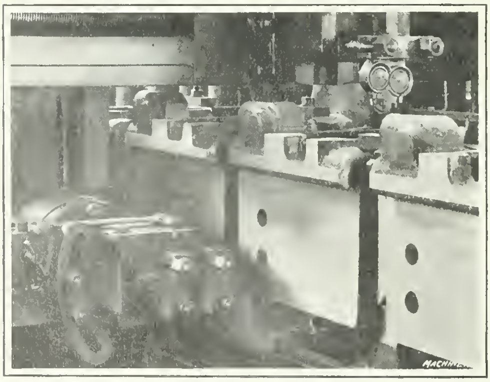


Fig. 9. Close-up View of Side-head used for planing the Column Bearing on Milling Machine Knees

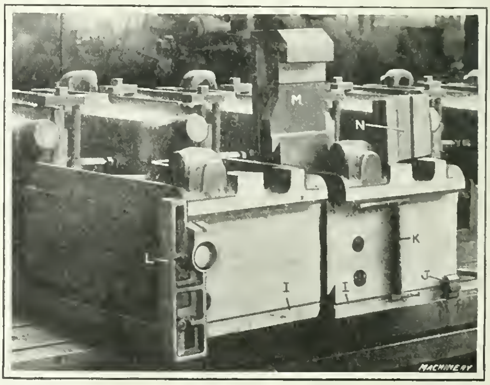


Fig. 10. Close-up View of Milling Machine Knees, showing Gages for testing Accuracy of Planed Column Bearings

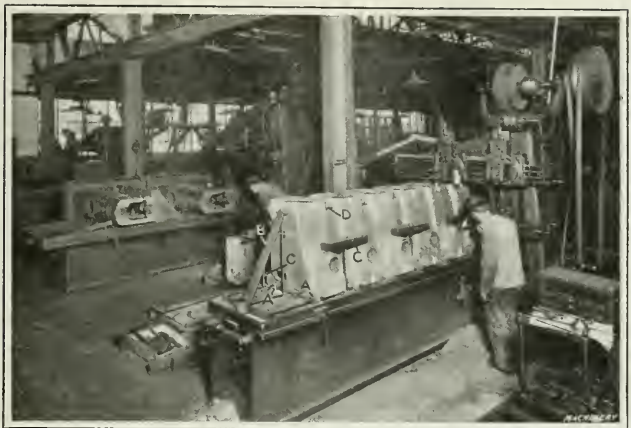


Fig. 11. Open-side Planer using One Rail-head and One Side-head simultaneously for planing Milling Machine Knees

on the planer table and the castings placed on them. The fixture at the end of the table nearest to the planer tools is next lined up, after which stops of the form shown at *C*, Fig. 7, are placed behind the fixture, and the adjusting screws are located to hold it in position.

Parallel spacing strips are placed at each end of the front of the first fixture in the row, and the next fixture of the line is then set against these strips, the same procedure being repeated until all twenty-two fixtures have been set up on the machine. After this approximate location of the fixtures has been obtained, one of the parallels is removed from between each fixture, care being taken not to disturb the position of any of the fixtures; and stops furnished with adjusting screws are substituted to secure the fixtures in place on the planer table. Then the milling machine knees are placed on the fixtures and a final adjustment of their position is obtained by means of the special square and dial test indicators shown in Fig. 8. A high degree of accuracy is required in the work done at this setting; and to attain such a result it is important to provide a perfectly rigid foundation for the work. With this idea in mind, it will be seen that packing papers are placed between the fixtures and the planer table at any point where there seems to be the least evidence of lost motion and consequent vibration.

Method of Clamping the Work in Place on the Fixture

It will be evident from Fig. 7 that so far as the procedure followed in clamping the fixtures to the planer table is concerned, the method is quite simple. Bolts *D* at each corner of the fixture provide for clamping it down to the planer table, and each fixture is held against endwise movement by means of various stops of the general type shown at *C*. It has already been explained that the work is supported on the fixture from the dovetail bearing, as clearly shown in Fig. 7, and provision is made for clamping down the casting by means of straps E_1 and E_2. It will be seen that strap E_1 is arranged to straddle the gap between two adjacent castings in the row, thus providing for holding them both; but at the opposite end, the contour of the milling machine knee is such that it would not be a desirable arrangement to have a strap extend right across the gap, and so strap E_2 is arranged with a post *F* to support its outer end. The way in which the clamping bolts extend up from the fixture will be evident from the illustration, without requiring description. However, it may be well to mention that on each post *F* there is a bracket *G* that supports a jack *H*, which extends between two adjacent castings to support the end thrust of the planer tools. The use of such jacks is not required at the opposite side of the row of castings owing to the steadying effect of straps E_1.

With the work set up in this manner, the planer-hand proceeds to perform the rough-planing operation on the column bearing on the knee, this work being done with the side-head of the planer as illustrated in Fig. 9. Fig. 10 illustrates two of the finished castings, with the various gages that are used for testing the accuracy of workmanship shown in place. Near the bottom, there will be seen a narrow slot *I* that is used for anchoring the opposite side of the dovetail bearing to the knee, and it is for the planing of this slot that the tool shown in Fig. 9 is employed. Everyone familiar with the requirements of high-grade milling machines as regards accuracy will realize that it is necessary to have the column bearing on the milling machine knee planed at exact right angles to the saddle bearing; and the greatest care must be exercised in holding all dimensions on the work within very close limits, in order to avoid the possible existence of lost motion and other undesirable features.

To assure attainment of the required degree of accuracy in planing, it is important to have each of the work-holding fixtures and each piece of work set with the finished face of the fixture and the previously planed saddle bearing of the knee at an exact right angle to the line of travel of the planer table, as previously described. In taking the first cut, there is a substantial amount of metal to be removed, and as a result the tools exert considerable pressure, which may disturb the setting of the fixtures. Hence, it is the practice to loosen the clamps securing the

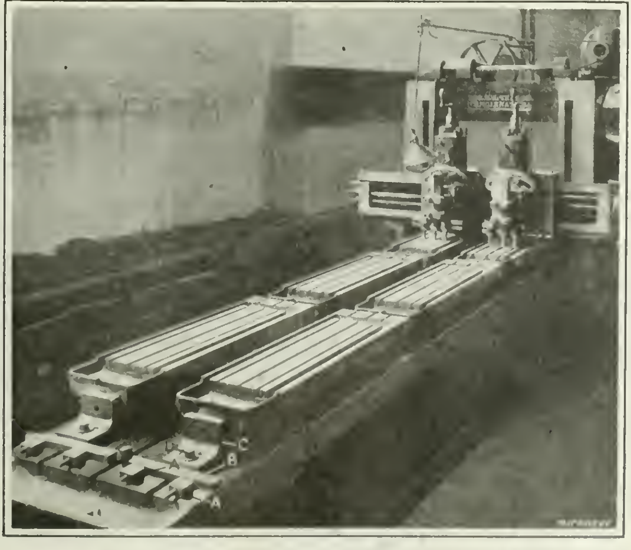


Fig. 12. Simultaneous Planing of the T-slots of Two Rows of Milling Machine Tables to ⅝ Inch Standard Width

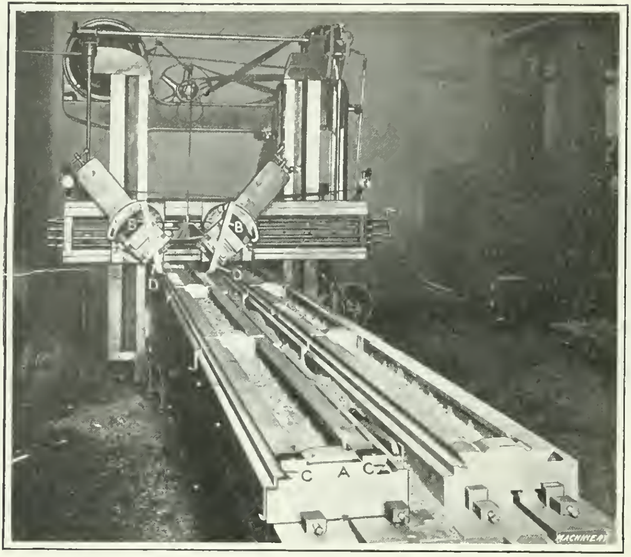


Fig. 13. Planing the Under Side of Two Rows of Milling Machine Tables

fixtures to the planer table and reset them between the performance of the roughing and of the so-called straightening out and finishing outs. After the clamps have been loosened, the square *B*, Fig. 8, and the dial test indicators are used successively on each casting to line it up accurately with the line of travel of the planer table by the use of the adjusting screws in the stops; after the castings are lined up, the clamps are retightened to secure each piece of work and its fixture in this position. The method of procedure is to loosen bolts *D*, Fig. 7, and all of the clamps, after which any fixture is free to have its position adjusted by swinging it on the parallel spacing strip between fixtures.

Amount of Metal Removed by Successive Cuts

In performing the rough-planing operation, it is planned to leave 0.025 inch for the straightening out cut, which is taken in such a way that 0.010 inch is left for removal by the final finishing cut. The roughing cuts are taken at a speed of 43 feet per minute with a feed ranging from 1/16 to 1/8 inch, and the straightening out and finishing cuts are performed at a speed of 35 feet per minute, with a feed ranging from 1/4 to 1 inch, according to the position on the work at which the tool is operating. Hand feed is employed for the performance of planing operations in the dovetail bearings and in the slot *I*, Fig. 10. The actual work of planing the various dovetail bearings and flat surfaces on these castings is performed in accordance with the general principles which have been explained in connection with preceding jobs. Attention has already been called to the high degree of accuracy that is required in the performance of planing operations on these milling machine knees. All dimensions are required to be within 0.0005 inch of the specified size, and the column bearing on the knee must either be at exact right angles with the saddle bearing or not over 0.001 inch "in favor." This term is used to denote a relationship between the column and saddle bearings of the knee that would result in assembling the table on the milling machine in such a way that its edge farthest from the column would be held higher than the edge nearest to the column. This is termed "in favor," because the weight of the work and fixtures, and the pressure of the cutters are supported by the knee, and obviously it is permissible to have the outer end of the knee 0.001 inch high, but never low.

Gaging and Inspecting the Finished Work

Before the work is removed from the machine, all dimensions are carefully measured and the contour of all formed surfaces is gaged to make sure that the required degree of accuracy has been obtained. The square *B* and the duplex dial indicator shown in Fig. 8 are again utilized in making the final test of whether the column bearing has been planed perpendicular to the saddle bearing. Then gages shown in Fig. 10 are employed for testing other dimensions. A "Go" and "Not Go" gage *J* is utilized for testing the width of slot *I*. The distance from this slot to the dovetail bearing must be held within limits of 0.0005 inch, and gage *K* is used for testing this dimension. It will be seen that a plug is used, which fits accurately in the slot and supports a length bar that has a ground cylindrical shaped member at its upper end. This gage is of the "Go" and "Not Go" type, the lower end of bar *K* being ground to two different lengths, one of which must allow the plug gage to enter slot *I* while the other makes it impossible to enter the plug in the slot.

Another dimension that is of vital importance, is the distance between the dovetail of the knee bearing on the column and the dovetail for the saddle bearing. For the testing of these dimensions, a special dial indicator *L* is employed. It is first set to a master gage *M*, allowing 0.002 inch of metal for scraping, and the needle is set to zero. Then the indicator can be used on the work and if the required accuracy has been obtained, it will continue to indicate zero. Any deviation from the zero reading shows an error in the spacing between the saddle and column bearings on the milling machine knee. Finally, the form of the dovetail bearings is

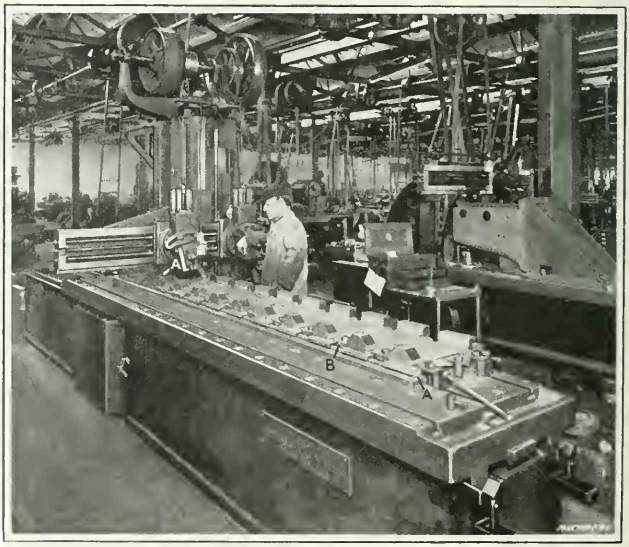


Fig. 14. Planing the Inside and Top Faces of Ten Milling Machine Vise Bodies

tested by means of a master plate *N* which is rubbed on the work with a coat of red lead on the plate, in order to test the form of the planed bearings.

Types of Planer Tools Used on Cincinnati Miller Knees

For the performance of rough-planing operations on the knees for Cincinnati Type 2M milling machines, the roughing operations are performed with the familiar round-nosed tools, which are forged in various shapes so that they can conveniently reach the surfaces on which they are to operate. Roughing cuts on the dovetail bearings are taken with dovetailing tools of the general type illustrated in Figs. 4 and 6, and the slot *I*, Fig. 10, is rough-planed with a square-nosed tool that is fed straight into the work. The so-called straightening out cuts on flat surfaces are taken with diamond point tools, while the finishing cuts are performed with square-nosed spring tools. For the performance of finishing operations on the dovetail bearings, use is made of dovetail finishing tools of the forms shown in Figs. 4 and 6.

Planing Operations on Cleveland Milling Machine Knees

In Fig. 11 there is shown the application of a Cleveland open-side planer in the Clark-Mesker plant, for use in simultaneously planing the front end of Cleveland milling machine knees and the bottom of the bearing for the elevating screw. It will be seen that six of these castings are set up in a string, and the two operations are performed simultaneously with tools carried by the rail-head and the side-head of the machine. In setting up the castings, stops *A* are employed to support the pressure of the tools and to square the work up with the line of travel of the planer table. The action of these screws is supplemented by a brace-bar *B*, and the work is held down on the table by means of straps *C* and smaller straps at the opposite side of the work. Placed between adjacent castings in the row are small jacks, which are employed to afford support and reduce the danger of developing vibration. The actual work performed on these castings is quite simple. It consists of the use of a round-nosed tool in the rail-head and of a similar tool in the side-head for the performance of a roughing operation on the two faces that are to be planed. Then after these cuts have been taken, the surfaces are finished with square-nosed tools used in the same manner. The production time for six castings is six hours.

Planing Tops of Tables for Brown & Sharpe Milling Machines

Fig. 12 shows a 30- by 30-inch by 30-foot planer built by the G. A. Gray Co., Cincinnati, Ohio, in use in the plant of the Brown & Sharpe Mfg. Co., Providence, R. I., where it is employed for planing the top or working surface of milling machine tables.

As the foundry delivers milling machine table castings to the machine shops, it is the practice to first rough-mill the castings on the bottom and then on the top. After this has been done, they are finish-planed, first on the top and then on the bottom. The preliminary surfacing is done on the milling machine to increase the rate of output, and the final finishing is done by planing because this is regarded as a method that gives a higher degree of accuracy. The castings are allowed to season for a short time between milling and planing. As the work comes to the planer, the rough-milled under side is available as a location point. The method of setting up is relatively simple, eight castings being arranged in two parallel rows of four castings each. On this job the same provision is made for supporting the end thrust as that which has been mentioned in connection with numerous other planing operations, although the actual means of accomplishing this result are somewhat different.

Reference to the illustration will make it apparent that at the end of each row of castings on the planer table there are two stops *A* that are carried in clamping bolt holes; but instead of having the work bear directly against these stops, an intermediate bar *B* is arranged to bear against a block *C*, the end of which is machined to engage a finished surface at the end of the milling machine table casting. It will be seen that block *C* is secured to the planer table by a bolt *D*, and each milling machine table to be planed is located for alignment by the fixture in which it is carried. Stops *A* and bars *B* are used more as a precautionary measure to assure rigid support of the work than because they are actually necessary.

While the work is set up on this machine, it is required to plane the top surface of the milling machine table castings and also to finish the T-slots, the latter operation being shown in progress in the accompanying illustration. It will be evident that this is quite a simple job, the chief point of interest being the arrangement of the tool-holders for supporting three cutter bits. It will be seen that the holder is made in the form of a letter T with a T-slot arranged in the cross-bar on which three cutters are mounted. Each cutter is held in position by a bolt in this T-slot, making it a very simple matter to adjust the distance from center to center of the cutters for handling different sizes of milling machine tables. The T-slots are rough-milled, after which the vertical part of each slot is planed to a standard width of 5/8 inch, and then the edges at the top and bottom of the vertical slot are chamfered.

Planing the Under Side of Brown & Sharpe Milling Machine Tables

Fig. 13 shows a 30- by 30-inch by 24-foot planer built by William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa., which is used for performing the finish-planing operation on the under side of Brown & Sharpe milling machine tables. The procedure followed in setting up the castings is similar to that of cases which have already been described, but attention may be called to tool-setting gage *A*, made of hardened steel to exactly duplicate the required cross-section of the slide bearing which must be finished on the under side of the milling machine table. An explanation has already been given of the way in which such a setting gage is used for properly locating tools for planing work to the required dimensions where accuracy is essential. It will be evident that on the job which is here illustrated there are ten surfaces to be planed, and gage *A* provides for properly locating the tools for operation on each of these faces of the work. As shown in the accompanying illustration, the tool-holders *B* are set for finishing the inclined faces *C* of the dovetailed slide bearing. For handling this part of the work, use is made of tool-holders with cutter bits *D* set at such an angle in the holders that the points can follow the inclined surfaces to be machined on the under side of the dovetail, without interference between the tool-holders and the work. It will be evident that the surfaces to be finished are in two groups comprising pairs of similar faces. For this reason two toolheads on the planer cross-rail are used simultaneously with a substantial saving in the time required to finish the job.

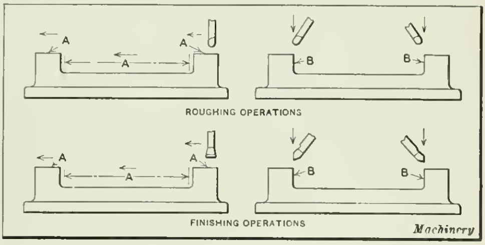


Fig. 15. Diagrams illustrating the Order in which Roughing and Finishing Operations are performed in planing Vise Bodies on the Machine illustrated in Fig. 14

Planing Cleveland Milling Machine Vises

Fig. 14 shows a Cleveland open-side planer used at the Clark-Mesker plant for planing the bodies of milling machine vises. This is quite a simple operation consisting of planing the top faces of the vise body and the sides and bottom of the opening. In setting up these pieces, a different principle is employed from any which has been previously illustrated and described. The pieces have been machined on their under sides, and there is a finished shoulder that can be utilized as a locating point. For this purpose, it will be noticed that two parallel strips *A* are secured to the planer table, so that the castings to be planed can be laid across these strips, with the machined shoulder on the under side resting against the strip. Then straps *B* extending from casting to casting in the string, are utilized to hold the work down; and the familiar arrangement of stops is employed to prevent the thrust of the tool from causing endwise movement of the work.

With a round-nosed tool mounted in the rail-head, a roughing cut is first taken across the tops of the two lugs on the work and across the bottom surface, as shown diagrammatically in Fig. 15, the feed of the head along the rail being utilized for this purpose. Then the inner sides of the lugs are planed with the same round-nosed tool, utilizing the vertical feed of the rail-head. After completing these operations, the same surfaces are finish-planed with a broad square-nosed tool. For planing ten castings set up on the machine in the manner described, the production time is eight hours.

In the February number of MACHINERY there will be published the second installment of this series of articles, which deals with the planer practice of representative lathe-building plants.

* * *

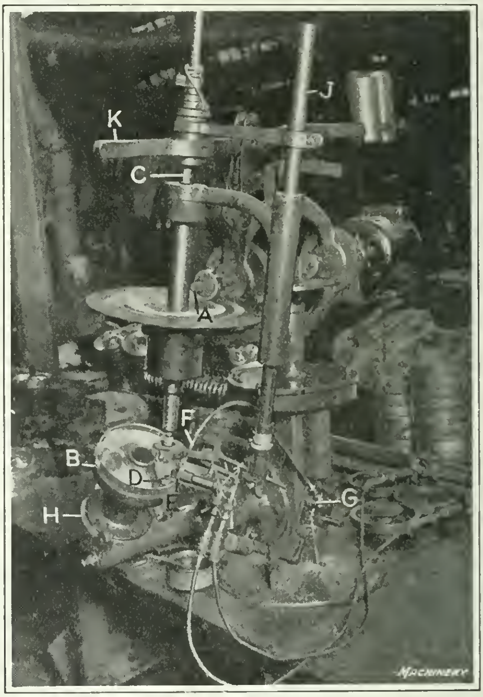
AUTOMATIC OXY-ACETYLENE CUTTING MACHINE

One of the most interesting British developments in connection with shop equipment, says our London correspondent, is the combination of the oxy-acetylene or oxy-hydrogen cutting blowpipe with the full automatic movements with which a universal type of machine tool is equipped. In effect, a new type of machine tool is available. The machine which is made by the Godfrey Engineering Works of Wood Green, London, England, has a T-slotted base, on one corner of which a pedestal is mounted, the pedestal carrying a swinging radial arm somewhat on the lines of a radial drilling machine. From the end of the arm is hung a cross-slide, carrying a second slide arranged at right angles to the first. A carriage hung from the lower slide carries a rotating arm, the radius of which can be varied. The cutting blowpipe is carried at the extremity of a light arm, pivoted at its other end to a second arm which, in turn, is pivoted to the pedestal. These arms are supported in ball bearings so that the blowpipe can be moved with practically no friction to any position in a horizontal plane. A pin on top of the blowpipe can be engaged in a hole in the rotating arm and causes the blowpipe to follow any movement of the slides or radius arm.

Feed is obtained from a light belt drive or small independent motor which drives through a pair of change-speed boxes, giving a feed ranging from ½ to 15 inches per minute to the blowpipe. Owing to the regularity of feed, remarkably clean cuts are possible, and a considerable economy in oxygen is effected. Plate 1 inch in thickness can be cut at the rate of 15 inches per minute with an oxygen pressure of only 20 pounds per square inch, the jet orifice being only 0.047 inch in diameter and the resulting cut 0.050 inch in width. A corresponding economy is effected in other plate thicknesses. By the use of templets cut from sheet fiber or thin wood, any irregular shapes can be cut, still using the automatic and regular feeds. As an instance of the accuracy with which cuts can be made, gears of 2 inches pitch and 16 teeth have been cut from ½-inch plate in sixteen minutes each, the finish being so good that the gears have run in mesh without dressing, the clearance being far less than would have to be allowed in cast gears of the same pitch even with dressing.

FILLET SOLDERING MACHINE

The accompanying illustration shows a soldering machine developed by the De Laval Separator Co., Poughkeepsie, N. Y., for the purpose of soldering the rims to the tin covers of cream separator bowls. A number of these covers are shown in the illustration, from which the nature of the work that this machine is engaged in performing will be understood. The soldered joint is a fillet extending around the interior edge of the covers, and the machine automatically makes this joint after the operator places the work in position. The machine is driven by a one-half horsepower electric motor, and the driving shaft *A* transmits power to both the work-holder *B* and the spindle *C*, by means of a friction disk drive. The speeds of both the spindle which carries the soldering iron *D* and the work, can thus be regulated to suit the diameter of the covers being soldered. A gas flame impinges against the point of the iron and the end of the soldering wire at *E* so that an even flow of solder is deposited as the work slowly revolves. The result is an even fillet without breaks or irregularities. The soldering wire *F* is fed to the work from a spool located underneath the bench on which the machine is mounted, and suitable feed-rolls *G* are provided for the purpose of delivering an even amount of wire to the flame. The power for driving the work-holder is transmitted from the main vertical spindle by means of suitable gearing held within case *H*. An operating lever *K* is provided for raising the soldering iron from the work by means of connections with shaft *J*. An inexperienced workman can operate the machine.



Special Soldering Machine used in the Manufacture of Tin Covers

* * *

The total imports of machinery of all kinds into New Zealand during 1920 amounted to about $6,000,000, of which electrical machinery represented about $3,500,000. The imports of machine tools represented a value of about $85,000, and all other metal-working machinery, about $12,500.

The Business Outlook for the Coming Year

By A. W. HENN, President National Acme Co., Cleveland, Ohio

In this article Mr. Henn outlines briefly his opinions as to the business prospects for the coming year. He points out that the railroads undoubtedly will become an important factor in machine tool buying, and that machine tool prices as a whole are not likely to be reduced materially, because the costs in this industry have not yet been reduced so as to warrant any cut in prices. He further deals with a very interesting method of taxation that has been proposed to take the place of the present excess profits tax, the results of which have proved extremely harmful to the nation as a whole, in that the tax has penalized capable management, encouraged waste and inefficiency, and been one of the principal causes for the extreme price increases.

NOTWITHSTANDING the fact that the machine tool business is passing through a period of depression, the industrial outlook throughout the nation, viewed in its broad aspect, is encouraging, and the industries generally may safely be said to be in a good condition. The automobile industry and the allied enterprises depending upon it are exceptions to this general statement. During the past year machine tool manufacturers have been called upon to equip automobile industries to the exclusion of almost all other lines of industrial endeavor, and this has tended to give them the idea that as soon as the demand from this one industry—important though it be—fell off there would be no other business in sight. This, I believe, is an erroneous impression, and it might be expected that the coming year will see a revival in several other industries that have not been very active for several years.

The Railroads as Prospective Buyers

A revival of the machine tool industry may be expected in the spring. By that time the general readjustment now taking place will have found its level, and the railroads, placed upon a firm financial footing by the increases in rates and fares allowed them, will be able to enter the market as buyers of machine tool equipment much needed by them. It is reasonable to presume that the important factor in the machine tool industry for some years to come will be the demand made upon it by the railroads; and as the demand falls off from the automobile factories, most of which are now well equipped and not in need of enormous quantities of machine tools for immediate delivery, the railroads will step in and occupy the center of the stage.

The needs of the railroad shops have repeatedly been pointed out and require no elaboration. The only thing that has prevented the railroads from buying during the last few years has been the depleted condition of their finances. Now, with the railroads receiving a greater income than ever on a falling market both in labor and materials, they should be in an exceptionally fine position to become active buyers, and there is no doubt that they will take full advantage of the opportunity offered them.

The Price Situation in the Machine Tool Field

It may as well be understood at the outset that there can be no material reductions in machine tool prices for some time to come. In the first place, present prices of machine tools are reasonable as compared with the prices still maintained in most other commercial fields. In the second place, there has been no reduction in costs up to the present time What slight reductions there have been so far in raw materials have been of no direct value to the machine tool manufacturer, because he must always have a large stock of materials and parts in process on hand and those now carried were acquired, in the main, at the high market price for materials during the period of inflated prices. Recent comparisons of costs in the building of several lots of machines show that the present costs are a shade higher instead of lower than those of machines put through at previous dates. Wages are as high as ever, and while it may be expected that there will be a gradual reduction, following the reduced cost of living which is already in evidence, this reduction will be so gradual that its effect upon costs of machine tools will not be apparent for perhaps a year or more to come.

The General Business Outlook

At the beginning of this article it was stated that the general business situation in the country presents no alarming aspect. It is true that we are passing through a period of deflation, but at the same time there is no over-production, except possibly in a few special lines, and on the whole there is a latent demand for the goods produced by the industries that will not be filled for a long time to come even though the industries be running at full capacity. As an indication it may be mentioned that screw products show general activity in all standard lines. The shelves of the dealers are empty and the orders that were placed for replenishing their stocks have not been cancelled to any great extent. The dealers found during the past year of industrial activity that deliveries were often months away, and they apparently are not taking chances on cancelling, with the result that they might have to step down to the end of the line and wait for deliveries over a more or less further prolonged period.

In many of the industries not directly allied with the machine industry much of the depression that exists is due to the holding off of buying on the part of the general public in the expectation of lower prices, but just as soon as it becomes generally recognized that prices have reached the bottom, it is likely that there will be a resumption of buying that will again set the wheels of industry to work in a satisfying manner.

The Foreign Trade

There is unfortunately not much hope that the foreign trade will revive at a very early date, because the foreign buyer cannot pay present prices as expressed in his own currency, due to the abnormal exchange, and the American manufacturer is unable to finance him indefinitely. Eventually this condition will right itself, but there is no immediate prospect of a foreign trade that will be of much help to the machine tool builder under existing conditions.

The Question of Taxation

There is no more important matter for the new Administration and the new Congress to consider than a rational system of taxation. Experience has shown that the present excess profits tax is utterly harmful to the country. It penalizes capable management, and it encourages waste and unsound business practices. Various other methods of taxation have been proposed, all of which ought to be carefully considered, and the one which seems to afford the least objection should be chosen. A general merchandise tax, placing a flat or possibly graded percentage tax on every sale has been proposed. Something of this nature is applied in

France and in Canada, and appears to work reasonably well. Objections to this tax that may be serious have been raised, however, by those who have analyzed it, but very able expressions of opinion on this subject have been made by Jules S. Bache. An interesting analysis has been made by Theodore H. Price, publisher of *Commerce and Finance*. Mr. Price outlines another method of taxation which appears to be free from most of the objections that have been raised to the other systems, and which in addition seems to have many advantages.

This method proposes to place a percentage tax upon the payroll of every employer, the tax to be payable monthly. One of the advantages claimed is that there would be no duplication of tax, as there necessarily is in a general merchandise tax. Our federal taxes come chiefly out of industry in one way or another, so that the tax must be placed primarily upon the products of labor. A simple and direct way in which this can be done appears to be by a tax upon the total amount of wages paid by an employer. In this way the exact amount of the tax is known at all times. There is no unknown or indefinite factor involved, as in the case of the present excess profits tax. Such a tax should encourage thrift and economy in the conduct of business, and the total that must needs be added to the cost of the product in order to cover the tax can be determined with the same accuracy as the direct labor cost; hence, the tendency will be toward reduction in prices, because there is no need of adding an arbitrary percentage in order to cover the unknown factor of the tax bill. Furthermore, the tax could be paid in monthly installments, immediately when due, and if, owing to depression in business or for any reason whatsoever the payroll were reduced, the tax would automatically be reduced also. When business is in a prosperous condition the industries are easily able and likewise willing to pay an increased tax on an increased payroll. Without prejudice to the merits that may be claimed for a general sales overturn tax, manufacturers might do well to give this proposition some concentrated thought, and if this method of taxation meets with their approval, they ought to communicate their views to their senators and representatives, and also to such committees of Congress as will aid in shaping the new tax laws of the nation.

* * *

GRINDING-WHEEL SPINDLE OPERATED AT AN UNUSUAL SPEED

A description of two grinding-wheel spindles intended for operation at high speeds was given in the December number of MACHINERY. The accompanying illustrations show another type of grinding-wheel spindle designed for very fine internal grinding operations, which was exhibited at the Olympia exposition in England, being operated at the almost inconceivable speed of 104,000 revolutions per minute—over 1700 revolutions per second. This spindle is equipped with a wheel ¼ inch in diameter, and is the product of the A. A. Jones & Shipman Co., Ltd., Leicester, England. The spindle was driven from a pulley mounted on a shaft running at the rate of about 9150 revolutions per minute, this intermediate shaft being, in turn, connected to a motor pulley having a speed of 2500 revolutions per minute.

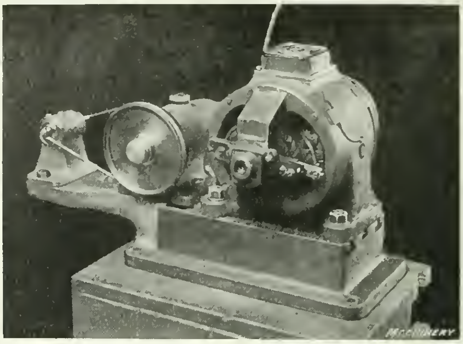


Fig. 2. Grinding-wheel Spindle which operates at 104,000 Revolutions per Minute, made by A. A. Jones & Shipman Co., Ltd.

The type of bearing adopted is shown in the accompanying sectional view, Fig. 1. It will be observed that the path of rotation of the balls is in a straight line at right angles with the axis of rotation, and owing to the limits imposed in the manufacture of the races the balls rotate exactly on the center line of the curved races. The result is that there is no spinning effect. The balls are not caged, and as they are carefully graded, they keep perfectly spaced. Assuming wear to take place, the adjustment at the rear end of the spindle farthest from the wheel will tend to push the balls up the radial bearings, but in practice it is claimed that wear on the balls and races is infinitesimal, so that the adjustment is always in a straight line with the axis of rotation and there is no tangential effort of rotation other than at right angles to the axis. End play is impossible with the bearings correctly adjusted, because the construction provides a double contraction.

The driving belt is made from a particular quality of rubber, which is necessary to secure the desired results. The spindle apparently reaches its critical speed at 33,000 revolutions per minute, as when it attains approximately this speed, the belt starts to oscillate badly, but as the speed increases, this effect dies down and the belt again runs smoothly. This spindle is yet in the experimental stage, but it has been run hour after hour without undue heating, the period being apparently limited by belt endurance. It should be mentioned that the wheel was not cutting during these runs.

A more definite stage of practicality has been reached with the next size spindle, which is fitted with the same type of cup and cone bearings. This is designed to run at 40,000 revolutions per minute, and is fitted with a ½-inch wheel to give a surface speed of approximately 5000 feet per minute. This spindle is regularly in work at the maker's plant, and is said to have been operated at 37,312 revolutions per minute, grinding out hardened steel gears, with a band of rubber that had stood for three working days without stretching or warping. This spindle has been tested by the National Physical Laboratory up to a speed of 45,460 revolutions per minute.

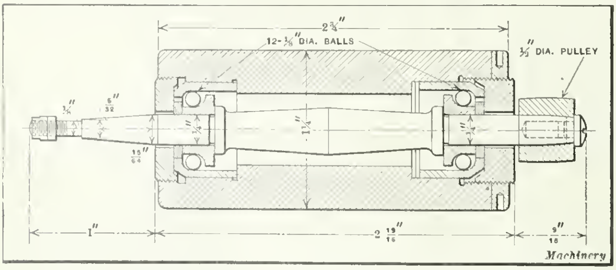


Fig. 1. Dimensions of High-speed Grinding-wheel Spindle shown in Fig. 2

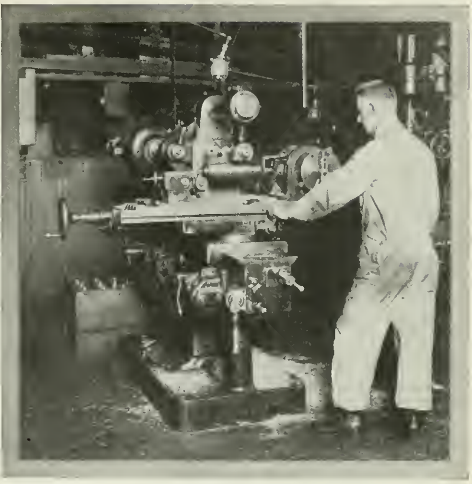
* * *

The amount of freight handled on the railroads of the United States, increased from 1914 to 1919 by about 40 per cent. The damage payments due to losses and damage in transit increased by 222 per cent, involving payments for loss and damage of over $100,000,000 in 1919. Doubtless, here is an opportunity for the railroads to take steps that will result in a large saving.

Training Operators in a Machine Shop

A Detailed Description of the Methods Employed in the Plant of the Norton Company, Worcester, Mass., in the Training of Machine Shop Workers

By JOHN C. SPENCE
Superintendent Grinding Machine Division, Norton Co.



In the article published in the December, 1920, number of Machinery, entitled "Increasing Production by Training Workers," the general principles upon which the Norton training department is based were outlined. It is proposed in the present article to describe in greater detail the organization of the training department, the methods used, and the results obtained.

At the Norton Co.'s plant a separate department has been set aside for the training of machine tool operators. This department is under the immediate authority and control of the superintendent of the machine division, and the same rules that apply to any production department of the shop apply to the training department. The training shop is under the direct supervision of a training supervisor, who has four instructors as his associates; these instructors give their entire time to this department, the idea being to have eight or ten men under each instructor.

The Objects of the Shop Training Department

The immediate objects of the shop training department may be stated as follows: (1) To carry out a predetermined policy of instruction; (2) to provide the shop with a good type of skilled workmen; (3) to teach the beginner the proper and safe way in which to operate machine tools; (4) to instill in the workman a pride in the honesty of the product, a respect for the rights of his fellow-workers and of the company for which he works, a sense of responsibility for the care of the company's property, and a desire to advance beyond the plane of the mediocre workman; (5) to influence the future attitude of the workers toward industry by giving them right impressions and correct information from the start; and (6) to provide an opportunity for partly skilled men already in the shop to obtain a more advanced training.

Incidentally, the shop training department makes it possible to obtain the following advantages: (1) It removes from the foremen of the production departments the burden of teaching beginners; (2) it decreases the amount of spoiled work in the factory, because of the careful training and supervision of beginners; (3) it stabilizes the labor turnover among skilled men by keeping out the floating group of transients; (4) it assists the employment department in distributing the men to the best advantage; (5) it provides a means whereby note can be taken of the qualifications and abilities of young men entering the shop, which may be of value when making promotions in the future; (6) it furnishes a man the means for finding out whether or not he is adapted for mechanical work, provided he is given the proper amount of training; and it saves him experimenting in the regular production departments where the opportunity is much smaller, and where the humiliation in case of failure is greater.

Equipment of the Training Department

The training shop is practically self-contained, that is, it has a complete equipment of the standard types of machine tools, jigs, and fixtures, and small tools, the same as a complete small machine shop. It has its own tool crib and washroom. The department comprises over 6000 square feet of floor space and is provided with the following machines and equipment:

14 lathes
1 speed lathe
5 horizontal milling machines
2 vertical milling machines
2 hand milling machines
2 two-spindle sensitive drilling machines
2 wheel and lever drilling machines
1 shaping machine
1 universal grinder
2 tool and cutter grinding machines
1 drill grinder
2 wet tool grinders
1 screw slotter
3 arbor presses
1 straightening press
15 vises
1 gas furnace
160 feet of benches

A department so equipped can handle sixty-five men at one time, including assemblers, but the usual number is between thirty and thirty-five. The training period averages six weeks, and as soon as the men are sufficiently trained, they are placed in positions open in the regular shop departments. On an average of from four to six men are transferred to the shop departments each week.

Starting to Work in the Training Department

Any man or boy over sixteen years of age is eligible for the training department if it is believed that he has the proper qualifications for making a good machinist and a valuable and loyal employe. Before being accepted he is required to pass a simple written examination in arithmetic, as it is considered that any man to be a good machine operator must understand the fundamentals of simple calculations. The examples given cover ordinary operations in whole numbers, fractions, and decimals. He also must pass a physical examination, after which the training supervisor has a talk with him, clearly defining what the company expects of the prospective machinist and what he, in turn, may expect of the company.

He is then given a booklet on safety rules for machine shop employes, and signs a statement saying that he will read it carefully and follow the rules that apply to his work. He is further shown the location of the sub-hospital, how to register on the time-clock, and how to obtain tools from the tool crib, and supplies from the stores. His first lesson in actual machine tool operation begins with a practical talk at the machine on the dangers to avoid. This talk is repeated at intervals throughout the course, especially during the first few days.

Methods Used in the Shop Training Department

The first training course consists of a six weeks' intensive training in work on a machine. In exceptional instances, when the beginner proves to be of a superior type, he may be given a general training on all the various types of machine tools in the training shop, but this is an exception. He nevertheless has an opportunity to obtain an all-around training by passing into the shop from the training department after he has been trained on the lathe, and then coming back into the training shop after a certain period and receiving further training on another machine, and so on, as will be described later.

In the training shop, charts are posted indicating to the student each progressive operation that he will be taught, in the proper sequence for each machine. These charts also contain an outline of all auxiliary information, trade mathematics, and "shop science" that he should learn in connection with each operation. This places the scope and object of the training directly before each man, and gives him part of the responsibility for seeing that he gets all the training that the course offers. These charts, which are based upon Bulletin No. 52 of the Federal Board for Vocational Education, adapted to the needs of the Norton Co., also guide the instructors in laying out operations in the proper sequence for each man.

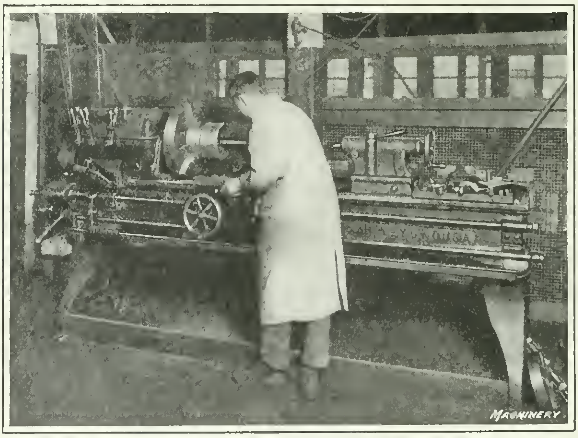


Fig. 1. Six Weeks of Intensive Training makes a Good Lathe Operator out of a Beginner

A given number of hours for training in each operation is stipulated, but each student must do the work habitually well, before he is permitted to do the next operation. If he does not show increasing ability as he advances in the work, the training supervisor explains to him that as he shows no aptitude for the work, it would be better for him to secure a job in some other occupation or trade. He is given an opportunity to secure this new job while still working for the company, so that he may leave the training department without publicity as to the reason for his doing so, thereby preserving his self-respect.

There is at present no class-room work in connection with the shop training. Such instruction as is required is handled by each instructor according to the lay-out of the chart for each operation, and each man being trained is dealt with individually. The operator being trained is expected to insist that he receive the instructions called for by the chart. It is not thought, however, that class-room work does not fill a proper place, provided it is conducted by a practical machine shop man, using throughout the instruction concrete shop problems. This part of the training program is handled by another department called the educational department by means of evening classes, but nevertheless the classroom work will always be supplemented with further individual instruction on the job, in the same way as it is now carried out.

The Training Shop is an Actual Production Department

It should be understood that the training shop is not a mere school but is an actual production department, aiding in carrying on the shop production. It has the authority to divert from the regular shop departments to the training department twenty-five pieces of any kind of work that affords training value. An inspector from the regular shop inspection department inspects all the work done in the training shop, and must be absolutely impartial in his judgment, because the parts that pass from the training shop enter into the regular manufacturing routine. In addition to the regular production work, the department takes care of all repair parts for the company's machines ordered by outside customers. An idea of the amount of work turned out by the training shop may be gained from the fact that one inspector is kept busy continuously inspecting work from this shop alone.

Promotion from the Training Shop to the Production Departments

From time to time, sometimes several times a week, the training supervisor and the general foreman of production hold a conference at which they consider which men in the training shop are fitted to take jobs that have opened up in the factory. When a man has been chosen for a given job by these two men, the foreman of the department for which he is proposed is informed, and his opinion asked. The foreman has the privilege of stating any objection that he has to the man, and may ask for any man in the department that appears to him to be better qualified for the work.

After the man has been transferred to the shop, the training supervisor keeps in touch with him for several weeks, encouraging him and advising him, and if he finds it necessary, he occasionally takes him back to the training shop for further instruction and training.

How a Man Receives an All-around Shop Training in the Training Shop

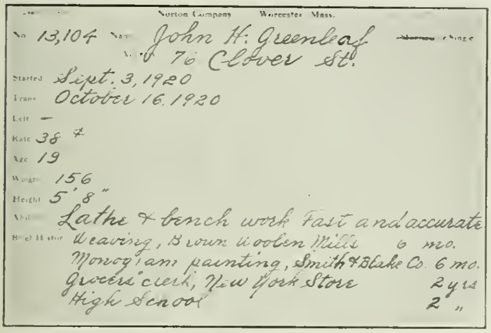
When a graduate of the training shop has been promoted to a production department, he must remain in this department at least three months and make a satisfactory record, before he can return to the training department for additional training on another type of machine tool. He must also have shown that he has the ability that warrants the company in giving him the opportunity. He then again returns to a production department, staying there another three months, after which he can return and obtain training on still another machine tool. The subsequent training periods usually last only from two to four weeks.

In this way an exceptional man can become an all-around machinist in about two years, and will have received, it is believed, a much better training than the ordinary apprentice receives in four years' time. Such a course of training will be distributed about as follows: Six weeks' lathe work in the training shop; three months in the shop in the lathe department; from two to four weeks' milling machine work in the training shop; three months in the milling machine department; from two to four weeks' drilling practice in the training shop; three months in the drilling department; from two to four weeks' training on planer and shaper work in the training shop; three months in the planer or shaper department; from two to four weeks in the training shop on universal grinding machines; three months in the grinding department; and finally, from two to four weeks' training in the training shop on tool and cutter grinding. At this time the man may claim to be an all-around machinist, and will be able to more than measure up with the average man trained by the four-year apprenticeship method.

During the three-month periods when the man is in the shop, he works as a piece-worker and attains the required speed necessary to become a good operator. It is also a test of the ambition of the man if he wants to come back into the training shop in order to become an all-around machinist. A great many of the men trained, do this, but, of course, there are others who, after having received training on one or two machines will remain operators on those machines continuously.

Compensation Paid in the Training Shop

In order to attract the right kind of young man it is necessary that the compensation paid in the training shop be at least sufficient to meet his actual needs of maintenance.



Norton Company Worcester Mass.

No. 13,104 Name John H. Greenleaf — Single

76 Clover St.

Started Sept. 3, 1920

Trans. October 16, 1920

Left —

Rate 38 ¢

Age 19

Weight 156

Height 5' 8"

Skill Lathe & bench work Fast and accurate

Brief History Weaving, Brown Woolen Mills 6 mo.

Monogram painting, Smith & Blake Co. 6 mo.

Grocers' clerk, New York Store 2 yrs

High School 2 "

Fig. 2. Record retained by the Training Shop Office, giving Information relating to Each Man

Men with no previous experience are paid 38 cents an hour for the first six weeks, if single, and from 42 to 45 cents an hour, if married. If they have some previous shop experience they will be paid from 42 to 45 cents an hour, if single, and from 45 to 50 cents an hour, if married. The man who returns to the training shop for additional training on other machine tools receives a compensation equivalent to 15 per cent less than the hourly rate that he was allowed in the production department where he was last employed.

In addition to the training of young men hired for that purpose, the training department is also open to men already employed in the productive departments, who want to acquire additional training on other kinds of machine tools than those which they are operating. These men come into the training department on the condition that they receive 15 per cent less than their hourly rate during their training.

In unusual instances, when a man proves to have remarkable qualifications for learning and seems to possess such ability as to make it advisable to train him as fast as possible on all the different types of machine tools in the training shop, he will remain there continuously for twelve weeks, which is a sufficient length of time to give such a man a fairly good idea of shop work, under the intensive and systematic methods used.

It has not been found necessary to keep many records of the performance of the men in the training shop. The supervisor and the instructors are so closely in touch with the men being trained at all times, that very few written reports or records are kept. The only data retained by the office of the training shop is a record such as shown in Fig. 2, giving information regarding the more important facts relating to each man who passes through the department.

Cost of the Training Shop

The question that will be asked by every manager of a machine shop who contemplates the installation of a training shop will be, "How much does it cost to train an operator in this way?" It has been found at the Norton Co.'s plant that the cost of training a man for six weeks is $65. The actual full cost of the training averages $125, but the work turned out by the operator during the six weeks in the training shop is worth about $60, the difference—$65—being the actual cost to the company for the training of a competent operator. If this cost is compared with the cost of training a man in the shop departments, including all the spoiled work resulting from the first weeks of his employment, and the time taken by the department foreman in instructing him, it will be found that the training shop is by far the cheapest method by which a man can be trained. Furthermore, it produces a far superior working force, creates a better spirit throughout the shop, and is apparently the only solution to the problem facing manufacturers of obtaining skilled help without resorting to the practice—which in the end only proves a boomerang—of hiring skilled men from neighboring shops.

* * *

CAST IRON FOR LOCOMOTIVE CYLINDER PARTS

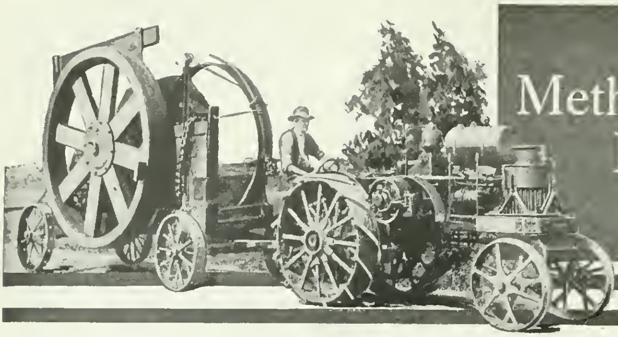
Frequent renewal of cylinder parts of locomotives results in greatly increased cost of maintenance to the railroads, and consequently the quality of the cast iron entering into their construction is a matter of paramount importance, particularly from the standpoint of wear. These parts include piston-valve bushings, piston-valve packing rings, piston-valve bull rings, cylinder bushings, piston packing rings and piston-head or bull rings. It was found that ordinary high-silicon cast iron gave unsatisfactory wear, particularly in modern superheater locomotives, and the tendency has been to use a harder and stronger iron.

At the request of the United States Railroad Administration, the Bureau of Standards has investigated the mechanical, chemical, and microscopical properties of a number of packing rings furnished with service mileage records, as well as arbitration-test bars, chill-test specimens, and miscellaneous samples from different manufacturers. All this material was cast iron such as is used for the various cylinder parts. The Bureau of Standards at the same time made a review of the previous work and specifications on this subject, to ascertain as far as possible the practice of the different foundries, and to suggest such revision of existing specifications as would be warranted by the results of the present and other investigations.

It was found that air-furnace iron is more uniform in character and in general of somewhat better mechanical properties than cupola iron. The latter, however, often equals or even excels the air-furnace product in mechanical properties. Because of the many variable factors, it was difficult to establish correlation between laboratory and service tests. It was recommended, as a result of the present and other investigations, that the transverse strength requirements of the standard American Society for Testing Materials 1¼-inch arbitration bar be increased from 3200 to 3500 pounds for castings ½ inch or less in thickness, and from 3500 to 3800 pounds for castings over ½ inch thick.

* * *

One of the results of the visit of the Swiss mission to the United States during the past year has been the formation of an organization designed to facilitate trade with the United States. This organization has headquarters at 8 Laupenstrasse, Berne, Switzerland, and its aim is to furnish exporters and buyers with any information that may be of assistance in furthering trade development between the two countries.



Methods in a Tractor Engine Plant

Special Machinery and Unusual Equipments for Standard Machine Tools

DURING recent years, much of the remarkable progress which has been made in the development of improved methods for the performance of machine shop operations and other lines of industrial work has resulted from a liberal interchange of ideas among men engaged in the same general lines of manufacturing. And in this connection, there is an important point to which attention should be directed, namely, the possibility of applying quite similar methods of conducting manufacturing processes and shop work in factories engaged upon the manufacture of widely divergent products. As a specific example, consider the work of the Avery Co.'s engine department in Milwaukee, Wis. This plant specializes on the manufacture of farm tractor engines, and for handling this work a number of unusually ingenious and efficient special machines and auxiliary equipments for standard machine tools have been developed for the performance of machining operations on engine parts. It would be reasonable to conclude that an equipment especially designed to meet the requirements of a shop engaged upon special work of this character would not lend itself readily to application in machining parts of other products; but as a matter of fact, there are a great many similar shaped pieces which enter into a variety of products, and similar methods could be employed on their production with desirable results. In studying methods in the Avery Co.'s plant, the aim has been to select for discussion only those which were felt to possess features which would make possible their application in a variety of industries.

In the series of articles, dealing with methods employed for the performance of production milling operations, which was published from April, 1919, to May, 1920, in MACHINERY, information was given in regard to various methods of milling cylinder blocks and heads for motor car engines. In all of the examples which were described, a practice was made of milling these parts on independent machines; but the production engineers of the Avery Co. realized that as there are no milling operations to perform on the sides of the cylinder blocks, and as the cylinder heads are thin so that they could be set in a vertical position and would occupy very little space, it would be entirely feasible to employ a multiple-spindle milling machine built by the Ingersoll Milling Machine Co., Rockford, Ill., and equip it with fixtures that would provide for holding the cylinder blocks in their normal position and the cylinder heads set edgewise in order to provide for simultaneously milling these two parts.

Fig. 1 shows the machine equipped for the performance of this operation, and reference to this illustration will make it apparent that the fixture holds the work for milling the crankcase side of the cylinder block and for milling the under side of the head that fits on the top of the block. So far as the actual design of this work-holding fixture is concerned, there is nothing particularly unusual in the method of locating and clamping the castings. It is the provision which has been made for holding the cylinder blocks and heads for machining them both at a single setting that is the noteworthy point. The possibility of increased efficiency in machining resulting from such a practice should appeal to the tool engineers in many plants engaged upon the manufacture of products in which there are similar parts to be milled.

It will be apparent that Fig. 1 shows a cylinder block set for milling the crankcase face *A*, while the cylinder heads *B* are shown held in an edgewise position on these same fixtures, to provide for milling the under side of the castings. At the same traverse of the milling machine table that performs these two operations, a milling operation is also performed on the head end *C* of the cylinder blocks that have been previously milled on their under side. This finished face of the work is used as a locating point, and it would be feasible to bolt the castings directly on the table of the machine, were it not necessary to elevate them to the same level as the castings which are set up for milling face *A*. This result is accomplished through the use of raising blocks *D*, the use of which will be clearly understood by reference to the illustration.

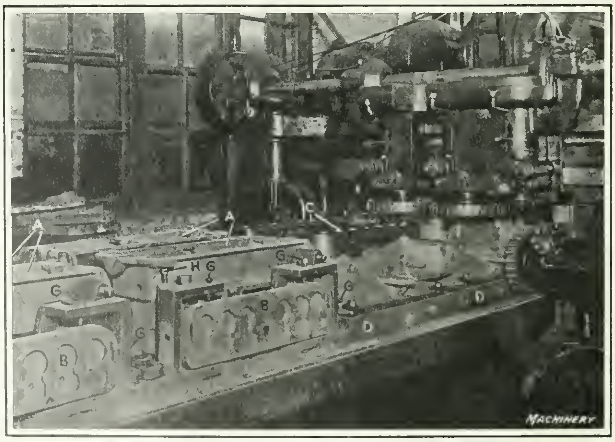


Fig. 1. Multiple-spindle Milling Machine equipped for simultaneously milling Avery Cylinder Blocks and Heads

Fig. 2 shows side and end elevations and a plan view of one of the milling fixtures for holding two cylinder blocks and two cylinder heads for the simultaneous milling of these parts. Referring to the plan view, it will be seen that there are three fixed points E_1 and three similar points E_2 against which the cylinder heads are pushed back, and the final location is accomplished by means of these points and three other fixed points F_1 and F_2. Clamping of the work in the fixture is accomplished by means of three set-screws G_1 and G_2 that secure the work against the fixed points F_1 and F_2. Bearing in mind that the plan view of the fixture shows provision for holding two cylinder blocks side by side for performing the first milling operation on the crankcase end of the work, it will be seen that there are three fixed points H_1 and three fixed points H_2 on which the two castings are dropped for a preliminary location. As this is the first cut taken on the work, it will be evident to experienced milling machine operators that the requirements of setting consist merely in providing a substantial foundation for the work during the period that the milling operation is being performed; then this milled face will be used as a locating point for setting up the work for performing subsequent operations. Each casting is lined up sidewise by pushing it against the heads of screws E_1 and E_2, which are allowed to project through the walls of the fixture for that purpose. Then the cylinder blocks are clamped down by means of bolts I_1 and I_2.

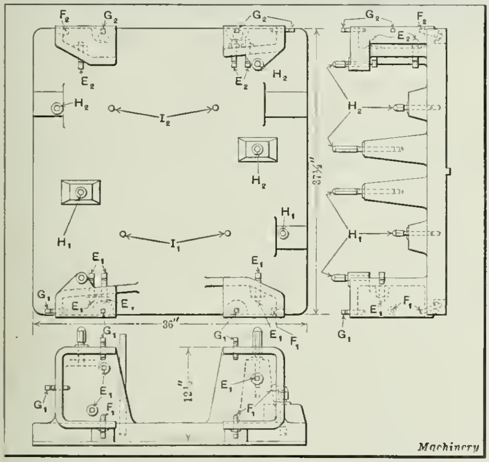


Fig. 2. Design of Work-holding Fixture used on Machine shown in Fig. 1

Special Drilling Heads for Use on Multiple-spindle Machines

For the performance of subsequent machining operations on cylinder blocks, the milled top surface *C*, Fig. 1, is utilized as a locating point. Fig. 4 illustrates a "Natco" multiple-spindle machine built by the National Automatic Tool Co., Richmond, Ind., which is employed for the performance of a drilling operation in the head end of the block. In this case, and for certain other multiple drilling jobs that have to be performed in the Avery plant, special drilling heads have been made to meet the requirements of operations where it is necessary to drill a number of holes on unusually close centers. Lower spindle members, of the type used on "Natco" drilling machines, were bought from the manufacturer, and special heads *A* were made to meet the requirements of each individual job. The spindles are permanently mounted in these heads, so that the entire outfit is kept in the tool-room as a unit and sent out to the drilling department when there are parts to be drilled of the types for which the special heads were made.

It will be seen that each spindle extends up to the point where the universal joint is located, and in setting up the machine for a job of this kind, the special head is secured to the main head by means of four bolts *B* fitting into the T-slot. Then the universal joints on the driving spindles are dropped into the corresponding members on the spindles of the special multiple head, and after setting up the drills, the outfit is ready for use. Mention was made of the fact that the previously milled head end of the cylinder block was used as the locating point for subsequent machining operations. In the present instance, it will be apparent that jig *C* is dropped into place over this finished surface and secured by means of set-screws. Otherwise, there is nothing that is particularly noteworthy in connection with this operation.

Fixture for Boring Cylinders Perpendicular to the Head End

Cylinders for Avery tractor engines are bored on the so-called "Hole-hog" type of machines built by the Moline Tool Co., Moline, Ill. Formerly, it was the practice to utilize the milled lower face of the block as a locating point for the performance of this operation; but for several reasons, it is more desirable to employ the milled head end for locating the work for boring the cylinders. To provide for performing the operation in this way, a fixture was recently designed which is shown in position on the machine in Fig. 5, while some of the details of the clamping arrangement are illustrated in Fig. 3. The purpose of this method of locating the work is to bore the cylinders exactly perpendicular to the milled top face of the block, and this result is accomplished by locating the casting against an upper finished face of the fixture and clamping it in that position. It is also necessary to have the cylinders bored in proper relation to other fixed points on the work.

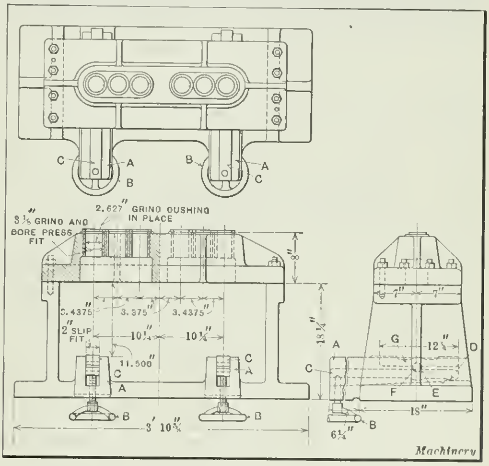


Fig. 3. Design of Work-holding Fixture used on Machine shown in Fig. 5

In starting to set up a casting in this fixture, it is lifted on the ends of rails *A* and slid forward. The milled top face of the casting is then raised into contact with the locating face of the fixture by turning handwheels *B*, which actuate elevating screws that lift two bars *C* located between the rails *A*, thus providing for forcing the casting upward. The best idea of the way in which this clamping mechanism on the fixture is operated will be gained by referring to the end view shown in Fig. 3, where it will be seen that at its forward end, each lift bar *C* has a shallow hole drilled to receive the point of the elevating screw that is turned by handwheel *B*. The weight of the casting holds the bar *C* firmly down on the screw point, and this engagement is depended upon to prevent the bar from shifting its position.

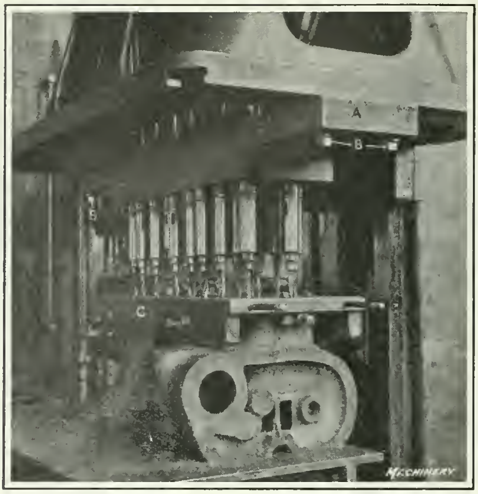


Fig. 4. Special Head designed for Use on Multiple-spindle Drilling Machine

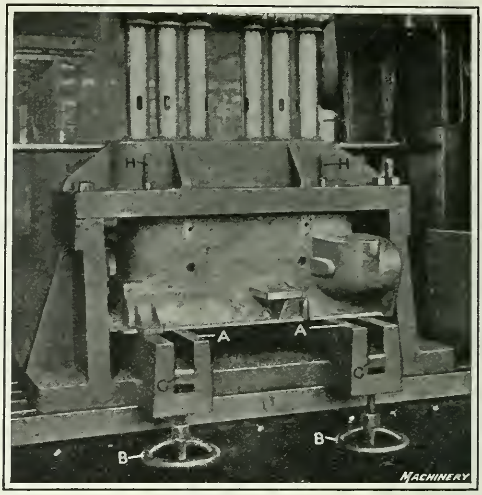


Fig. 5. Method of setting up Cylinder Blocks for boring perpendicular to Head End

At its rear end, each of these bars *C* is machined to a cylindrical form on its under side to afford a rolling action on a finished surface *D* on the bed of the fixture.

Near the center of each bar *C*, a semi-cylindrical shaped pocket *E* is machined to receive the under side of a roller *F*, and the upper side of this roller fits into a similar pocket cut on the under side of an equalizing clamping bar *G* which engages the bottom of the cylinder block that is to be bored. It will be evident that as handwheels *B* raise bars *C* the changes of angularity in these bars do not affect the clamping action on the work because the clamping bars *G* swing on rollers *F* and continue to apply a uniform pressure to the casting that will result in pushing its milled top surface tightly against the finished seat at the top of the work-holding fixture. After the casting has been placed in the fixture and before the clamping has been completed, two dowel-pins *H*, Fig. 5, are introduced into drilled holes in the top of the work to obtain the desired location of the bored cylinders relative to other fixed points. The milled top face of the cylinder block is also utilized as a locating point for the performance of the cylinder grinding operation.

Special Machine for Boring Combustion Chambers in Cylinder Heads

At *A* in Fig. 6 there is illustrated the head of a two-cylinder Avery tractor engine. For boring the combustion chambers in these castings, a special duplex boring machine has been built, which is illustrated in Figs. 6, 7, and 8. As the castings come to this machine they have been milled on their top and bottom faces, and they are dropped into fixture *B* on four fixed locating points, on which they are held down by the combined action of their weight and set-screws *C* that prevent the work from lifting. On the machine there are two tracks *D* on which the fixture *E* moves forward to provide for dropping the casting into place, after which the fixture is withdrawn to its position under the spindles for performing the boring operation in the combustion chambers.

The best idea of the way in which this special boring machine operates will be gathered by reference to Fig. 8, which shows the important parts of its mechanism in diagrammatic form. The drive is by means of a belt running over single pulley *F* and thence to a worm *G* on the horizontal driving shaft, that meshes with worm-wheels at the tops of the boring

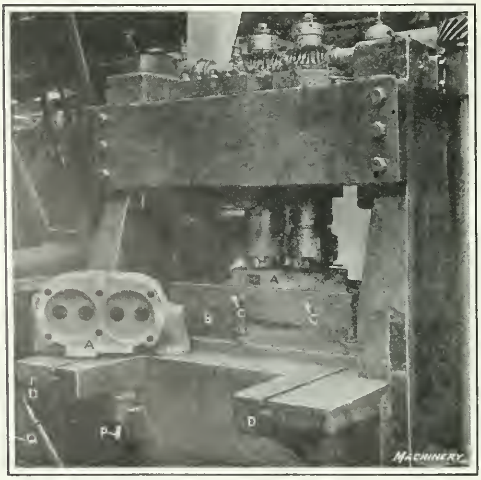


Fig. 6. Close-up Front View of Special Machine for boring Combustion Chamber in Avery Cylinder Heads

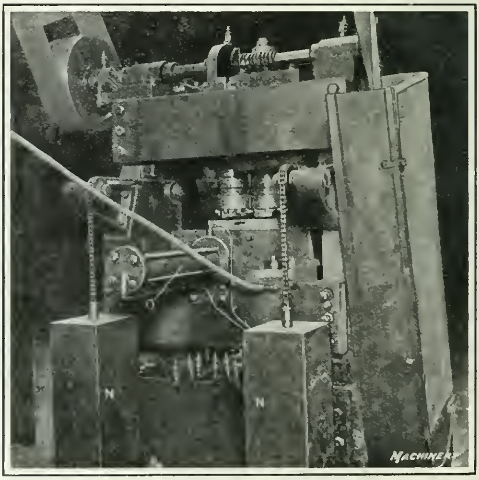


Fig. 7. Rear View of Machine showing Table Counterweights and Air Cylinder for Manipulation of Work-holding Fixtures

spindles *H*. From the horizontal driving shaft at the top of the machine, power is also carried down to the feed mechanism by a pair of spiral gears *I*, a vertical shaft and a worm and wheel *J*, and thence through a horizontal shaft carrying two worms that mesh with worm-wheels *K* which are threaded on vertical lead-screws *L* that are keyed to the table *M* of the machine to prevent them from turning. Worm-wheels *K* are free to turn, but are supported in such a way that they cannot move vertically; and as a result, the rotation of these worm-wheels threaded on the lead-screws *L* raises or lowers the table *M* according to the direction of rotation.

Referring now to the back view of the machine, Fig. 7, it will be seen that there are two counterweights *N* that balance the weight of the table so that the screws are merely required to overcome inertia and provide for feeding the work up to the cutters or withdrawing the table after the operation has been completed. The spindles *H*, Fig. 8, occupy a fixed vertical position and take no part in the feed movement, their function being merely that of rotating the boring tools. At the rear of the machine, Fig. 7, it will also be seen that there is an air cylinder *O* that is controlled by means of a lever *P* at the front of the machine, Fig. 6. This air cylinder provides for running the fixture *B* out for removing the bored casting and substituting a fresh one in its place, or for running the reloaded fixture back into position for performing the boring operation. After the boring operation has been completed, a clutch in the worm-wheel *J*, Fig. 8, on the feed-shaft is released, and a friction clutch (not shown) that is mounted on a pulley at the left-hand end of the horizontal shaft that transmits power to worm-wheels *K* on the elevating screws, is engaged by turning handwheel *R*, and provides for lowering the table to the starting position at a high rate of speed.

* * *

The Bureau of Foreign and Domestic Commerce of the Department of Commerce, Washington, D. C., has recently published a book entitled "Industrial Machinery in France and Belgium" for the benefit of American machinery manufacturers, engineers, and contractors interested in supplying the equipment necessary to rehabilitate the industries of the countries. The industrial needs of France and Belgium are classified, and industrial conditions after the war, as well as the application of American methods and credits in these countries are discussed. In a section devoted to trade methods, the markets available through France are given. Copies can be obtained from any of the bureau's district offices or from the superintendent of documents, Washington, D. C.

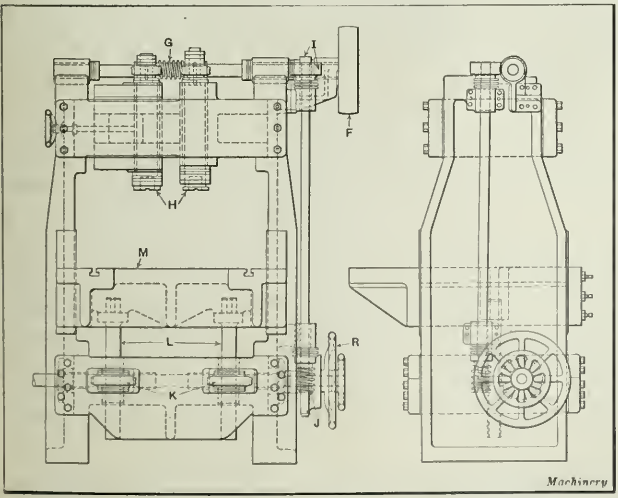


Fig. 8. Arrangement of Mechanism on the Special Cylinder Head Boring Machine illustrated in Figs. 6 and 7

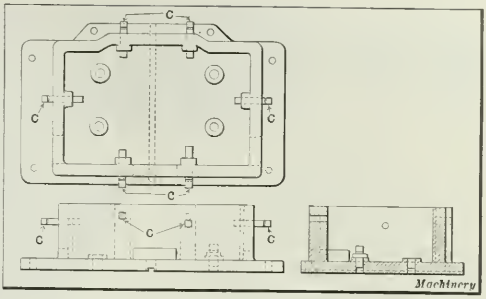


Fig. 9. Design of Work-holding Fixture used on the Special Cylinder Head Boring Machine

AMERICAN ENGINEERING COUNCIL

At the first meeting of the American Engineering Council, (the governing body of the Federated American Engineering Societies) recently held at Washington, Herbert Hoover was elected president of the federated societies. Delegates were present from twenty-one member societies, having a membership of over 50,000 engineers. Permanent headquarters are to be established at Washington, D. C. One hundred and sixteen organizations have been invited to become members of the federation. Of these thirty-five have definitely accepted the invitation, and a number of others are now merely awaiting formal action by their membership or governing boards.

* * *

INTERCHANGEABLE CONTAINERS FOR TRANSPORTING FREIGHT

A long step toward relieving the tense situation in the transportation lines of the country appears to have been made by the River & Rail Transportation Co. of St. Louis, Mo. This company has developed an interchangeable metal container, termed "Trinity Freight Unit," for facilitating the transfer of goods at terminals, as described by the *Railway Age*. Merchandise is placed in the container at a manufacturing plant or in a warehouse and then, locked and sealed, the container is transported by motor truck to a railroad, or to a waterway, where it is transferred to a flat car or to a boat without rehandling the materials.

The complete unit includes a specially constructed flat car, which differs from those now in use on the railroads of the United States only in providing a means of clamping the containers fast to the platform. Containers made in a number of different ways are provided for carrying various kinds of material. A type is designed with side-opening doors for package freight, another with top doors and drop bottom for loose bulk freight, and there are other types for refrigerator service and for carrying liquids. The units are made in capacities of 2½ tons and 10 tons each and are proportioned so that five 10-ton units, or twenty 2½-ton units, or several units of both capacities, and for any of the different classes of freight, can be carried on a flat car of 50 tons capacity. The system has already been tried and proved successful. The United States Railroad Administration adopted it to facilitate water-rail shipments of war supplies. Twenty of the 10-ton package units were built and gave satisfactory service in the New Orleans district in handling package freight. It is stated that estimates based on the performance of these units indicate that the handling of freight is greatly expedited, and can be handled at about 300 per cent less cost than with present methods.

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COMMON CAUSES OF ERRORS IN MACHINE DESIGN

The many excellent articles and books dealing with the basic principles of machine design and manufacturing practice are almost indispensable to designers of mechanical apparatus, as they contain a vast amount of useful data, established facts, standard formulas and general information covering the important branches of engineering practice. But the young draftsman or designer soon learns that developing or originating various mechanisms is anything but a "cut-and-dried" process, and the facts and figures given in textbooks, while helpful, must be so applied as to conform to the conditions affecting each problem in design. The endless variety of combinations and factors relating to work the mechanism is to perform, the conditions under which it must be used and the operating and manufacturing costs, must be considered in the design and tend to multiply the chances of drafting-room errors or the adoption of designs not representing the best practice.

The first of a series of articles on "Common Causes of Errors in Machine Design" is published in this number of MACHINERY and represents a careful study of drafting-room errors and their underlying causes, and gives some reasons why designs are not always what they should be. Draftsmen as well as experienced designers will benefit by studying these fundamental causes, which have been analyzed and recorded from the results of years of diversified experience. While all designers realize the importance of preventing errors as far as possible, the fact that they can be reduced to a minimum by a systematic study of fundamental reasons is not so generally appreciated as it should be. The general subject of errors in machine design will be treated in this series of articles from many different viewpoints, the assumption being that to neglect any element of design affecting operating results, manufacturing costs, quality of the product, or the reputation of the manufacturer, is an error. Another important point made is that draftsmen should not confine their efforts strictly to technical features, but should make a study of all factors which affect the commercial values of new or improved designs.

* * *

BALL BEARINGS FOR ELECTRIC MOTORS

With the increasing application of the electric motor drive to machine tools, the question of motor bearings is of great importance to the machine tool builder, because the motor virtually becomes part of his machine, and he, in a measure, is held responsible for its reliability. As any serious motor trouble will keep the machine idle, the continuous operation of the motor is one of the most important factors in the mechanical combination.

The electric motor of today is one of the most reliable mechanisms in general use, but there are opportunities for improving the mechanical features which merit more careful attention by electrical engineers. Those most familiar with the use of electric motors in the industries state that a great part of all motor troubles originate in the bearings, and that those troubles could be largely, if not entirely, avoided if electric motors were generally provided with ball bearings. In many instances, after difficulties with the bearings have developed, ball bearings have been used to replace the ordinary type, with very satisfactory results. The first cost is greater; but it is believed that the general application of ball bearings to electric motors would in the long run save the motor user several times the additional cost.

* * *

CONCERNING FIRE INSURANCE POLICIES

Owing to the high prices of labor and building materials, the average value of investments in industrial buildings has increased at least 100 per cent during the last five years, and the manufacturer faced with the necessity of increasing his plant soon learns how very much more it would cost to reproduce existing buildings than it cost a few years ago. Despite this fact, many manufacturers have overlooked the importance of increasing their insurance policies to cover replacements at present prices in the event of losses through fires. Those unfortunate enough to have had fires before taking such precautions have learned at high cost that insurance based on valuations of five years ago is entirely inadequate; furthermore, the co-insurance clause of the fire insurance policy makes it exceedingly risky not to carry full insurance. Bearing this in mind, factory owners who have not had occasion to look up their insurance for some time are advised to do so. Many will find that the amount of protection they carry on their property is inadequate to provide for replacement at present valuations. Building costs are not likely to come down for some time to come.

* * *

AN ENGINEER'S QUALIFICATIONS

The Carnegie Foundation for the Advancement of Teaching recently made a thorough investigation of many problems connected with engineering education. In the course of this investigation, questionnaires were sent to leading engineers throughout the country, asking them to state the characteristics which, in their opinion, counted for most in a successful career in the engineering profession. Over 6000 replies were received, and on a percentage basis the following qualities were considered the most important for a successful engineer: Character, 24 per cent; judgment, 19.5 per cent; efficiency, 16.5 per cent; understanding of men, 15 per cent; professional knowledge, 15 per cent; technique, 10 per cent. It is interesting to note that men who themselves have been successful in their profession considered general qualifications, such as character and judgment, to be far more important than mere professional knowledge and technique. Probably they had found it easier to acquire knowledge and technique than the other qualities essential to success in engineering.

Annual Meeting of the American Society of Mechanical Engineers

THE annual meeting of the American Society of Mechanical Engineers, held in New York City December 7 to 10, was marked by an unusually diversified program covering many different fields of mechanical engineering. Special sessions were provided by the Fuel Section; the Textile Section; the Sub-committee on Woodworking; the Machine Shop Section; the Management Section; and the Railroad Section. In addition there were two special sessions on design, two on research, two on transportation, a general session, and an organization meeting of the Ordnance Section.

Machine Shop Section

Three papers of unusual interest were read at the Machine Shop Section's meeting—one on "Side-cutting of Thread-milling Hobs," by Earle Buckingham, of the Pratt & Whitney Co., Hartford, Conn.; one on "Cylindrical Grinding in 1920," by W. H. Chapman, of the Norton Co., Worcester, Mass.; and one on "Mechanical Engraving and Die-sinking," by J. F. Keller, of the Keller Mechanical Engraving Co., Brooklyn, N. Y. Each of these papers was a distinct contribution to the literature of mechanical engineering, and recorded the results of years of investigation and study in different fields of theory and practice as applied to the machine shop.

Side-cutting of Thread-milling Hobs

It has long been known that, due to the helix of a thread, the side-cutting action of a hob distorts the form of the thread on the work. In other words, the form of the tooth on the hob is not reproduced on the threaded part. Mr. Buckingham's paper is the result of a mathematical investigation of this subject, and points out the corrections in the form of thread-milling hobs which can be readily made and which will produce threads sufficiently correct as to form for all practical purposes.

The profile of the thread cut with a hob is a combination of two distinct curves. First, a small fillet is formed at the root of the thread which is the path of the outside corner of the hob. No correction in the hob form can be made to rectify this. Second, the larger part of the flank of the thread consists of a slightly curved profile formed by the overlapping paths of the infinite number of cutting points which form the cutting edge of the hob. Mathematically, a curved correction can be applied to the form of the hob which will correct this profile entirely. Practically, a straight-line correction can be applied which is almost exact, as the amount of the actual curvature on the flanks of the thread is seldom greater than one-tenth of a thousandth of one inch. The greater the angle of helix of the thread, the greater the correction necessary.

One very interesting fact is that the diameter of the hob has no effect on the form of the main part of the profile. The actual amount of side-cutting is more, and the height of the fillet at the root of the thread is greater as the diameter of the hob is increased, but the rest of the profile is unchanged. The general conditions of side-cutting are identical in both externally and internally threaded parts. On a screw, however, the flanks of the hobbed thread will be convex, while in a nut they will be concave. Furthermore the height of the fillet at the root of the thread and the actual amount of side-cutting are relatively greater in a nut than on a screw.

Cylindrical Grinding in 1920

Mr. Chapman's paper comprises a study of the laws involved in cylindrical grinding and an analysis of grinding action (1) for draw-in cuts and (2) for traversed cuts. Grinding efficiency is usually considered as (production) ÷ (wheel wear). Accordingly formulas are derived for wheel wear in terms of grain size of wheel, work speed, wheel speed, feed, etc. By calculating values for wheel wear for different conditions and comparing them with production figures calculated under the same conditions, a proper selection of wheels can be made.

The fact that wheel wear is a comparatively unimportant item in the total cost of grinding, however, frequently leads to wrong conclusions if this is made the controlling factor. The all-important factor is the rate at which the wheel may be made to cut and still not get out of truth. It is shown that production efficiency is materially increased by increasing production at the expense of wheel wear within limits which are defined. The paper concludes with a discussion of production costs on this basis and with a series of practical conclusions, one of the most important of which is that increase of traverse speed increases production without increase of wheel-wearing action. These conclusions are given in full in the following paragraphs:

Conclusions Drawn from Investigation of Laws Governing Cylindrical Grinding

The greatest grinding efficiency is obtained by the use of the softest wheels suited to the nature of the material ground. This efficiency is dependent upon the control of the dimension and speed relations between the wheel and the work so that the individual chip may have the minimum depth for a given volume determined by the maximum allowable radial depth of cut. This means long arc of contact, low work speeds, and maximum feeds. With the above conditions established, increase of traverse speed increases production without increase of wheel-wearing action. The machine conditions must be such as to maintain as accurately as is reasonably possible the speed and dimensional relations of the wheel and the work. This includes a great number of factors, some of the most important of which are as follows:

The power drive must not allow speed variations unless under the control of the operator.

The wheel must be in good running balance and in absolute truth, and must be held in its position relative to the work within the closest possible limits.

The work must be accurately held with respect to the wheel and must be uniformly rotated. The relative traverse between the work and the wheel must be uniform.

The work must be rigidly supported over its entire length and no vibration allowed to occur between centers.

The feed control must be sensitive and accurate, and the feeding must be at a rate such that the feed increment never exceeds the maximum grain penetration. This is the most frequently violated of the factors involved.

The work must be kept at a uniform temperature and local heating prevented at all times. A copious supply of grinding compound should be directed to the arc of contact at all times. Eccentric work, due to bowing from heat effects, is the usual result of failure to supply sufficient compound at the arc of contact. In truing the wheel with a diamond, the use of the cooling medium is vital to accuracy. The diamond may be saved by using a dresser to true the wheel roughly, using the diamond only when necessary to put the wheel in exact truth for precision work. A diamond should never be fed over 0.001 inch per traverse. A single wheel should not be used for a variety of work sizes or materials unless the job is too short to warrant efficient grinding as compared with the time of changing wheels. Hard work (hardened steel, manganese steel, stellite, etc.) requires soft, rather fine wheels. The fine grain reduces the chip size but removes more chips, and the wheel wear is not so likely to cause a pounding of the wheel, nor will the small grains cause the glazing which is bound to occur with coarse, hard wheels.

An accurate finish requires the use of a soft, free-cutting wheel so controlled that the chips are very small (light feed and slow work speed with traverse to make the wheel face just cover the lead).

A burnished finish may be obtained by a peening action of a coarse, hard wheel trued dead smooth. Heating and inaccuracies of the surface are likely to occur.

Cases are rare where a wheel harder than grade M (Norton classification of grading) may be properly used in cylindrical grinding. Low wheel speeds, too small a wheel, too high a work speed and excessive feeding are usually the causes for the use of hard wheels. Mention should also be made of failure to take draw-in cuts to establish traverse limits, thus requiring too hard a wheel in order to make the "corner stand up." The designer and draftsman should not call for sharp shoulders where a generous fillet might be allowed. This makes needless difficulty in grinding and weakens the piece ground.

The contact of the wheel face with dry work at any time immediately ruins its value for finishing. The common practice of just touching the dry work when bringing the wheel to contact is wrong, due to the charging of the wheel face with the uncooled chips (loading).

When the machine is properly designed and operated, the grinding action will closely follow the theoretical law laid down in the first paragraph of these conclusions.

Mechanical Engraving and Die-sinking

In his paper on "Mechanical Engraving and Die-sinking," Mr. Keller reviewed the development of the art of reproducing designs from large models on a smaller scale, and the development of mechanical and automatic die-sinking machines by means of which dies are reproduced from models of the same size and shape. Numerous illustrations were shown indicating how this type of machine has been developed from the original simple form to a highly specialized semi-automatic or automatic machine that is capable of reproducing practically any form required for dies of various kinds. Some of the machines referred to have been previously described in MACHINERY in the article entitled "Mechanical Production of Drop-forging Dies," which was published in the September, 1915, number; in the article "Mechanical Die-sinking," published November, 1916, and in the article "Keller Universal Cutter and Tool Grinder," June, 1919.

Papers Read at Other Section Meetings

There were a number of papers read at the other section meetings that were of interest in the machine tool and the general machine-building fields. Among these may be mentioned several of the papers on design. One of these, entitled "Tests on Rear-axle Worm Drives for Trucks," by Kalman Heindlhofer, of the S K F Research Laboratory, Philadelphia, Pa., recorded a series of tests on worm drives used in the rear axles of motor trucks to determine the efficiencies under load variations.

An important paper by Louis Illmer, of the Southwark Foundry & Machine Co., Philadelphia, Pa., entitled "Experiences with Large Center-crank Shafts," described some disastrous experiences with a number of large gas-engine shafts of the center-crank type. Investigations as to the cause of the repeated shaft failures revealed inherent structural weakness due to defective design. The reinforcements undertaken to remedy this condition were based upon careful stress analysis of actual sag determinations conducted upon the shaft.

Rational Design of Hoisting Drums

Everett O. Waters, assistant professor of machine design, Yale University, New Haven, Conn., in "Rational Design of Hoisting Drums," called attention to the fact that the main problem of hoisting-drum design resolves itself into the determination of flange shape and thickness, and the determination of the thickness of the drum body. The correct proportioning of drum flanges is dependent upon the side pressure brought to bear against them by the coils of rope wound about the drum. In other words, flange thickness is a function of rope tension and depth of winding. Previous theoretical investigations have recognized these factors, but have failed to take account of the friction between adjacent coils of rope, and between rope and drum, which tends to hold the coils in position without the aid of the flanges, and have also disregarded the flattening of the inside coils under pressure from the outer layers.

The author has deduced a theoretical formula for the total pressure against a drum flange caused by the winding-on of rope to a given depth and under a given initial tension. Two other formulas are deduced, which relate this total pressure to the flange thickness and the maximum allowable tensile and shearing stresses in the material. By means of these formulas a flange of the usual straight-sided or the mushroom type may be designed to withstand safely the pressure of the rope wound upon the drum.

The drum body is subjected to combined stresses, since it is under compression from the coils wound upon it, under tension due to the lateral pressure against the flanges, and under combined torsion and bending caused by the load which is to be hoisted. Formulas are derived which may be used to obtain the correct thickness both at the center of the drum, where the normal stresses are greatest, and at the ends of the drum, where the shearing stresses are most prominent.

Foundations for Machinery

In a paper on "Foundations for Machinery," N. W. Akimoff clearly defined the purpose of building foundations, and showed that their purpose differed radically from that of providing substructures for machinery. Considerable contradiction can be found in blindly applying the principles of the former to the latter, and the results are sometimes so unsatisfactory as to necessitate the use of cushions and other yielding means, thus entirely undermining the very theory on which the foundation was supposedly built. Vibrations arise from either lack of balance or from other causes. The proposed theory contemplates the latter, the problem of balancing being considered as capable of complete solution by suitable treatment.

Flywheel Design

A paper was presented by R. E. Doherty and R. F. Franklin, of the General Electric Co., Schenectady, N. Y., on "The Design of Flywheels for Reciprocating Machinery Connected to Synchronous Generators or Motors." The results of an extended investigation are given as follows: (a) a complete solution of the problem of flywheel moment as related to the crank effort, synchronizing force and damping force; (b) modification of (a) for practical calculation; (c) a short method for determining the crank effort from the engine or compressor design; (d) practical method of determining the "initial angular deviation" from the crank-effort curve; (e) tests confirming the equations; and (f) discussion of the electrical forces involved and of the limitations which must be imposed upon power fluctuations.

Non-technical Sessions

The annual meeting was also marked by the important non-technical sessions held. A Brashear memorial meeting in memory of the late Dr. John A. Brashear, past-president of the society, was held at which an oration on "John Brashear as Scientist and Humanitarian" was delivered by Dr. Henry S. Pritchett. The Management Session was practically a memorial session in memory of H. L. Gantt.

Fluctuations in the Machine Tool Industry

An Interview with F. A. SCOTT, Vice-president, Warner & Swasey Co., Cleveland, Ohio

In the present interview Mr. Scott points out some definite reasons why prices in the machine tool industry must be maintained if the industry is to remain in a healthy financial condition. He shows why any reductions that may become economically feasible must be gradual, and dwells upon the fundamental differences between the machine tool industry—which makes a product that is not intended for immediate consumption but for producing other products—and the industries and commercial activities that have to do only with the production of articles for consumption. He makes a plea for the recognition of these fundamental principles in order that machine tool builders may be enabled to retain their organizations in times of depression so that they will be in a position to meet the needs of the industries in times of industrial and commercial expansion.

If a chart were made that would indicate the volume of business done in the machine tool industry over a period of years, this chart would show extreme conditions of activity and of depression. Were such a chart compared with one indicating general trade conditions, it would be seen that the differences between the high peaks and the low points are much greater in the case of the machine tool industry than in most other fields of industrial or commercial activity.

The reason for this may easily be found if the peculiar conditions surrounding the machine tool industry are examined. Machine tools are not bought for immediate consumption, as are food products or clothing; the commercial activities devoted to the latter products show, when charted, a comparatively even curve. Machine tools are bought as a capital investment, and hence find a ready market only in time of industrial expansion. When such an expansion takes place, the machine tool industry is exceedingly active, but when the period of unusual activity in the industries has passed, and especially at any time when there is a contraction or deflation of values, the machine tool industry experiences a dullness which frequently takes the form of depression. Yet, the machine tool industry is the basis of all other manufacturing industries, because the machine tool is used in making the machinery needed in every other industrial activity. If, because of its nature, it must experience severe fluctuations, the conditions surrounding it must be made such that it can survive these periodic depressions without too great an impairment of its organization and be ready to serve the commercial and industrial community again as soon as a period of expansion and capital investment makes this necessary.

The Present Period of Deflation and its Relation to the Machine Tool Industry

The present readjustment of prices and values is the real and permanent deflation that always follows the inflation of values during a war. The slight changes that took place immediately after the signing of the armistice were not due to real economic causes. Some price reductions were made at that time in the belief that just as soon as the war had ended, the readjustment, which everyone knew had to come sooner or later, would at once take place; but the readjustment at that time was based upon psychological factors rather than caused by economic forces. The changes that took place were due to beliefs and not based upon facts. The readjustment taking place now, however, is entirely different. It is based upon a definite economic law—the necessity for deflation of abnormal values.

During this period of deflation the machine tool industry must face a depression the same as most other industries; but the characteristics of the machine tool industry, as already explained, are such that machine tools will not be able to stand such a reduction in price as will take place in many other industrial products. The reasons for this are obvious to anyone who wishes to examine them. Before the war, machine tools were not priced anywhere nearly in proportion to their value as compared with the products of other industries. The evidence upon which this statement is based is ample. No great wealth, such as has been amassed in many other commercial and industrial undertakings, has ever been created in the machine tool industry. Even where prosperity is in evidence in this industry, it is a prosperity that has been due to the constant effort of two or more generations. Previous to the war, machine tool prices were practically never raised except when a new model was brought out. Yet, there was a gradual rise in costs and wages for a period of nearly twenty years previous to the war. The war brought about an increase in the prices of machine tools that was, in most instances, simply the normal increase that should have taken place previous to the war, and the increases, when compared with many other products, were moderate. The average increase, as shown by statistics compiled from the whole machine tool field, is not 100 per cent. In the same period many textiles, leather and food products increased in price from 200 to 400 per cent.

Reduction in Machine Tool Prices Must be Slow and Gradual

Any reduction that may take place in machine tool prices must be gradual. The machine tool industry differs from most other industries in that it cannot work off its raw materials and its inventory in a single season. In many cases the parts on hand will not be assembled into finished machines for a couple of years to come. Machine tool builders are not able to produce in great quantities like a maker of automobiles or sewing machines. This is one of the reasons why the makers of machine tools are generally referred to as machine tool "builders" rather than as machine tool "manufacturers." This industry must meet the constant requirements for improved types and has as yet had little opportunity to standardize and to profit financially by the production of standardized machines. On the contrary, profits have continuously been invested in development work and in the bringing out of new and improved machines and methods.

In view of all this, it is evident that the machine tool industry has no great surplus of war profits to draw upon to meet the present depression and cannot afford to make liberal reductions in prices while present inventories are on hand and present wages in force. Wages, as is well known, rise more slowly than prices, but they are also reduced much more slowly than other costs; and as wages are one of the greatest items of expense in the machine tool industry, because of the high proportion of skilled and experienced help required, there is no possibility, from an economic point of view, of reducing prices in view of the fact that a corresponding decrease in the cost of production has not taken place.

As regards raw materials, the coming year may see a decided reduction in pig iron, and this will naturally be followed by a reduction in the prices of castings which constitute an important item in the machine tool builder's costs. But the advantage gained will not benefit the machine tool builder until his present inventory has been worked off, and this, with the present state of the machine tool trade will be a very slow process. As to steel, there is no reason to expect any material reduction from the base price now adhered to by the U. S. Steel Corporation, as this base price is generally considered to be as low as may be expected even with a considerable drop in pig iron prices.

Do Reduced Prices Stimulate the Machine Tool Market ?

A decided price reduction in articles sold for immediate personal consumption may stimulate the market. The conditions are entirely different, however, in the case of machinery bought as an investment and for use in the production of other products. Machine tools are not bought because they are cheap. They are bought because they are needed to produce something else for which there is a demand. If there is no demand for this secondary product, there will be no demand for machine tools, and a sacrifice price would not make it advisable for the buyer to place an order, because a machine standing idle would be expensive at any price. On the other hand, when machine tools are needed in the industries, they will always find a ready market at any fair price, so long as they produce economically and advantageously. An intelligent buyer of machine tools does not buy on price but on quality. His selection is determined, not by the price, but by the adaptability of the machine to his purposes. The machine tool industry is not justified, by economic conditions, in reducing prices at the present time, nor would such a reduction be helpful in stimulating trade.

It has been pointed out that the present machine tool prices are lower than those of other products when compared with the pre-war prices, and the fact has also been emphasized that the pre-war prices were lower than justified by a healthy financial condition of the industry. It may also be said that in buying a machine tool the purchaser receives a greater definite value for his money than in buying practically any other article on the market, with very few exceptions. The average machine tool has a useful life longer than that of most other manufactured articles or devices. For fifteen or twenty years it will continue to turn out products for the purchaser, and in many instances will enable the original capital investment to be regained many times during the life of the machine. A product having such valuable characteristics should and must be so priced that the industry producing it is enabled not only to weather the periodic depressions that in the very nature of the industry it will be expected to encounter, but also to develop and expand so that it may, in ever-increasing measure, contribute to the general industrial advance of the country.

* * *

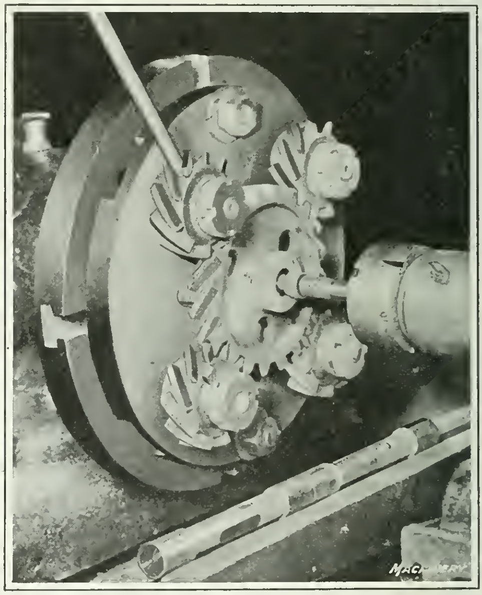
BRITISH RESEARCH ASSOCIATION

A research association for the gray and malleable cast iron and allied industries has been organized in England, and is the second trade, in which Birmingham is greatly interested, to take advantage of the government offer of one million sterling, to be placed at the disposal of the research committee. Up to the present time no fewer than eighteen trades have taken advantage of this offer, and five others have been approved and will shortly receive licenses from the Board of Trade. This effort to bring science into closer relationship with industry is, needless to say, the outcome of war experience, when the best brains of the country and the resources of the laboratory were called upon either to expedite or originate production. In addition to promoting research and disseminating information, the association will foster education and do all it can to make foundry life more hygienic.

GARRISON SPIRAL GEAR CHUCK

In the article on "Cadillac Grinding Practice," published in October MACHINERY, a No. 75 Heald internal grinding machine equipped with a chuck for holding spiral gears while grinding the bore was shown in Fig. 3, page 105. This chuck comprises principles which are covered by patents owned by the Garrison Machine Works of Dayton, Ohio, who manufacture a chuck for the work described in the Cadillac article, and we regret that no mention was therein made of this fact, as it was not known to the author at the time of writing the article.

The Garrison chuck is a practical and ingenious device for holding a gear from the pitch circle during the performance of grinding and other similar operations. For such work, accuracy of the diameter of the ground hole is valueless unless the hole is concentric with the pitch circle of the gear, rather than with the outside circumference. As the pitch circle of a gear is the point from which computations are made for manufacturing and for determining the center distance between two gears, this is a logical point from which to locate gears when chucking for the performance of any operation that is required to finish the bore or any other surface concentric with the pitch circle. This method of chucking insures concentricity of the bore with the pitch circle, regardless of errors produced in turning the blank or resulting from inaccurate mounting of the work on the arbor of the gear-cutting machine. Accuracy of the grinder chuck is of unusual importance, owing to the fact that it is usually employed for performing the last operation, and if inaccurate it will adversely affect all previous work, even though this work has been properly done. Patented chucks are made by the Garrison Machine Works for holding other types of gears in addition to the spiral type shown in the illustration.



Spiral Gear Chuck made in Accordance with Principles covered by Patents owned by the Garrison Machine Works

* * *

The value of metal-working machinery of all kinds exported from the United States to Sweden during 1919 amounted to about $850,000, of which about $450,000 was represented by machine tools. In 1920 the figure for all metal-working machinery was about $460,000 and for machine tools about $300,000.

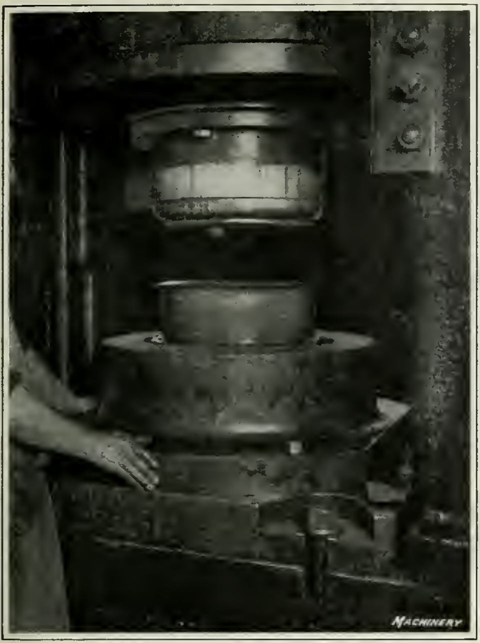


Fig. 1. Double-geared Power Press equipped for performing Third Operation on Seamless Kettles

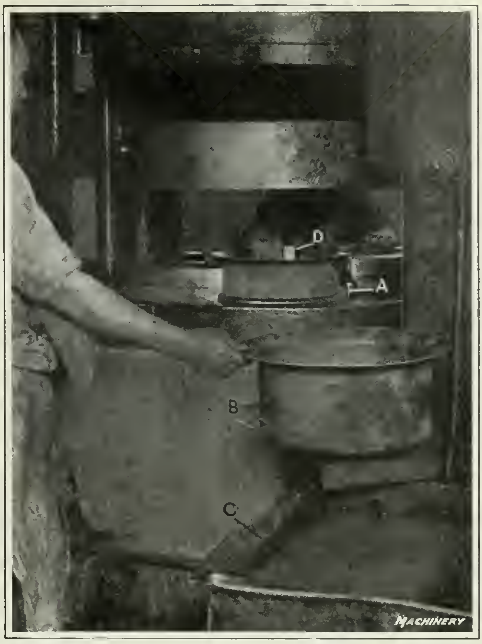


Fig. 2. Bulging Operation performed hydraulically on a Press equipped with a Split Die

Drawing Operations on Seamless Kettles

Design of Dies and Step-by-step Operations in Making a Difficult Drawn Shape

By FRED R. DANIELS

KETTLES containing no seams, corners, or crevices in which particles of foreign substances can collect, and which are shaped to eliminate all splash resulting from pouring liquids into them, require in their manufacture a variety of interesting drawing dies. Figs. 6 and 9 show a kettle of this type made by a large manufacturing concern.

The material from which these kettles are made is No. 18 gage sheet steel, and the pieces from which they are drawn are about 24 inches square. The first operation consists of blanking and drawing, and this work is performed on a Toledo toggle press. The second and third operations are drawing operations in which the depth of the shell is grad-

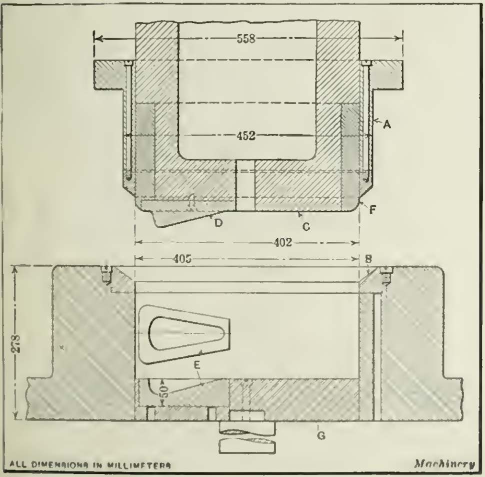


Fig. 3. Punch and Die employed in the Third Operation in the Manufacture of Seamless Kettles

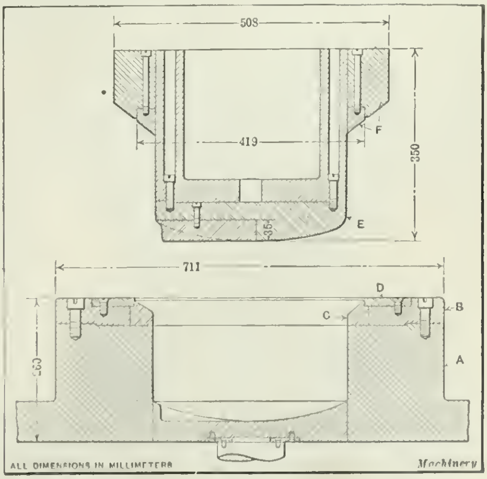


Fig. 4. Punch and Die used in rounding the Bottom and partially forming the Drain Spout Gutter

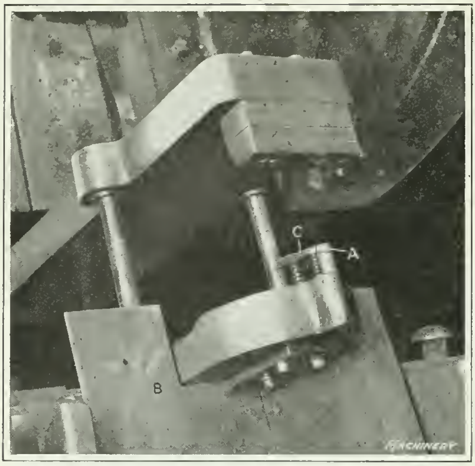


Fig. 5. Inclined Press and Equipment for piercing Hole for Faucet

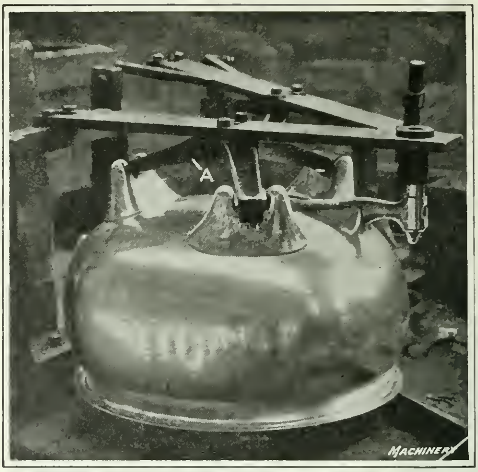


Fig. 6. Locating Jig employed in assembling the Legs and Faucet

ually increased to produce a straight cylindrical form. The punch and die used on Operation 3 is illustrated in Fig. 3, and the set-up of the machine with the work in place, in Fig. 1. Referring to Fig. 3 it will be seen that these dies are of the double-action type, and that the blank-holder *A* holds the top of the work against the die ring *B*, while punch *C* enters the die and draws it to the approximate depth and shape indicated by the proportions of the die. Carried in punch *C* is an auxiliary punch *D* for forming the drain spout gutter in the kettle. The die used to form the gutter is shown at *E* and is set into the knock-out plate *G* as shown. Punch *C* is provided with a sleeve *F*, which may be replaced when the diameter becomes worn sufficiently to need attention. The kettles are next annealed in special sheet-steel covered cans at a temperature of 1350 degrees F. for a period of one hour and cooled, after which they are placed in the die illustrated in Fig. 4, for the purpose of rounding the bottom of the shell and forming the drain spout gutter approximately to its final shape. This die is used on a Toledo No. 59½ toggle press. The essential parts of the punch and die are the die-block *A* to which the die-ring holder *B* and die-ring *C* are attached; the die ring *D* for trimming the shell; the punch *E;* and the flange punch and holder *F*. These tools are also provided with the same general type of auxiliary punch and die for forming the drain spout gutter as employed in the performance of the third operation.

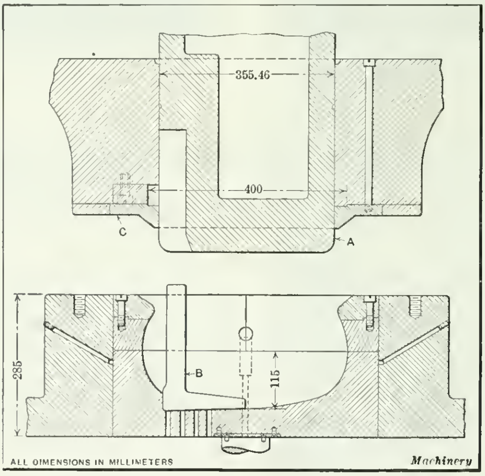


Fig. 7. Sectional View of the Bulging Die shown in Fig. 2

The seventh operation is a bulging operation and is performed hydraulically on a No. 157½ Toledo toggle press, as shown in Fig. 2. This illustration shows the change which occurs between the previous drawing operation and the bulging operation. By referring to this illustration in connection with Fig. 7, which shows a sectional view of the punch and die, a good idea of the functioning of the tools and their construction may be had. The upper portion of the die, as Fig. 2 clearly shows, is made of two parts, which are matched together by half-holes that fit pin *A* in the die-block.

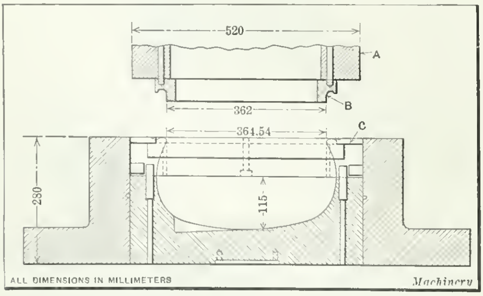


Fig. 8. Punch and Die used in curling the Top of the Flange and trimming its Edge

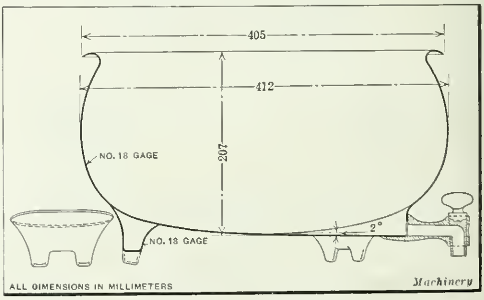


Fig. 9. Sectional View of the Seamless Kettle with Legs and Faucet assembled

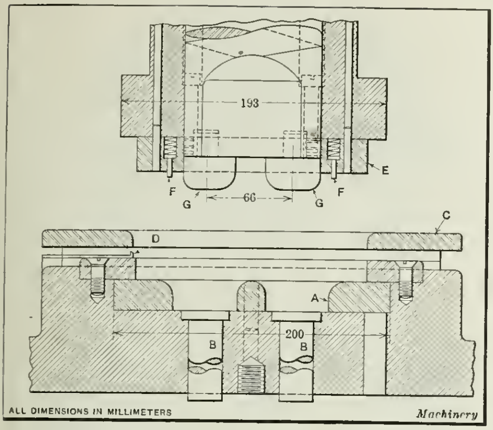


Fig. 10. Punch and Die used in the First Operation on the Kettle Legs

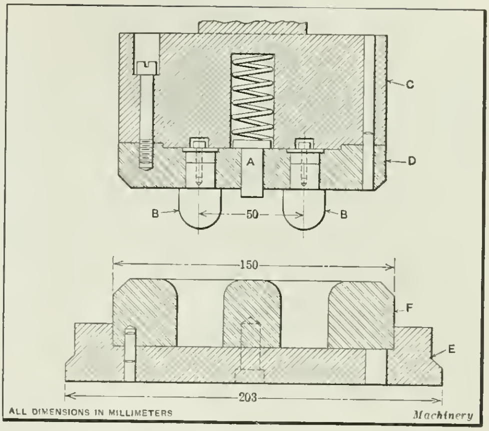


Fig. 11. Punch and Die used in the Fourth Operation on the Kettle Legs

This operation is performed in the following manner: The operator fills shell *B* with water from tank *C*; the shell is then set in the lower part of the die, and the two halves of the upper portion of the die are placed around it so that as punch *A*, Fig. 7, descends, carrying blank-holder ring *C*, it will compress the water and bulge the shell to the shape of the dies. In this operation a special drain spout gutter former *B*, also shown at *D*, Fig. 2, is placed in the work, to maintain the shape of the gutter during the bulging operation. A part of the punch is cut out to enable it to pass down over the gutter-former without disturbing its position in the shell. This is a double-action press, and the punch and die operates on the same general principle as that employed in other double-action drawing dies.

The eighth operation consists of curling the top of the flange and trimming the edges. The equipment used is illustrated in Fig. 8, *A* being the punch-holder, *B* the curling and trimming punch, and *C* the die ring. This die is necessarily, on account of the bulged shape of the work, of two-piece construction. The tools are used on a No. 59¼ single-action Toledo press.

Burring Edge of Kettle and Punching Hole for Faucet

In Operation 9, the edge of the kettle is burred, the work being mounted in a Prentiss lathe fitted with an expansion air chuck. Operation 10 is that of punching a hole for the faucet in the end of the projection formed for the drain spout gutter. This is done on the No. 6½ Toledo inclined press illustrated in Fig. 5. The kettles are placed over punch *A*, and rest against the plate *B* in such a position that when the ram of the press descends, spring-stripper *C* will be depressed, and on the upward stroke of the ram the stripper will force the work up until the punch, which is the lower tool in this case, has been withdrawn. The ends of the gutter, after this piercing operation, are then squared up and the hole shaped to conform to the shape of the faucet. This is also done on an inclined Toledo press equipped similarly to the press employed in punching the hole. The kettles are now ready to be cleaned, tinned, and polished preparatory to assembling the legs and faucet, which have been similarly treated.

Dies for Forming the Kettle Legs

The construction of the punches and dies used in the several operations necessary to shape the kettle legs may be understood by referring to Figs. 10 to 18 inclusive. The first operation on the legs is performed in the dies shown in Fig. 10. In this connection reference should also be made to Fig. 6 and to Fig. 9, where in the lower left-hand corner, the shape of the finished legs may be seen. In the fabrica-

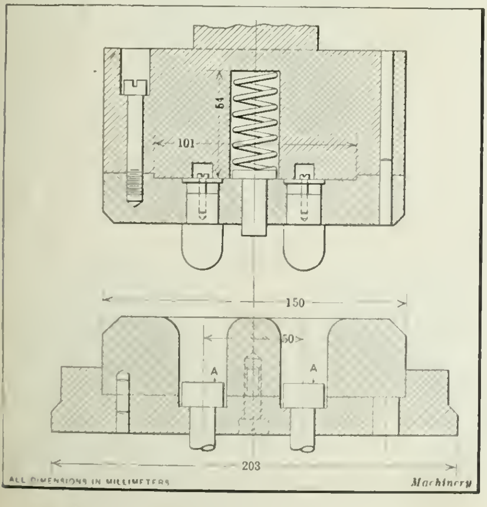


Fig. 12. Punch and Die used in Fifth Operation on the Legs

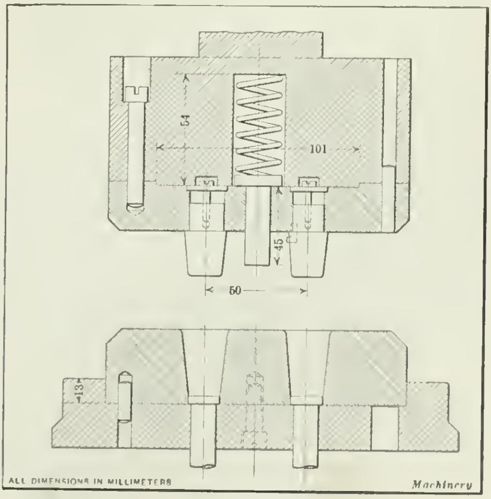


Fig. 13. Dies for producing First Taper on the Legs

tion of the legs, the feet are first formed in the double forming die *A*, Fig. 10, which is provided with two knock-out pins *B*, operated by a spring buffer of familiar construction. The legs are made from strip stock which is fed under stripper *C* and against stop *D*. It will readily be seen that this is a combination blanking and drawing die, and that blanking punch *E* carries two spring stripper pins *F* for forcing the work from the forming punches *G*.

The dies used in the second and third operations are so similar to those employed in the fourth operation that no reference to these dies need be made. Referring now to the fourth-operation dies shown in Fig. 11, it will be seen that this is a straight drawing operation and that the tools are employed in a single-action press. The upper member is equipped with a spring stripper *A* for removing the work from the punches *B*. The punch-block *C* and die-block *E* are made of cast iron, and the punch-holder *D* and die ring *F*, of hardened tool steel.

Fig. 12 shows the tools used in performing the fifth operation. These tools are of essentially the same design as those just described, but in addition the die is provided with a knock-out device, the two pins of which are shown at *A*. The punch and die used on the sixth operation will be seen in Fig. 13. The punches used in this operation are tapered, whereas those used in the preceding operations are straight. A knock-out is provided for both the punch and the die, as in previous constructions.

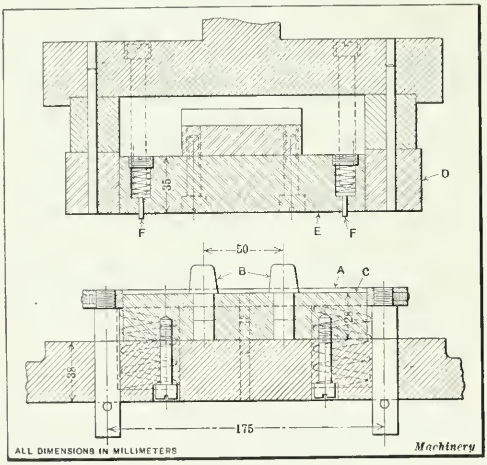


Fig. 14. Punch and Die which starts the Draw on the Upper Part of the Legs

Drawing Operations on Upper Part of Legs

In Fig. 14 the punch and die used in performing the first drawing operation on the upper part of the legs is shown. This is the seventh operation on the parts, and in it the work is placed on the spring-supported stripper plate *A*, located by the two guide pins *B*. These guide pins are carried in die *C*. The punch *D* is made of tool steel, and carries a stripping mechanism consisting of block *E*, in which the two stripper pins *F* operate. In operation, the punch *D* descends on the flat part of the work which rests on stripper plate *A* and draws the legs at a 90-degree angle over the edge of the die. On the upward stroke of the press ram, strippers *F* function and prevent the shell from adhering to the punch. At the same time stripper plate *A* lifts the drawn shell from guide pins *B* so that it may be readily removed from the die.

The punch and die used in the second drawing operation on the top part of the legs (Operation 8) is illustrated in Fig. 15, and the shape to which the work is drawn may be seen by inspecting the shape of the punch *A*. It will also be seen that the shape produced in the dies for the seventh operation is such as to enable the work to rest on die *B* and be located within the die ring *C*. The ninth operation shapes the feet to the approximate shape shown by die *A*, Fig. 16. This punch and die is used on a single-action press, the punch member being provided with a knock-out *B* operated by stripper bar *C*.

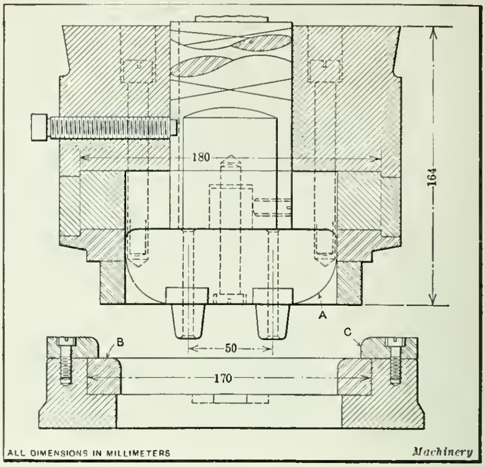


Fig. 15. Tools used for Second Drawing Operation on the Upper Part of the Legs

Operation 10 forms the legs to practically the finished shape, and the tools employed in this forming operation are shown in Fig. 17. It will be noted that two knock-out pins *A* are provided for the two feet, these being operated against spring pressure by means of a knock-out plate, located below the die-block (not shown in the illustration). The punch follows the general design of the preceding punches, and carries the customary knock-out rod or stripper.

In order that the legs may fit the curvature of the kettle and seat evenly, the punch shown in Fig. 18 is employed to produce the same curvature for the top of the legs. It will be seen that the tool-steel forming member *A* is of simple design and that the cast-iron die-block is sunk to receive the

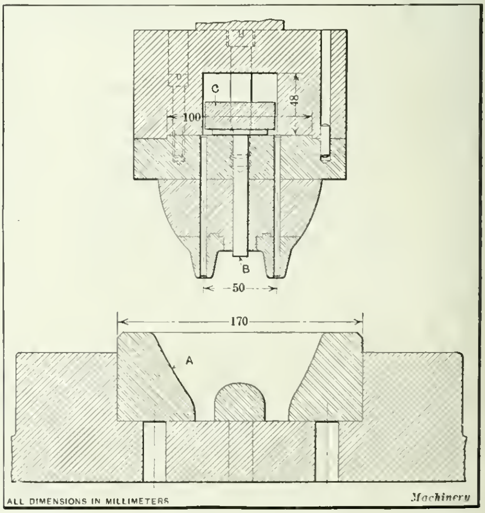


Fig. 16. Tools used in the Ninth Operation for forming Legs to Shape shown by Punch

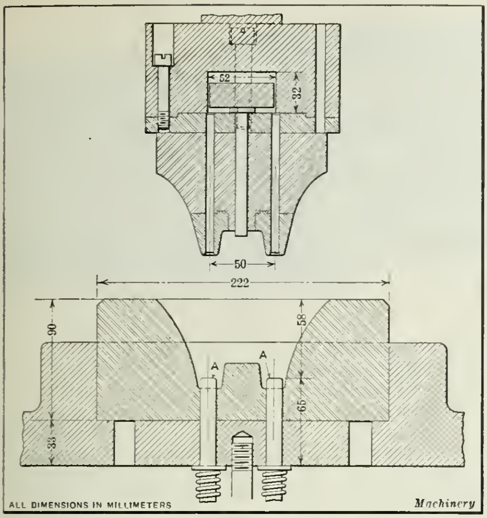


Fig. 17. Dies in which the Legs are formed to approximately the Finished Shape

formed leg. The machine steel knock-out *B* is offset from the center of the die a sufficient amount to overcome the lack of symmetry in the shape of the leg, and to enable one knock-out to eject the parts, instead of requiring two.

Assembling the Legs and Faucet

The work of assembling the legs and faucet is performed on one bench, the work passing from one end of this bench to the other, at which time the legs are correctly located, and securely fastened. Fig. 6 shows the first operation in assembling. A spider *A*, which is a counterpart of the bracket on which the kettle is supported when in use, is employed to locate the legs accurately on the bottom of the kettle. The arm of the locating fixture which carries this spider has a suitable plug to fit the hole in the faucet, which is previously set into the pierced and formed hole in the end of the drain spout gutter. With the three lugs and the faucet held in this position, the operator tacks them in position with solder, and then removes the fixture from the work, which is then passed along to the next workman who finishes the soldering operation. Finally the kettles are tested for leakage and are hand-polished and given a thorough visual inspection.

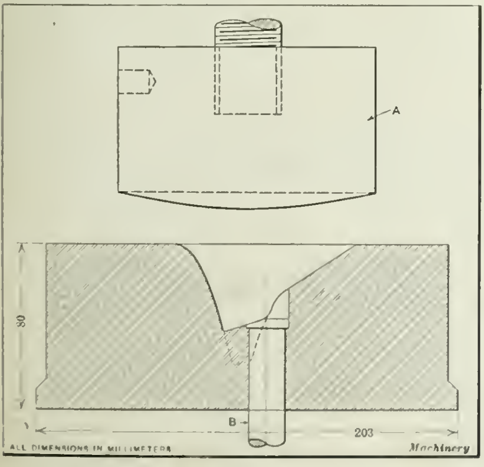


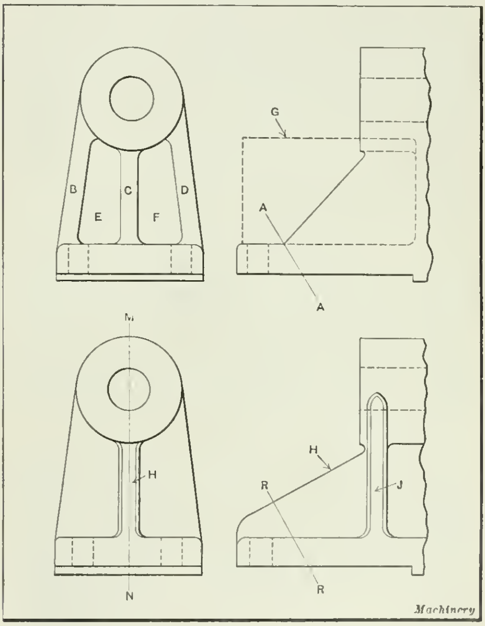
Fig. 18. Final Operation—Shaping the Upper Edge of the Kettle Legs

SIMPLIFIED PATTERN FOR QUICK REPAIR JOB

By M. E. DUGGAN

In replacing broken machine parts, it is sometimes possible to improve on the design of the original part so that its efficiency is increased or so that it may at least be made much quicker than if an attempt were made to produce an exact duplicate of the original part. The following example of a repair job which had to be done in a hurry is a typical illustration of what may be accomplished along these lines by a patternmaker when called upon to make patterns for the replacement of broken cast-iron parts.

The design of the casting that broke is shown in the upper view of the accompanying illustration. The break was along line *AA* which shows that this section was too weak in proportion to the strength of the ribbed section. It is evident that ribs *B* and *D* are unnecessary and that the strength of the casting will be more uniform if only one rib *C* is employed. As the pattern for the original casting was lost, the patternmaker was called upon to make a new pattern. He saw at once that to follow the original design would mean spending considerable time constructing a core-box for a balanced core *G* which would be required to form the pockets *E* and *F*. He also knew that molding and casting would be greatly expedited by making the pattern with only one rib, as shown in the lower view. By tapering ribs *H* and *J* to make an easy "cope" lift, it was possible to make the pattern in one piece and thus save considerable time. Ordinarily, however, when time is not so important a factor, the pattern would be split through the middle on line *MN*. It will be seen that rib *H* extends down to the end of the casting base, thus giving greater strength through section *RR* which corresponds to section *AA*, where the original casting failed.

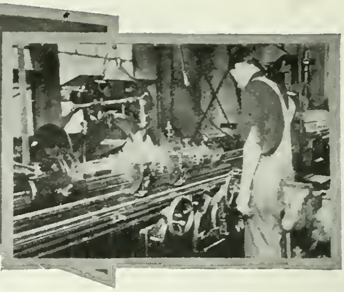


Cast-iron Bracket which broke at AA, and Bracket as redesigned

* * *

Painting safety guards on machines in a bright color has a psychological effect on the operators, for if a guard should be out of position it becomes very noticeable. The guards are not as likely to be left off the machine in this case, as they advertise the neglect of the men.

Work Speeds in Cylindrical Grinding



Showing the Fallacy of the Idea that the Faster the Rotation of the Work, the Higher the Rate of Production

By ROBERT J. SPENCE

CYLINDRICAL grinding machines are furnished with means in the headstocks for obtaining a range of work speeds. This variety of speeds is provided, the same as on other machine tools, for the purpose of accommodating the speed of the work to the action of the cutting tool. In most machine tools the work speeds usually advance in steps, from the slowest speed to the fastest, in geometrical progression. This scheme permits an accumulating increase in momentum from each speed to the next higher in the series. The grinding machine usually has a change from one work speed to the next in a ratio of about 1.2 to 1—a trifle less for the slower speeds and a trifle more for the faster ones. This gives a satisfactory, gradual increase from the slowest work speed, which is supposed to accommodate the relatively fast surface speed of large-diameter work, to the next work speed, without too radical a change. Yet, at the same time, this ratio makes a sufficiently increased gain in speed for work of small diameters where a decided increase in work speed is required when a change is made from one small diameter to a still smaller size.

Why Unsuitable Work Speeds are Often Used

The importance of the function of the speed-changing device does not seem to be understood in general by operators of grinding machines. In fact, it is seldom that an operator is found who appreciates the full value of the means at hand whereby he can, as a rule, increase production, decrease wheel wear, increase the life of the machine, and decrease the amount of power consumption. It is surprising how many operators erroneously believe that the faster the work revolves, the greater the amount of work produced. This fallacy is so prevalent and wide-spread that it seems almost hopeless to attempt to teach the real facts. To operate a grinding machine continually on the fastest work speed, is just as wrong and just as wasteful, as it would be for a lathe operator to run his machine continuously at a filing speed when turning work.

Through experience and intuition a lathe operator will usually approximate the correct speed at which to run the work and traverse the carriage to accommodate the cutting tool and the power of the machine. In fact, the chances are that he will set his speed and feed a trifle under those which the machine can conveniently stand. Yet the same lathe operator, if placed on a cylindrical grinding machine, will depart from the things he learned on the lathe, and use the fastest work speed with which the grinding machine is equipped.

Importance of Instructing Operators Concerning Proper Work Speeds to be Used

Perhaps the fault lies in the fact that the usual operator of a grinding machine does not really know his cutting tool—the grinding wheel. It is possible that he has no conception of what is taking place when the wheel and the work come in contact. For this ignorance he may be entirely innocent of blame; the fault may be due to improper or indifferent instruction. The probability is that the real encouragement for proper instruction must come from the executives of a firm who are directly interested in the cost of machines, wheels, and power consumed. Such executives would readily consider this subject if they were aware of the fact that scientific and mechanical laws enter into the subject of grinding just as they do in all other engineering questions, and that it is susceptible of proof by demonstration alone that with a fast, consistent table traverse, a soft wheel, and a relatively slow work revolution, which will permit the use of the full width of the wheel face per revolution of the work, the minimum power will be consumed with minimum wheel loss per volume of stock removed, and the maximum production obtained.

In these days with the price of coal constantly mounting and deliveries uncertain, power consumption is going to be looked into closer than hitherto, with an idea of conserving the coal supply. Grinding machines cannot long escape a close scrutiny, and so the fact that a battery of grinding machines operated in a hit-or-miss fashion consumes considerably more power than when operated in the correct manner, is going to be considered as bearing some relation to the amount of coal used.

Problem Presented to Illustrate Points under Discussion

A grinding machine is the best thing to have handy in attempting to demonstrate any statement about grinding, but when this is impossible the same points can be emphasized by a logical analysis. Assume that a man is grinding a bar of steel and using the fastest work speed and fastest table traverse with which the machine is equipped. This, as previously mentioned, is such common practice that it is reasonable to make the assumption. It will be further assumed that the exact conditions under which the operation is being performed are as given in the following:

Wheel: Diameter, 18 inches; width, 2 inches; diameter of hole, 5 inches; and constant speed, 6000 surface feet per minute.

Work: Length, 12 inches; diameter, 2 inches; and speed, 190 revolutions per minute (the fastest on the machine) or 100 surface feet per minute for a 2-inch diameter bar.

Table traverse: 150 inches per minute (the fastest on the machine).

Feed: Radial depth of cut, 0.001 inch per traverse of table, which is the maximum depth within the power of the machine for the speed and feed given.

Stock to be removed: Thickness, 0.025 inch. The ratio of cubic inches of stock removed to the cubic inches of wheel wear is 10 to 1.

An attempt will be made in the following to show the effect on production and wheel wear of a reduction in the speed of the work, production being considered as the volume of stock removed in a given time. If a thickness of 0.025 inch is to be removed from the surface of the work, and the depth of cut is 0.001 inch per traverse of the wheel, it is obvious that 25 traverses are necessary to grind one piece of work to size. The table traverses 150 inches per minute, and as the work is 12 inches long the machine makes 150 ÷ 12 or 12.5 traverses per minute. Hence the total of 25 traverses required to grind the work to size will be accomplished in 25 ÷ 12.5 or 2 minutes.

With a work speed of 190 revolutions per minute and a table traverse of 150 inches per minute, the amount of traverse for each revolution of the work equals 150 ÷ 190 or 15/19 inch. In other words, this means that a wheel with a face 15/19 inch wide would be just wide enough to present the full face width to the work at the speed and traverse mentioned. Continuing to use the same table traverse of 150 inches per minute, but utilizing the full width of the 2-inch face of the wheel, the number of revolutions per minute of the work would be 150 ÷ 2 or 75. In this way a new condition is set up whereby the full width of the wheel is utilized per revolution of the work rather than only 15/19 inch of the wheel face.

Wheel Becomes Glazed when Entire Face is not Used

When only part of the wheel face is used, the remaining part simply laps over on the surface ground during the preceding revolution of the work and there is a non-uniform wearing action. The portion of the wheel face which is not cutting, but simply dragging on the work, becomes glazed and adds useless friction to the operation, thus increasing the power consumption of the machine. As the particles of abrasives which stand the brunt of the cutting become worn away, the cutting action is passed along to the portion of the wheel face which has become glazed, and an undue stress is set up in making these glazed particles cut. This continuous transfer from cutting particles of abrasives to glazed particles consumes power to an extent that is apparent in the pulling power of the machine, as evidenced by the belts; this is no theoretical conclusion.

When the entire wheel face is grinding during each revolution of the work, a uniform wheel wearing action takes place, the burden of removing the stock is distributed over the entire face of the wheel, each individual particle performs its equal share of the work, the wheel face remains flat because of the uniform wear, and there is a consequent decrease in the amount of power consumed. The evidence of this comes to the operator in a practical way when he sees that by setting his work speed to this latter condition he is enabled to increase the radial depth of cut to a greater depth per traverse before again coming to the maximum pulling power of the machine.

Gain in Production Time by Increasing the Depth of Cut

Going back to the new condition of 75 revolutions per minute, we make another observation. As the table traverse per minute has not been changed, and the radial depth of cut per traverse remains the same, two minutes is still the grinding time per piece, and the production remains constant. It is known that the condition of using the full face of a wheel is ideal so far as power consumption is concerned, and thus a greater radial depth of cut will next be considered.

The importance of attempting to gain in the radial depth of cut is worth dwelling upon. It is interesting to note that even an increase of 0.00025 inch in the radial depth of cut permits the number of table traverses necessary to grind the work to size to be reduced to 20, as 0.025 ÷ 0.00125 = 20. The number of table traverses still remains 12.5 per minute, as the rate of traverse is unchanged, but the time consumed in grinding a piece is reduced, as 20 ÷ 12.5 = 1.6 minutes. This is a saving of almost half a minute in grinding each piece, which is worth considering in a day's output.

Results Obtained by Reducing the Work Speed

Using the same conditions, a study will now be made of the effect on the amount of stock removed in its relation to wheel wear of changing from a work speed of 190 revolutions to 75 revolutions per minute. Professor George I. Alden has evolved a graphic analysis of the action of a grinding wheel, by which, through clearly graded mathematical steps, certain principles of grinding are revealed. These principles give to the empirical rules for changes of speeds and feed, a rational basis from which to draw conclusions that run true to practice. In this analysis a depth of cut other than the radial depth of cut is introduced, this being known as the "grain depth of cut." It is unnecessary to go into the details of the theory other than to note a few foundational figures, which follow:

100 = the number of surface feet per minute of the 2-inch diameter bar at 190 revolutions per minute;

40 = the number of surface feet per minute of the 2-inch diameter bar at 75 revolutions per minute;

6000 = the number of surface feet per minute of the 18-inch diameter grinding wheel;

0.0475 = the value of the sine of a certain angle dependent upon the three factors, the diameter of the work (2 inches); the diameter of the wheel (18 inches); and the radial depth of cut (0.001 inch). The grain depth of cut, when the surface speed of the work is 100 feet per minute, is found as follows:

$$\frac{100 \times 0.0475}{6000 \times 1} = 0.00079 \text{ inch}$$

and when the surface speed is 40 feet per minute,

$$\frac{40 \times 0.0475}{6000 \times 1} = 0.00032 \text{ inch.}$$

This shows a reduction in the grain depth of cut when the work speed has been changed from 190 revolutions per minute to 75, equal to $\frac{0.00079 - 0.00032}{0.00079}$ or about 60 per cent. A gain of a less amount of wheel wear is always directly proportional to a reduction in the grain depth in a free-cutting wheel if the traverse of the table has not been changed. In the case considered, the table traverse remained constant at 150 inches per minute for both work speeds. At the beginning of the problem it is stated that for this particular wheel under the conditions given, the ratio of stock removed to wheel wear, measured in cubic inches, is 10 to 1, and as the reduction of 60 per cent in the grain depth of cut is directly related to wheel wear, it is evident that a new ratio of stock removed to unit of wheel wear can be figured.

The original wheel wear was given as 1, and as the wheel wear when the surface speed of the work is 40 feet per minute, is 60 per cent less, the new wheel wear is 0.4 as compared to the original. The original stock removed was represented as 10 in its relation to the original wheel wear. With the present relation of 0.4, a new ratio of 10 to 0.4, or 25 to 1 is obtained.

Thus, it will be seen that a change of work speed from the original 190 revolutions per minute to a new rational speed of 75 revolutions per minute increases the amount of stock removed per unit of wheel wear 150 per cent; but someone may say that it is inconceivable that a wheel which removes such a good ratio of stock to wheel wear as 10 to 1 with a work revolution of 190 revolutions per minute, will also act as a free-cutting wheel at the slower rate of revolution, and that surely the slower rate of revolution will make the wheel act the same as a harder wheel.

These things are true, which brings up the following point: The figures given pertaining to stock removed and wheel wear do not take into account certain physical laws which enter into grinding-wheel action. The figures are correct, however, and are good for illustrative purposes. The real condition met with in actual grinding would be that a softer wheel and a slower rate of work revolution would need to be used in order to make the wheel cut at all. The ratio of stock removed to wheel wear would therefore be reduced to about 12 to 1, or 15 to 1, with the softer wheel. However, and here is the advantage of the whole thing, the use of the soft wheel would permit an additional increase in the radial depth of cut because of a less amount of power consumed in the grinding action of a soft wheel, and the actual gain in the time taken to remove the stock would more than compensate for the loss in the ratio between the stock removed and the wheel wear.

Under these new ideal conditions there is an opportunity to operate the machine with a radial depth of cut of 0.0015 inch. This, of course, changes the number of traverses of the table necessary to grind one piece of work, which is found to equal 0.025 ÷ 0.0015 or 17 traverses. By dividing this number by 12.5—the number of traverses per minute—it will be seen that 1.3 minutes is required to grind the work. Before proceeding to another consideration of the effects of operating a machine at the fastest work speed, it might be well to say that the figures relating to grinding time do not take into consideration certain time losses that invariably enter in, to make the cut appear to be held somewhat in suspension. The grinding time under actual conditions would be greater in each case.

Effect on Wear of Wheel and Output when Wheel is Fed by Hand

The cases presented show what is happening to a wheel and to production when a fast work speed is being used in conjunction with a constant, predetermined automatic radial feed. What happens when the operator feeds the wheel in by hand, irregularly, is beyond calculation. It is safe to begin this phase of the consideration of the subject by saying that an operator can make any wheel act too soft, and can even make a very hard wheel act softer than a much softer wheel by abnormal hand-feeding. This is especially noticeable in the rough-grinding of camshafts from rough forgings.

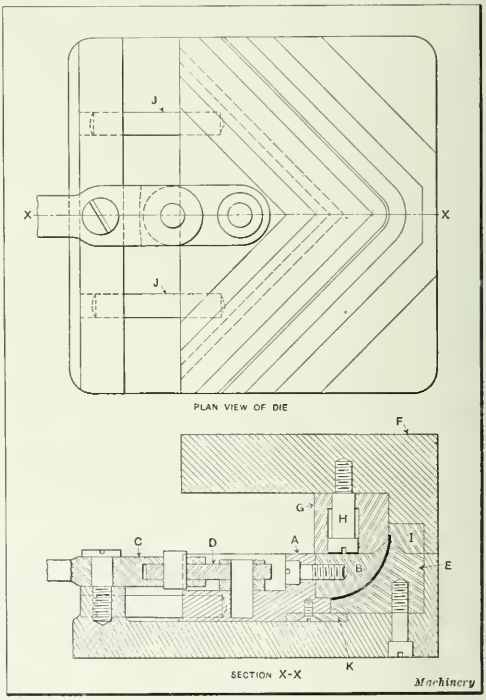
The writer has seen a considerable amount of good rough-grinding on camshafts with a 36-O Norton wheel, the work speed being comparatively slow, the wheel feed deep but steady, and the wheel-slide not gibbed to the wheel-slide base. The amount of production under these conditions, with the least effort on the part of the operator, was exceedingly good, and the full capacity of the machine was utilized. The writer knows of a similar operation, where the operator started with a slow work speed and a relatively soft wheel, and as time progressed, increased the work speed by steady stages to the maximum and the grade of hardness of the wheel until a 30-S Norton wheel was found to be too soft for the work. In this case, the wear of the wheel was 0.080 inch per camshaft.

In the course of the evolution from a soft to a hard wheel the operator found that it became necessary to first put scrap castings on the wheel-slide to hold it down, then to gib the wheel-slide to the wheel-slide base, and to replace the spindle boxes of the machine with new ones. The vibrations caused by forcing the work against the over-hard wheel made the table jump as much as 0.015 inch from the base. No machine can long stand such abuse as this. To follow up such an unnecessary and unreasonable style of grinding to a likewise unreasonable conclusion would mean that the machine would have to be made more solid, the wheels would have to be made harder and the belts wider, and the driving power increased; this cycle would never end. A wheel wear of 0.080 inch per shaft is excessive and exceptional, but the fact remains that similar grinding practices to a minor degree are common in many of our industries. An overfast work speed is the basic cause of most cylindrical grinding troubles, and eventually, when this is more generally known, the method used by the operator will be governed more closely by someone in authority who has made a study of the principles underlying grinding.

DIE FOR CURLING RIGHT-ANGLE STOVE TRIMMINGS

By J. BINGHAM

A punch and die of somewhat unusual construction is employed in curling right-angle trimmings such as found at the corners on the tops of most types of cooking stoves. In many instances these trimmings are nickel-plated after having been bent to shape. The die here illustrated has a movable member *A* that is operated in a horizontal direction to permit the removal of the work. Slide *A* has a steel face *B* and is operated by hand through the medium of lever *C* and link *D*. The flat strip metal from which each trimming is formed is cut to the proper length and then bent around a bar of circular cross-section to the shape of an approximate right angle. After slide *A* has been moved into an almost closed position, the lower edge of this bent strip is placed between face *B* and die part *E* at the top of these two members. Then as slide *A* is moved to its closed position, this edge of the strip is bent to a true right angle.



Die used in curling Stove Trimmings

On the downward stroke of punch *F*, pad *G* descends an amount ahead of the punch equal to the movement permitted by the counterbored holes in which the heads of several special screws *H* are contained. A number of coil springs exert sufficient pressure on pad *G* to cause the strip metal to be pushed to the front of the pad as it descends, and so the pad forms a backing for the metal during the remainder of the operation. Then, as the punch continues to descend, the steel face *I* forces the strip metal into the space between face *B* and die part *E*, causing the strip to be curled and at the same time bending it to the shape of a true right angle. The space between face *B* and part *E* is about 0.025 inch wider at the bottom than it is at the top, to allow for the upsetting of the metal. Plate *K* extends beneath part *E* when the slide is in the closed position; this prevents the lifting of the slide when the metal in the work is being upset. The two guide pins *J* keep slide *A* in correct alignment.

Compound Blanking, Forming and Piercing Die

By F. H. LE JEUNE, Divisional Chief Engineer, Wire and Steel Division, Hayes Wheel Co., Jackson, Mich.

THE tractor wheel spoke cover stamping shown in Fig. 1 was originally made in four operations, and in order to reduce the amount of time required to produce the stamping, a compound die was designed, the construction of which is described in this article. The stamping is made of No. 16 B. & S. gage stock, 0.065 inch thick, and contains twelve 11/32-inch holes and a central hole 3⅛ inches in diameter through a formed flange. The series of operations previously employed to produce this part was as follows: (1) Blank and first draw; (2) redraw; (3) Cut out bottom of cup, trimming neck to length; and (4) pierce holes. The third operation was performed on a lathe.

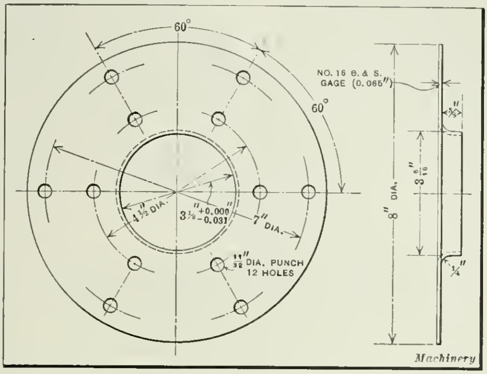


Fig. 1. Tractor Wheel Spoke Cover produced in One Operation by the Die shown in Fig. 2

In considering a means of reducing the cost of producing the work, it was evident, as long as the drawing operation entered into the manufacturing problem, that the piercing of the holes would need to be a separate operation. The drawing operation, therefore, was the first detail to require a change. It was decided to punch the center hole to the proper diameter so that the neck could be formed by spreading the metal around the hole. The method of ascertaining the diameter of punch to use was arrived at experimentally, a punch and die being made with a set of removable pilots of slightly varying diameters. A strip of production stock was then drilled so that the holes would be of suitable size for performing the experiment by means of which the size of the pilot was to be determined. The experimental equipment was then set up on an arbor press, and thus the proper size hole was found which would stretch into the required length of neck without breaking the metal.

From these experiments it was also learned that all the operations could be performed at a single stroke of the press if the proper sequence of operations was established. This order was subsequently incorporated in the die illustrated in Fig. 2, and the functioning parts were timed to first punch the center hole; second, stretch the neck; third, punch the twelve small holes after the center forming punch had advanced sufficiently so that further movement would not cause the stock to draw toward the center; and fourth, blank to the required size. The timing of the center forming punch is a vital factor in the successful operation of the die, for any movement of the stock after the small punches are in action, would probably result in these slender tools being broken.

Referring now to the sectional view of the die, it will be seen that it is of the sub-press type, there being two pillars employed to align the upper and lower members. The upper member of the die consists of the usual holder *A* with a steel punch plate *B* in which the center forming punch *C* and the twelve piercing punches *D* are carried. The upper pressure pad *E* is backed by a series of six heavy coil springs *F*, so that as the die is being closed, the stock which is shown by heavy lines in the illustration, will be firmly held against the upper surface of the lower die *G*.

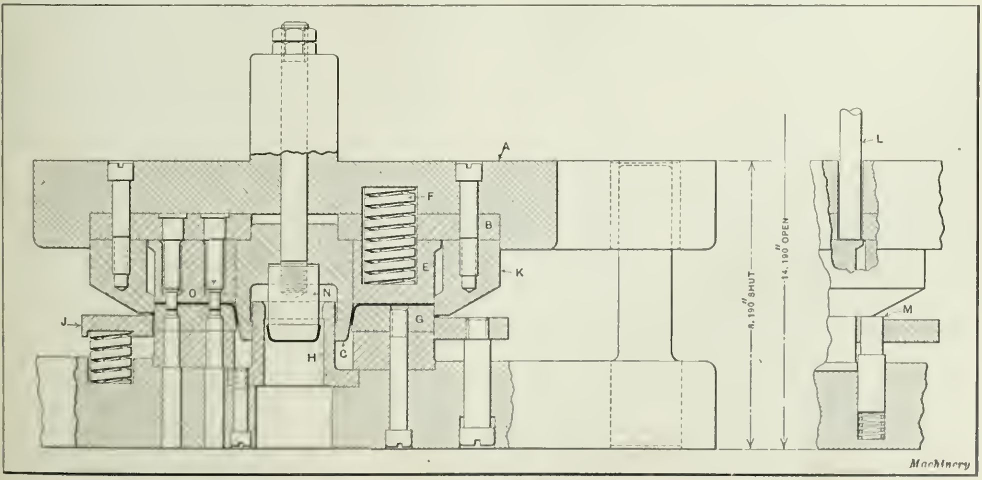


Fig. 2. Compound Die of the Sub-press Type used in making Tractor Stampings

The lower holder carries the center punch *H* and supports the plate *J* by six coil springs, so that as the blanking punch *K* carries the scrap stock downward after the stock has been blanked, the springs will be compressed in readiness to eject the scrap as soon as the dies have opened again. These members, two knock-out pins *L*, and one gage pin *M* (shown in the partial view at the right of the die) were incorporated in the original design and were found to produce the stamping as planned.

Trouble was experienced in the operation of the die however, in that the center slugs were pushed up into punch *C*, for although the knock-out in the ram would push the slug out again, it became necessary for the operator not only to feed the stock into the die and remove the finished work, but also to remove this scrap center. Herein lay the difficulty for, as all men who are familiar with punch press work know, it is difficult to remove a thin flat steel disk, covered with oil, from the ground face of a die. To eliminate this objectionable feature a small drawing punch *N* was provided in the center of the upper die member and a drawing die incorporated in punch *H* by making it in the form of a flanged ring, as clearly shown in the illustration. By this provision the center slug was drawn to a cup shape, thus reducing its diameter so that it could be readily pushed through the center of the die. It will be seen that the end of punch *N* is tapered so that the scrap will be readily stripped from it as the drawing punch ascends through punch *H*.

The operation of the die is as follows: After the stock has been fed into the die the press ram descends forcing the blank below punch *H*, immediately after which the center forming punch *C* starts to operate and form the neck. After the center forming punch has proceeded downward far enough to prevent the stock from creeping toward the center, punches *D* are brought into operation and pierce the twelve small holes in the work. Directly after the holes have been pierced punch *K* blanks out the work. During these operations, the center slug has been steadily forced down through the center punch *H*, forming the cup as previously mentioned. This completes the cycle of operations, so that as the die is opened, it is only necessary for the operator to remove the finished work from the face of the die and proceed as before. The punchings from the small holes pass down through clearance holes in the lower die member. In addition to the time saved, this die was the means of saving one-half inch of metal from the width of the stock.

* * *

WORK OF THE BUREAU OF MINES

The Bureau of Mines has been provided with magnificent central laboratories at Pittsburg during the past year. For the first time in its existence, the Bureau of Mines has a suitable home and central headquarters for field and investigation work, and will be able to be of greater usefulness to the mining and metallurgical industries in the future. The facilities of the bureau are at the disposal of private organizations upon certain conditions. Any private company that has a mining or metallurgical problem, the solution of which would benefit the company and the public, may appeal to the bureau for assistance. The firm agrees to pay part or all of the costs in personnel and materials for the investigation, which is carried on under the direction of the bureau; but the bureau retains the right to make public and print the results of the investigation. The facilities of the bureau are such that in many instances it can do investigation work that would be impossible for a private firm to undertake. At present, the bureau has cooperative agreements with nineteen firms for work of this kind. The total amount of money that has been spent by outside interests under these cooperative agreements under the direction of the bureau has amounted to approximately a half million dollars during the past year, and every indication shows that this service will grow in importance.

JIG FOR ASSEMBLING GEARS AND COLLAR ON SHAFTS

By F. SERVER

The assembling of two gears and a collar on a shaft by means of pins, when the gears and collar must be accurately located relative to each other and to the shaft ends, is accomplished by the use of a jig described in the following. The manner in which the gears and collar are mounted on the shaft will be apparent by referring to Fig. 1. The jig used in the assembling operation is illustrated in Fig. 2. Provision has been made in this jig for locating the shaft and clamping it in position, and for locating the gears and collar on the shaft correctly and clamping these parts in place. The drill bushings are contained in hinged covers, which can be lifted after the pin-holes have been drilled, so that the holes can be reamed while the parts still remain in the jig.

By reference to Fig. 2 it will be seen that the various members of the jig are attached to the long cast-iron base *A*. A tool-steel plate *B*, slotted to conform with the tapered end of the work and being provided with clearance for the threaded portion at the same end of the shaft, is mounted at the right end of this base. The flat spring *C*, at the opposite end of the jig, pushes the shaft into the slotted plate *B*, thus locating it endwise and sidewise; block *D* locates the shaft at the left-hand end. The shaft is supported by the locating blocks *D*, *E*, and *F* and by the finished top surface of lug *G*, being clamped on the latter by means of screw *H* when the screw is turned so that the circular portion of its head comes over the shaft. The gears and collar are put on the shaft before it is placed in the jig, being spaced so that the hubs of the gears will be placed against locating blocks *D* and *E*, respectively, and one side of the collar will be placed against the locating block *F*. The gears and collar are clamped in place by means of clamps *I*, which are provided with a recess at their upper ends to clear the shaft. These clamps are operated when shafts *J* are turned by means of rods *K*, the eccentrics *L* on shafts *J* causing the clamps to swivel on pins *M* so that their upper ends tighten against the gears and collar. This arrangement insures the accurate location of the parts to be assembled. To loosen the clamps, shafts *J* are turned in the opposite direction, springs *N* forcing the clamps away from the gears and collar.

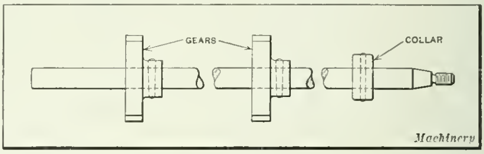


Fig. 1. Shaft with Gears and Collar assembled on it by the Use of the Jig shown in Fig. 2

The bushings *O*, used in drilling the holes, are contained in the three hinged covers *P*. The covers pivot on pins *Q*, provision being made for fastening them down after the work has been inserted in the jig. This is accomplished by means of three locking levers *R*, shown clearly in the end view. These levers swivel on pins *S*, springs *T* holding them in the locked position when the cover is down. A curved surface on the top of each lever causes the lever to spring out readily as the cover is lowered. It is necessary for the operator to hold the levers back in order to raise the covers.

In operation, a straight hole is drilled through the collar and shaft, the drill being guided by the bushing in the hinged cover above the collar. The cover is then lifted and a straight hole is reamed through the collar and shaft. The two holes to be drilled through the gears and shafts at these points are for taper pins. The manner in which these holes are produced is to drill a straight hole part way through each gear and the shaft, then substitute another straight drill of a smaller size in the machine spindle and drill a hole through the remainder of the shaft and the lower side of the hub in each case. A depth gage *U* is provided to serve as a contact for a stop-collar on the drilling machine so that the hole produced by the drill used in the first step, will not be drilled too deep. After the smaller size hole has been drilled, the hinged covers are swung back and the holes are taper-reamed.

This method of drilling a taper pin hole enables quicker reaming of the hole, as the stepped diameters left by the two sizes of drills allow the reamer to start cutting at a point midway through the hole. However, care must be taken to see that the two drills are of correct relative diameters so that the finished hole will conform to the reamer throughout its entire length. Another point to be noted in the construction of the jig is that pins *V* are provided so that pins *W* will strike against them when shafts *J* are turned too far, and thus prevent rods *K* from hitting surfaces on a level with, or beneath the bottom of, the jig base when handling with the work removed. Should this occur the rods would probably be broken. It is obvious that by the use of this jig, the gears and collar can be mounted so accurately that all shafts will be interchangeable.

* * *

The development of the American railway system is well indicated by the increase in the size of rails used on leading American railroads. In 1875, the Pennsylvania Railroad introduced 60-pound rails, which were considered heavy at that time. In 1884 the first 70-pound rails were laid, followed in 1886 by 75-pound rails, and in 1887 by 85-pound rails. It was only five years later that the first rails weighing 100 pounds to the yard were laid by the Pennsylvania Railroad. These 100-pound rails have now been found to be insufficient for the heavy cars and locomotives and the steadily increasing traffic of the present day, and the work of replacing the 100-pound rails in the main line tracks with rails weighing 125 and 130 pounds to the yard is now proceeding at a rapid rate; 125-pound rails are used on level straight track and 130-pound rails on heavy grades and curves, were the strain imposed upon the track by the increase in weights in locomotives and cars is the greatest. A careful study of rails was made during a whole year, previous to making a decision to put in heavier rails. It was found that a heavier rail would insure a greater degree of safety and would in the long run prove economical because of its greater endurance.

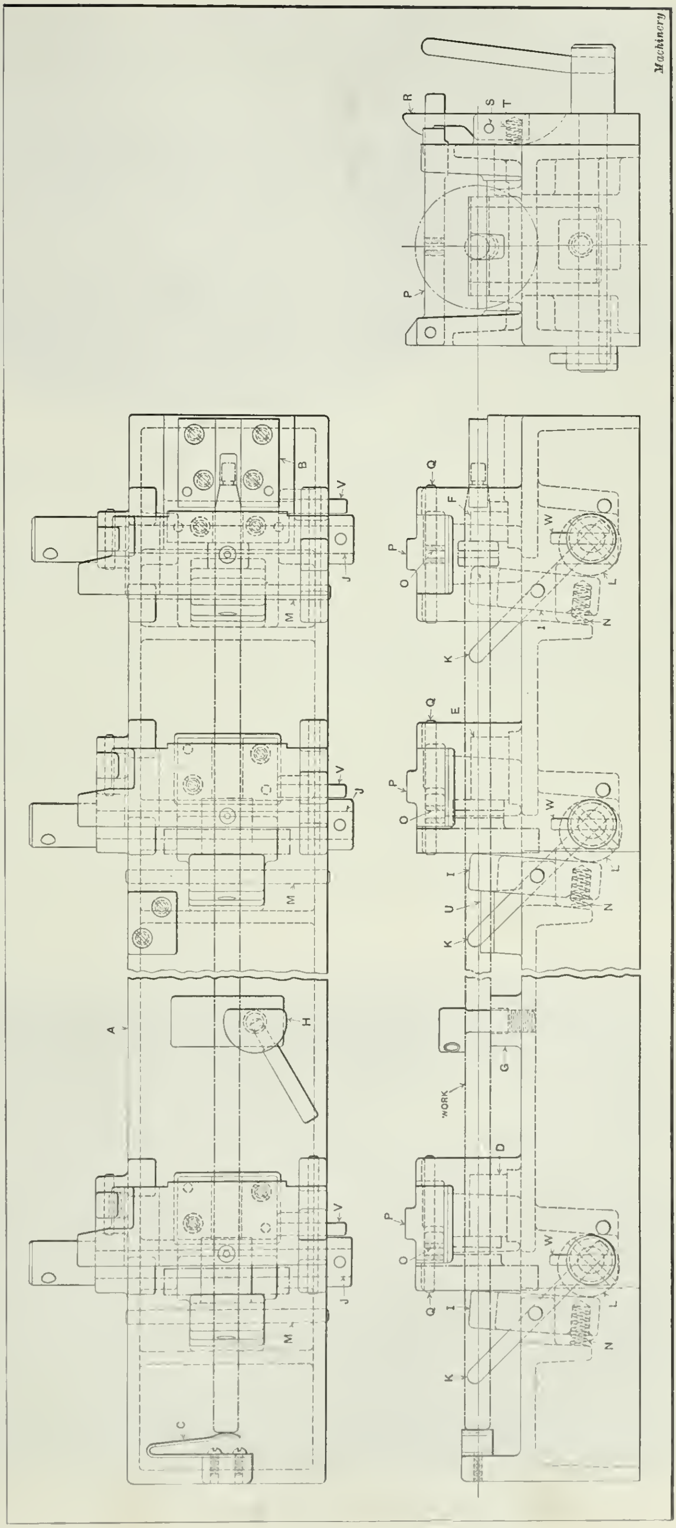


Fig. 2. Jig for locating Gears and Collar on Shaft shown in Fig. 1, and holding them in Position while being drilled

Machining Cream Separator Bowls

Methods Employed by the De Laval Separator Co., Poughkeepsie, N.Y.—Second of Two Articles

IN the previous article on this subject, published in the December number, the manufacture of the tubular shaft which, with the bowl shell, forms the housing within which the separation of cream occurs, was described. The present installment deals with the procedure followed in producing the bowl shell of the cream separator.

The bowl shell is made from hot-rolled steel, 0.180 inch thick, having the following analysis: Carbon, 0.08 to 0.12 per cent; manganese, 0.35 to 0.50 per cent; phosphorus, 0.01 to 0.018 per cent; and sulphur not over 0.045 per cent. The shell is made by a series of power-press operations, the first two of which consist of a blanking and a straight drawing operation. After the first drawing operation, the work is annealed to relieve all strains produced in the preceding operation and the surfaces are tallowed to prevent the dies used in the subsequent operations from becoming abraded by the rough surface of the shells. The next operation is a redrawing operation, which is followed by seven forming operations for the purpose of producing the neck *L* and conical surface *M* of the shell. (See Fig. 1 in the December article.)

The press work of forming the neck on these heavy shells is performed on Toledo open-back geared presses, two of which are shown engaged in the performance of the first two necking operations in Fig. 13. The appearance of the shell before necking may be seen by reference to the chute in the foreground of the illustration. A stripper is employed on these presses to remove the shell from the punch. The production rate on each necking operation is 300 pieces per hour. The shells are then sent back to the annealing room, where they receive the same treatment as before, after which they are returned to the press shop where three more neck-forming operations are performed, the first of which is illustrated in Fig. 14. This operation consists of finish-forming the shell with the punch shown at *A*, and of piercing the hole in the bottom of the neck with the piercing punch *B*. This auxiliary equipment enables two operations to be performed with one stroke of the press ram The machine used is a No. 59¼ Toledo straight-sided double-geared press, and the production rate, as in the other necking operations, is 300 pieces per hour.

The shells are next returned to the annealing department to be annealed and tallowed before the final forming of the shell is accomplished. Fig. 12 is a view of the annealing room, and shows the equipment employed to hoist the annealing pots from the furnaces and deposit them outside to cool. This is accomplished by means of a heavy overhead structure, with a hoist for raising the extending arms on which the annealing pots are lifted. Attention is directed to the ball track, shown in the foreground of the illustration, by means of which the annealing pots are rolled into the furnaces. The work is sealed in the annealing pots with fire-clay, heated for five hours at a temperature of 1450 degrees F., and then removed and allowed to cool in the pots. The tallowing operation consists simply in dipping the shells

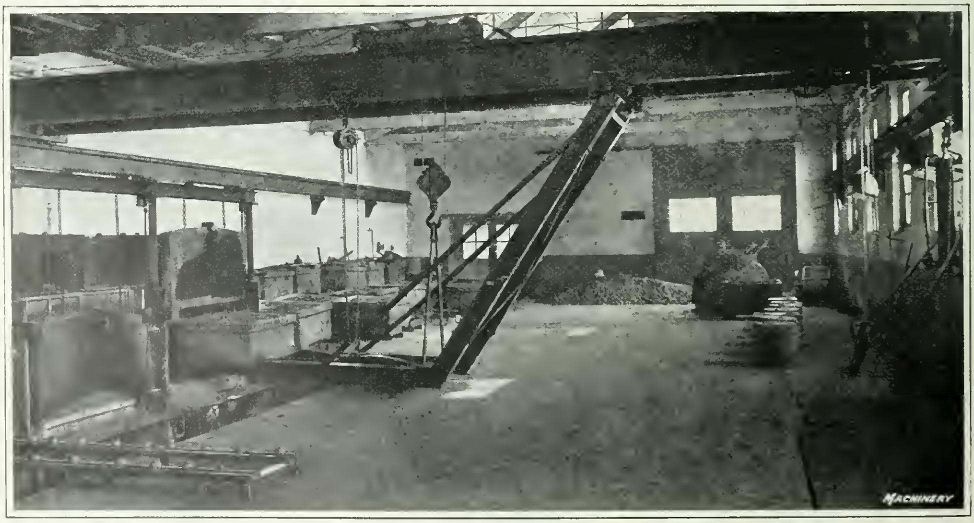


Fig. 12. View of the Annealing Room, showing a Battery of Furnaces and Several Annealing Pots Ready to be deposited in the Furnaces

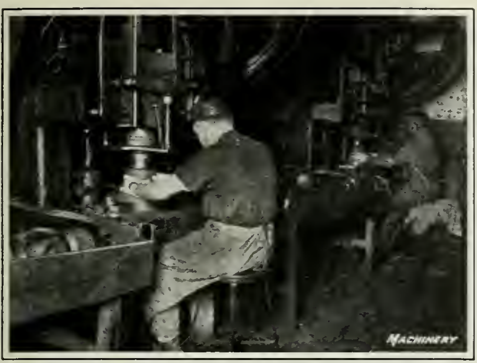


Fig. 13. Open-back Geared Presses employed in necking the Shell

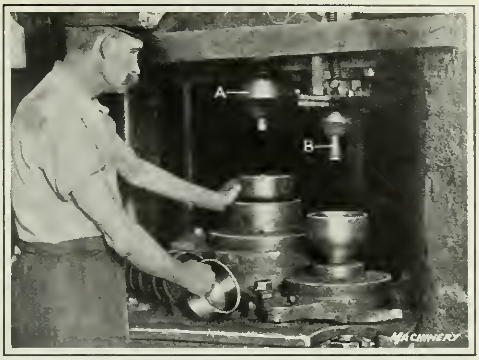


Fig. 14. Finish-forming the Shell and piercing a Hole in the End

in hot tallow and placing them on a conveyor which carries them over a gas flame for the purpose of permitting the tallow to saturate under the scale on the shell.

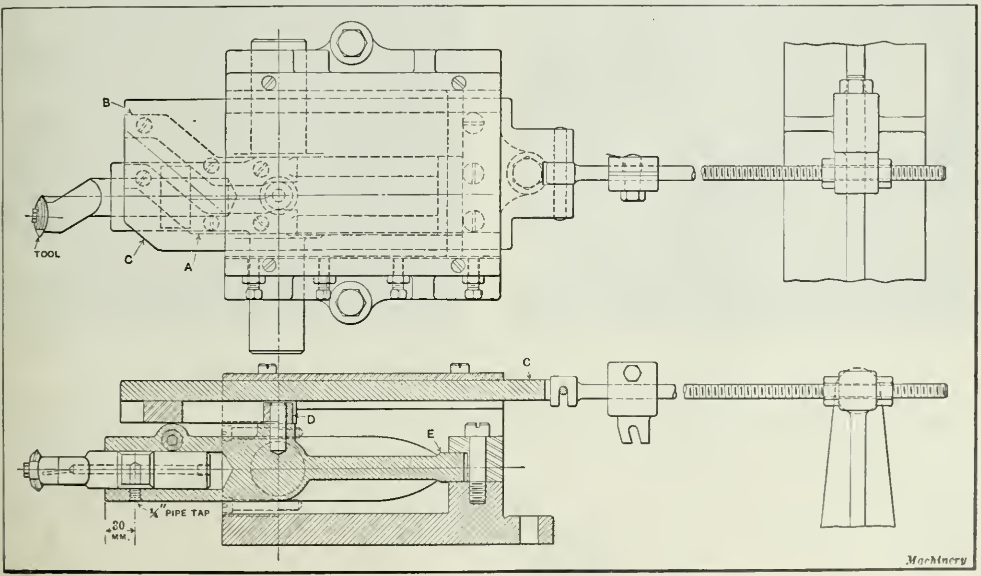


Fig. 15. Sectional and Plan Views of the Attachment used in machining the Interior of the Shell. This Attachment is applied to the Lathe shown in Fig. 17

After being tallowed, the shells are drawn to finished size, and then the contour at the bottom of the shell is formed. This is accomplished by means of the punch and die illustrated in Fig. 16, at *A* and *B* respectively, in conjunction with the expanding arbor *C* which fits into the shell after it is located in the die, so that as the forming ring of the punch encases the shell, the continued pressure exerted by the

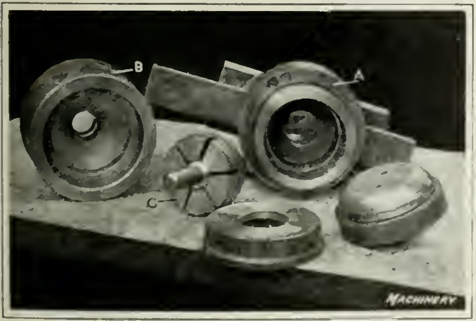


Fig. 16. Some of the Tools used in the Press Work. Expansion Arbor C fits in the Shell, producing the Correct Curvature when formed by Punch A

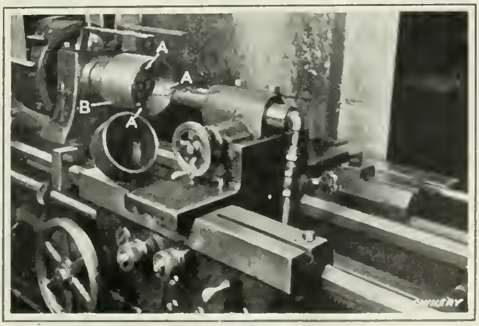


Fig. 17. Lathe equipped for roughing out the Interior of the Shells. The Lathe is equipped with an Air-chuck and Taper-turning Attachment

downward stroke of the press ram will produce the desired curvature. The construction of the expanding arbor is shown in Fig. 18, from which it will be seen that a taper on mandrel *A* enables the segments to be expanded to fit the contour of the interior surface of the shell. A coil spring is wound around a groove in these segments, which provides the yielding construction necessary. The production rate on this curling operation is 500 pieces per hour with two operators working on one machine. The other punch and die shown in Fig. 16 is the equipment used on the blanking and drawing operation of the shell.

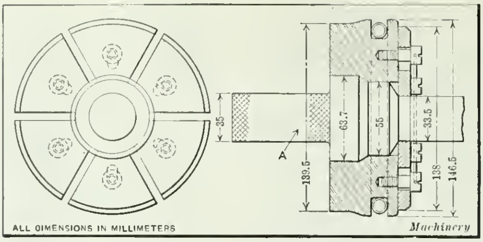


Fig. 18. Sectional and End Views of the Expansion Arbor used in curling the Bottom of the Shell

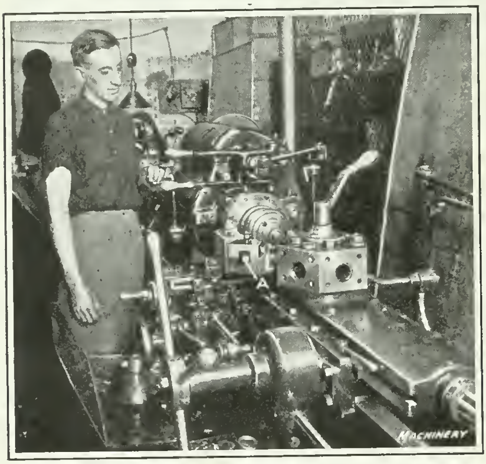


Fig. 19. Finish-turning the Neck of the Bowl Shell on a Hexagon Turret Lathe

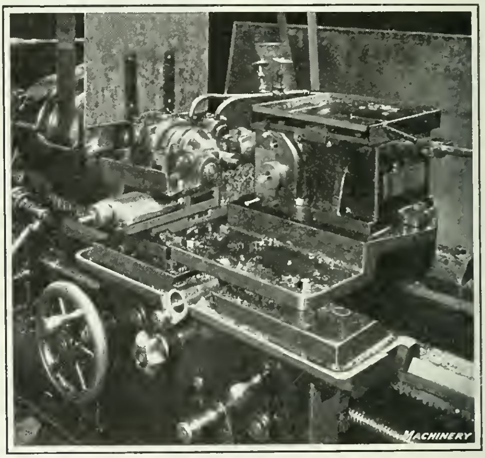


Fig. 20. Set-up of Lathe for turning Outside of Shell, using Special Turning Attachment

The flow of metal during the forming operations produces an irregular edge at the bottom of the shell, which in the first machining operation is trimmed to length. Operation 2, performed on a Brown & Sharpe No. 6 hand screw machine, consists of rough-boring the interior shoulder, the rate of production being 109 shells per hour. Operation 3 consists of rough-turning the neck, and boring and rough-reaming the hole at the end of the neck. This work is also performed on a Brown & Sharpe hand screw machine, using a box-tool for turning the neck and a floating reamer for rough-reaming the hole. The rate of production is forty-eight shells per hour.

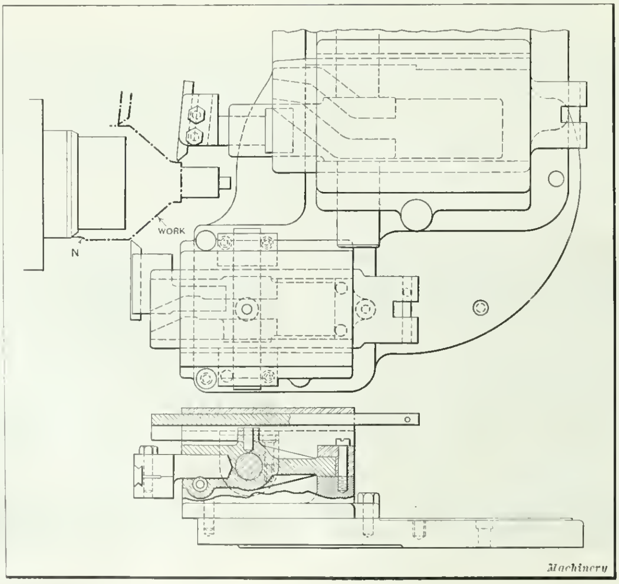


Fig. 21. Plan and Partial Sectional Views of the Double Turning Attachment employed in machining the Outside of the Shell

Operation 4—the roughing out of the interior of the shell below the neck—is illustrated in Fig. 17, and the attachment used is shown in detail in Fig. 15. It will be seen that cams *A* and *B* attached to slide *C* form the path within which the hardened steel cam-roll *D* operates. The cam-roll path is such as to enable the tool, which is carried in the tool-holder *E*, to turn the interior of the shell to the correct contour as it feeds into the shell. These two illustrations should enable the operation of this taper-turning attachment to be clearly understood. The work is held in an air chuck and is drawn against three locating points *A*, Fig. 17, within the chuck, and located concentrically by means of a pilot within the machine spindle, which engages the hole in the end of the neck. A split collet which engages the outside of the neck within chuck *B* operates in a floating ring within the spindle, and holds the shell concentric by the rough-turned neck, regardless of any eccentricity which may exist between the surface of the neck and the outside of the shell. This work is performed on a Prentiss lathe at the rate of 90½ pieces per hour.

The next machining operation, which is the finish-turning of the neck, is performed on the Warner & Swasey hexagon turret lathe shown in Fig. 19. A tool in the toolholder on the cross-slide chamfers the end of the neck, while a tool carried in a toolpost at the back of the lathe performs a similar operation on the inside of the hole. The turning tool *A* is carried in the turret of the lathe. The work is finished to within limits of 0.05 millimeter, and is held on an arbor which fits the inside of the shell and which is provided with a draw-bar and air chuck to hold the shell against the angular surface of the tapered arbor. By locating the shell from the interior surface, concentricity between it and the finished surface of the neck is assured. The production rate on this job is 27 pieces per hour.

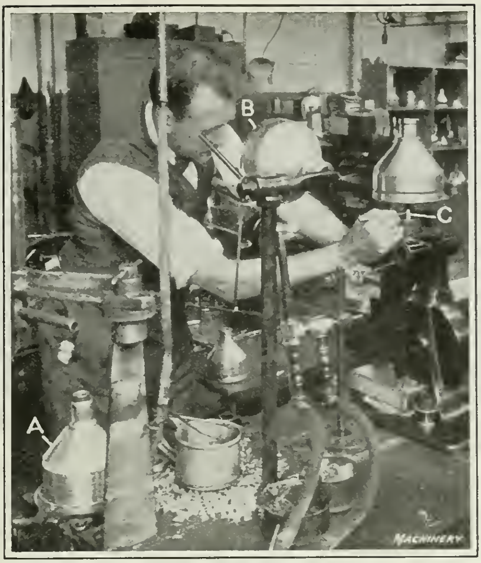


Fig. 22. Equipment used in placing the Assembled Shells in Dynamic Balance

The sixth operation, in which the outside of the shell is turned, is performed in a Chard 16-inch lathe, as shown in Fig. 20. This machine employs a special cam-slide turning fixture, a modification of the design of which is shown in detail in Fig. 21. This illustration shows the two tools, which are used simultaneously, and their relative position to the work; the work is shown in heavy broken lines. The contour of the cam, which guides the tool in turning the conical part of the shell, is such that at the end of this operation the tool turns the radius which joins the conical surface with that of the cylindrical body and then passes off at a tangent, so that the two surfaces being turned in this operation merge at this point into a nicely formed arc. The position of the tool as it leaves the work is also indicated by heavy broken lines.

The contour of the cam used for turning the cylindrical part of the shell also provides for turning the surface *N* to the proper curvature. This fixture is attached to the lathe carriage in such a manner that the regular longitudinal and cross feeds can be employed. Inspection of the sectional view will make it apparent that this attachment is similar in construction and operation to that shown in connection with the fixture used in Operation 4 illustrated in Fig. 15. The rate of production is 26 pieces per hour.

Operation 7 is that of reaming the inside of the neck and finishing the shoulder within the shell where the neck joins the lower part of the shell, so that this surface will blend with that of the inside wall. This work is performed on a Warner & Swasey turret lathe at the rate of 27 pieces per hour. A single-point tool is employed to machine a recess within the neck of the shell, and a forming tool provided with a roller pilot is used for finishing the shoulder. As in most of the operations on the bowl shell, an air-operated chuck is used to hold the work. The function of this recess is to permit any accumulated cream to be discharged through a small drain hole, which is later drilled into the recess. This is a sanitary provision to prevent any accumulated cream from souring by permitting it to drain out of the machine.

The necks of the shells are next polished in a speed lathe, by the use of oil and aloxite cloth, after which a pin-hole is drilled and tapped, in which the pin that engages the pin slot in the tubular shaft is screwed. In line with this hole and located in the neck of the shell, another hole is drilled which is the starting point for the milling cutter used to mill the slots in which the cream outlet lug on the top cone fits. The milling of this slot, which is the tenth operation in machining the shell, is performed on a Whitney hand miller provided with a Porter-Cable milling head. The production rate is 95 pieces per hour. Operations 12 and 13, which consist of milling the milk-slot, are also performed on Whitney hand milling machines. The preliminary milling operation is illustrated in Fig. 23, which shows the hand-operated chuck that holds the work by the neck and an end-mill that produces the two cuts *A* on the inside of the neck. The depth of these cuts is such that the diameter across them is equal to the diameter of the outside of the neck, so that they nearly break through. In the second milk-slot milling operation the slots are opened, using the same type of equipment and a T-cutter, to machine the sides of the slot parallel. The first milling operation produces 83 parts per hour, and the second, 150 per hour.

After the burrs produced in machining the lug slot and milks outlets have been filed off, the work passes to the machine shown in Fig. 24, in which the fifteenth operation is performed. This operation consists of facing the top of the

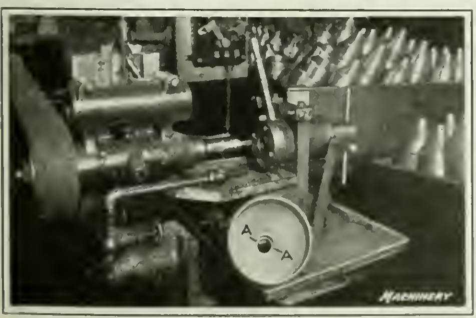


Fig. 23. Hand Milling Machine equipped for performing the Preliminary Milling Operation in the Machining of the Milk-slots

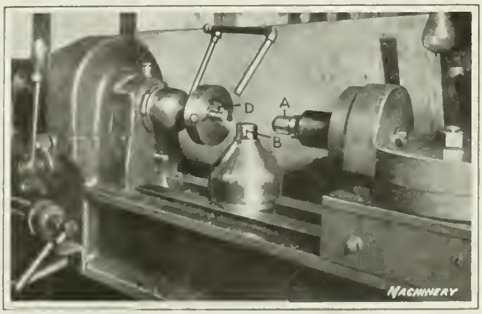
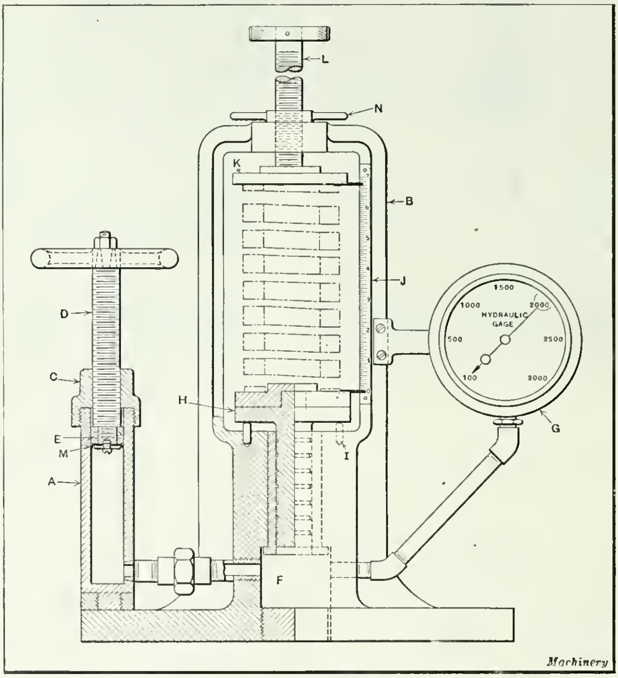


Fig. 24. Lathe equipped with Special Mandrel and Pilot Facing Head for finishing the End of the Neck Concentric with the Interior of the Shell

shell, the work being held by means of a lug on mandrel *A* which acts as a key to engage the lug slot *B* of the work. A hole in the end of the mandrel receives pilot *C* of the cutter-head, in which the pilot is a sliding fit. The axial pressure exerted between the mandrel and the cutter *D* holds the work securely on the tapered surface of the mandrel so that there will be no vibration between the work and the cutter, and no inaccuracies will result. In this operation the shell is held stationary while the cutter revolves.

The remaining operations required to finish the shell are of a less interesting nature than those already described, and for that reason will merely be mentioned. They consist of drilling the discharge hole for the recess within the neck; broaching the milk outlet; removing burrs; polishing; and retapping the pin-hole and removing the burrs from the inside of the shell produced by this operation. The bowl is then sent to the tinning department where it is immersed in a stannic bath.

As is the case with the tubular shaft, the bowl receives a careful inspection before the bowl proper is assembled. After assembly, the unit (including the stack of tin cones, distributor, etc.) is carefully balanced, the operation being illustrated in Fig. 22. This illustration shows a bowl mounted on a motor-driven vertical spindle on which it is balanced as a unit. The tin cones mentioned in the preliminary description of this machine are numbered so that, if kept in their numerical order after the proper dynamic balance has been established, this condition will not become disturbed after the machine is in commercial use, either during washing the cones, or when disassembling the bowl for any other purpose. In the illustration, the stack of cones *A* is in view, and the bowl shell *B* has been removed from the bowl unit, being supported on a bracket, in which position solder is put into the shell by the balancer, when placing the unit in perfect running balance. A number of solder slugs will be seen on the table, and attention is also directed to the use of a gas flame which is applied to the outside of the shell, as it is supported by the bracket, so as to melt the solder on the inside.



Testing Appliance on which Pressure applied to Spring is shown on Gage while Deflection is indicated on Graduated Scale

A great deal of experience is required by the workman to select pieces of solder of exactly the right weight to overcome the estimated amount that the shell is out of dynamic balance. The driving spindle *C* is supported at its lower extremity by a step, and at the upper end in a yielding spring bearing, so that if the shell is out of balance the spindle, when run at a high velocity, will run out. The remedy for this is added weight on one side of the bowl shell. This location is determined by the balancer by holding a colored pencil in contact with the vibrating spindle and observing the length and location of the resulting pencil mark.

HYDRAULIC SPRING-TESTING MACHINE

By H. A. PEARSON

A machine for testing compression springs by hydraulic pressure is shown in the illustration accompanying this article. The number of pounds pressure exerted on the spring is indicated on a gage, while the deflection of the spring in inches, or fractions thereof, is shown on a graduated scale. Prior to using this appliance, oil is poured into cylinder *A* until space *F* in the bottom of body *B*, and the piping between the cylinder and the body, and between the body and gage *G*, are filled, and the cylinder itself is almost filled. It is, of course, necessary to remove cap *C*, screw *D*, and plunger *E* from the cylinder in order to accomplish this, and sufficient space should be left between the oil level and the top of the cylinder to permit these parts to be replaced without any pressure being registered on the gage.

In testing a spring, plunger *E* is first raised by turning the handwheel on screw *D*. This removes any pressure there may be on the oil, so that piston *H* rests on dowel-pins *I*; with the piston in this position the indicator attached to the plate on the piston points to the zero mark on scale *J*. The spring to be tested is next placed on the plate on piston *H* and plate *K* is lowered, by revolving screw *L*, until the spring is held firmly in place. After screw *L* has been adjusted to suit the spring, nut *N* is screwed tight against the boss on body *B* to prevent the screw from turning when pressure is placed on the spring. Pressure is exerted on the oil by rotating screw *D* so as to force plunger *E* into the cylinder. The pressure exerted on the oil raises piston *H*, thus causing deflection of the spring. The amount of this deflection is read on scale *J*, while the pressure on the oil, and therefore on the spring, is indicated on the gage. A leather washer *M* is attached to the bottom of screw *D* by a steel washer and a small round-head machine screw, to prevent oil from leaking past the plunger.

* * *

The saving in coal resulting from the installation of hydroelectric plants to take the place of steam power plants for lighting and power purposes is well illustrated by a statement in a recent *Commerce Report* regarding two hydroelectric power plants situated at Fadalto and Nove, Italy. These plants, which are now capable of producing 20,000 and 8000 horsepower, respectively, are being enlarged so that they will be capable of producing 280,000 additional horsepower. It is estimated that the increase in capacity of these two plants will mean a saving of about 1,000,000 tons of coal in Italy per year.

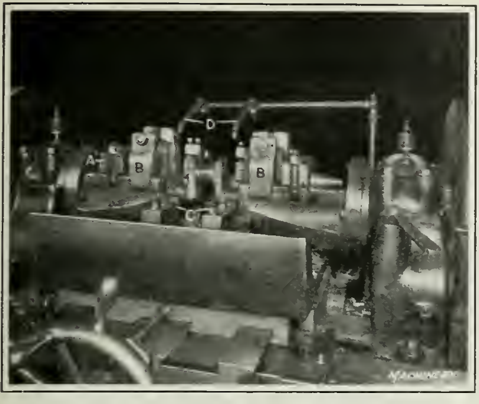


Fig. 1. Lathe equipped with Two Tools for simultaneously turning Two Crankpins on the Essex Crankshafts

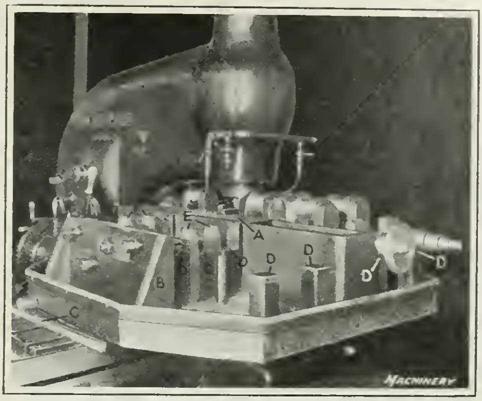


Fig. 2. Vertical Miller equipped with Multiple Fixture for milling Counterweight Seats on Essex Crankshafts

Machining Essex Crankshafts

Methods Used by the Hudson Motor Car Co., Detroit, Mich., in Machining the Crankshafts for the Essex Car

In working out the design of the four-cylinder motor for the Essex car built by the Hudson Motor Car Co., of Detroit, Mich., many of the general features of the Hudson "Super-six" motor have been retained. As a result, the Essex engine may be referred to as a "Super-four." It is the purpose of this article to describe methods of manufacturing and not to enter into a discussion of motor car engine design; but the features of the Essex crankshaft illustrated in Fig. 3, in connection with the accompanying operation sheet for machine work done on this part, will make it apparent to readers who are familiar with the Hudson engine that the Essex crankshaft is designed along the same general lines. For instance, attention is called to the provision for using counterweights, which give an accurately balanced running action and which enable the engine to operate smoothly and with very little noise. A complete outline of the machine work performed on these parts is presented in tabular form, and these data will be supplemented by detailed descriptions of several of the more interesting operations.

Rough-turning the Crankpins

R. K. Le Blond crankshaft lathes are employed for turning and spacing the crankpins. These lathes are equipped with double toolposts so that provision may be made for simultaneously performing a roughing operation on two pins. Fig. 3 illustrates the crankshaft to be machined, and Fig. 1 shows a lathe tooled up for machining the two center pins. Reference to this illustration will make it apparent that the lathe is equipped with a driving head at each end of the bed, instead of having the usual arrangement of headstock and tailstock. Such an arrangement is considered desirable, owing to the use of two tools that are frequently required to take heavy cuts in tough forgings. With power applied from each end of the machine, there is assurance of a uniform drive, and the amount of torque developed in the work is not as great under such conditions of operation.

It will be noticed that on each of the faceplates of this machine a cat-head is furnished, which grips the work by means of pivoted straps *A*, Fig. 1, that are tightened down on the end bearings *a* and *e*, Fig. 3, and pivoted straps *B* which are secured to the Nos. 1 and 4 crankpins *i* and *j*. The turning tools for operation on the Nos. 2 and 3 crankpins *k* and *l*, are shown at *C* in Fig. 1, and the saving effected through the possibility of simultaneously roughing out two pins will be obvious. On account of the toughness of the work, there is usually danger of the tools being damaged by burning, and to reduce to a minimum the danger of overheating the tools and work, a double lubricant pipe *D* is arranged to deliver a copious flow of coolant to the point of each tool. On this job the tools are operated at a cutting speed of 52 feet per minute, and the actual time for turning and spacing the Nos. 2 and 3 pins is 4.20 minutes.

Milling Seats for the Counterweights

Mention has already been made of the practice of counterweighting the crankshaft of the Essex motor to assure

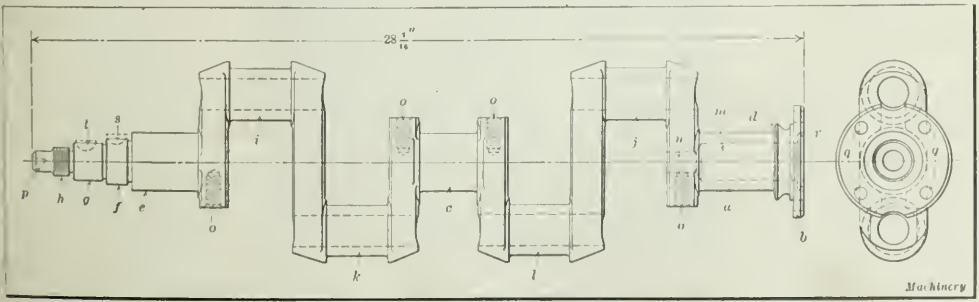


Fig. 3. Crankshaft of the Essex Motor, on which Machining Operations are to be performed

smoothness of operation. For this purpose it is necessary to mill four seats o to which the counterweights are attached. A Kearney & Trecker vertical-spindle milling machine is employed, which is equipped with a multiple work-holding fixture that provides for setting up four crankshafts for facing the counterweight seats. Reference to Fig. 2 will make it apparent that the milling fixture is divided at the center by a wall *A*, and in the performance of the milling operations that are required on the counterweight seats, it is the practice to use one-half of the fixture for holding the forgings on which the machine is working while the operator is engaged in removing milled crankshafts from the other side of the fixture and resetting fresh pieces of work in their places.

At each end of the fixture there is a sliding jaw *B* which is moved inward against the work by tightening up the bolts with a socket wrench *C*. In the condition in which the crankshafts come to this machine, the line bearings have been turned, and these partially finished surfaces are used as the locating points. On the fixture there are pads *D* on which the line bearings are supported, and for spacing the individual forgings in the fixture, there are floating wedges *E* that extend upward between the turned bearings on the work. The milling fixture is mounted on a pivotal support so that after the seats at one end of the forgings have been milled, the fixture may be indexed through 180 degrees to bring the counterweight seats at the opposite end of the crankshafts into place under the milling cutter. After milling two of the counterweight seats on each crankshaft forging, it is necessary to remove the forgings from the fixture and reset them for milling the two counterweight seats at the opposite side. On this job the milling cutters are operated at a speed of 75 feet per minute, and the time required to complete milling four counterweight bosses on a forging is 5.35 minutes.

Tapping Holes in Counterweight Seats

Fig. 4 illustrates a convenient equipment for use in tapping the holes o, Fig. 3, in counterweight seats, that receive bolts which secure the weights in place on the crankshaft. This tool consists of a pneumatic drill equipped with a tapping chuck, the entire drill, air hose, etc., being suspended by a cable *A* secured to a counterpoise, so that very little effort is required to feed the tap down into the work or withdraw it after the hole has been threaded. There is nothing unusual about the method of performing this tapping operation, but there is another feature of the way in which the apparatus is arranged that adds greatly to the facility with which the operator is able to perform his work. The holes have already been drilled in the forgings and no special provision has to be made for obtaining an accurate location of the work. As a result, the forging can be dropped into V-blocks *B* that engage the line bearings at each end of the crankshaft. After the holes o have been tapped in the two counterweight seats adjacent to the bearings c at the center of the shaft, it is merely necessary to turn the shaft through a half turn on its supports to bring the other two counterweight seats into position to tap the holes.

Still another feature of the provision that has been made

ORDER OF MACHINING OPERATIONS ON ESSEX CRANKSHAFTS

Oper. No.	Operation	Type of Equipment	Cut. Speed, Feet per Min.	Prod. Time, Minutes
1	Rough inspection	Bench	....	....
2	Heat-treat	Furnace	....	....
3	Pickle	Acid tank	....	....
4	Sand-blast	Sand-blasting machine	....	....
5	Straighten	Metalwood straightening press	....	....
6	Center both ends	Duplex centering machine	....	....
7	Rough-turn bearing a and outside diameter of flange b, Fig. 3	Wickes engine lathe	58	3.16
8	Rough- and finish-turn and cheek bearing c	LeBlond engine lathe	72	5.25
9	Space flange b and web, space bearing a and form oil thrower d	Wickes engine lathe	83	6.80
10	Face, chamfer, and finish-turn outside diameter of flange b	Wickes engine lathe	80	4.37
11	Face web, space bearing e to length and rough-turn front end	Wickes engine lathe	80	3.00
12	Rough-turn bearing e and fits f, g, and h; space bearing e and neck diameters f, g, and h	Wickes engine lathe	80	3.95
13	Inspect	Bench	....	....
14	Cheek web on all pins	LeBlond crankshaft lathe	125	6.52
15	Spot-turn pins i and j; space to length	LeBlond crankshaft lathe	52	4.20
16	Spot-turn and space pins k and l	LeBlond crankshaft lathe	52	4.20
17	Inspect	Bench	....	....
18	Cut clearance slots in flange	Niles-Bement-Pond drilling machine	40	1.20
19	Mill counterweight bosses	"Milwaukee" milling machine	75	5.35
20	Drill holes m and n through bearing a	Foote-Burt drilling machine	56	6.19
21	Drill eight holes o	Baush multiple drilling machine	35	3.00
22	Countersink and tap eight holes o	Carlton radial drilling machine	60	3.15
23	Drill axial hole through pins k and l	Foote-Burt Vertical drilling machine	40	2.88
24	Drill axial holes through pins i and j	Foote-Burt Vertical drilling machine	40	2.88
25	Wash and blow-out eight holes o	Soda tank and air hose	....	1.25
26	Remove burrs	Bench	....	2.00
27	Straighten	Metalwood pneumatic press	....	2.13
28	Cut to length, re-center both ends, finish-turn fits f, g, and h, and pilot p	Monarch turret lathe	75	3.20
29	Tap eight holes o	Air drill and tapping chuck	....	3.50
30	Rough-grind bearing c	Landis grinding machine	....	....
31	Rough-grind bearings a and e	Landis grinding machine	....	....
32	Rough-grind pins k and l	Landis grinding machine	....	....
33	Rough-grind pins i and j	Landis grinding machine	....	....
34	Finish-grind pins i and j	Landis grinding machine	....	....
35	Finish-grind pins k and l	Landis grinding machine	....	....
36	Straighten to 0.003 inch	Metalwood pneumatic press	....	2.15
37	Inspect	Bench	....	....
38	Finish-grind bearings a, c and e	Landis grinding machine	....	....
39	Finish-grind fits f and g, and pilot p	Landis grinding machine	....	....
40	Finish-grind outside diameter of flange b	Landis grinding machine	....	....
41	Inspect	Bench	....	....
42	Drill and ream holes q in flange	Baush multiple drilling machine	56	4.18
43	Finish-face and chamfer flange b, chamfer hole m and counterbore at r	Monarch turret lathe	76	3.60
44	Finish-space bearing e, and fits f and g, chamfer and thread at h, and finish-turn pilot p	Monarch turret lathe	40	3.53
45	Mill keyways s and t	Special milling machine	35	1.18
46	Remove burrs	Bench	....	2.00
47	Polish bearings a, c and e, and pins i, j, k and l	South Bend lathe	....	3.38
48	Final inspection	Bench	....	....
49	Weld forging defects	Acetylene torch	....	29.00
50	Finish-grind pins i and j after welding	Landis grinding machine	....	....
51	Finish-grind pins k and l after welding	Landis grinding machine	....	....
52	Straighten after welding	Metalwood pneumatic press	....	....
53	Finish-grind bearings a, c, and e after welding	Landis grinding machine	....	....
54	Finish-grind and space fits f, g, and p	Landis grinding machine	....	....

Machinery

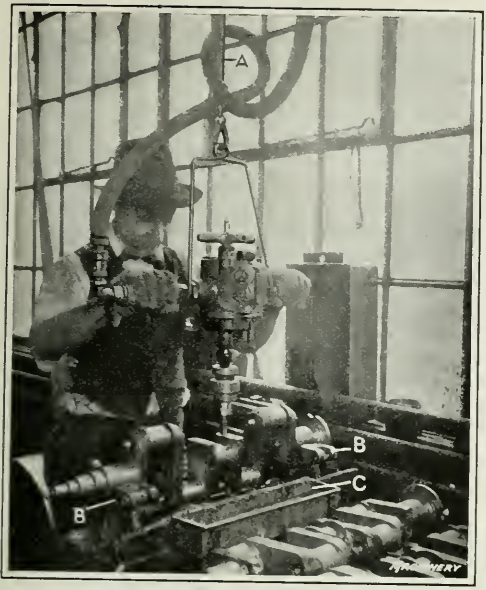


Fig. 4. Conveniently Arranged Air-operated Tool for tapping Holes in the Counterweight Seats on Essex Crankshafts

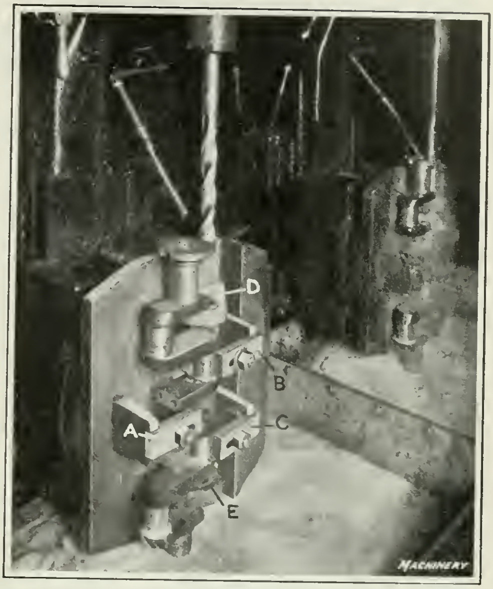


Fig. 5. Drilling Machines provided with Indexing Jigs for drilling Axial Holes through the Crankpins

for the performance of this tapping operation, which adds substantially to the rate of output that can be attained, is the provision of a pan *C* directly in front of the work-holding fixture. Owing to the toughness of the forgings to be machined, it is found desirable to employ lard oil as a combined coolant and lubricant for preventing undue wear of the tap. Pan *C* is filled with lard oil, and preparatory to the performance of each tapping operation, the workman dips the point of the tap into the oil, so that it will be covered with a film that is sufficient for tapping one hole. Owing to the counterweighted supporting cable *A* that carries the tool, little physical effort is required of the workman in lubricating the tap in this way, and such a method of applying oil is very much more rapid than using a small brush to cover the tap with a sufficient quantity to lubricate it during the performance of each tapping operation. For this job the production time is 3.50 minutes for tapping eight holes.

Drilling Axial Holes in Crankpins

In order to provide the necessary projected area for the crankpin bearings, and still avoid having the shaft unduly heavy, a practice is made of drilling an axial hole 1⅛ inches in diameter through each of the pins. Fig. 5 shows two units of a battery of eight Foote-Burt vertical drilling machines which are equipped with indexing jigs to provide for the performance of these drilling operations. In this illustration the machines are shown equipped for drilling holes in the Nos. 2 and 3 crankpins *k* and *l*, Fig. 3, but the arrangement for drilling the Nos. 1 and 4 pins *i* and *j* is essentially the same. It will be seen that the forging is secured in the fixture by means of three straps *A*, *B*, and *C*, which hold the work back into V-blocks that engage the middle line bearing c and the Nos. 2 and 3 crankpins *k* and *l*.

At the top of the jig there will be seen a drill bushing *D*, Fig. 5, which guides the drill while it is removing the excess metal from the center of crankpin *l*, and after this result has been accomplished, the drill is withdrawn and a locking pin is pulled back to enable the jig to be indexed through 180 degrees, thus bringing drill bushing *E* into place under the drill for drilling a similar hole in crankpin *k*. One operator is able to look after four machines. The drills are driven at a cutting speed of 40 feet per minute, and the time required for drilling holes through the Nos. 2 and 3 crankpins or the Nos. 1 and 4 pins is 2.88 minutes.

On the Essex crankshaft, it is necessary to mill two Woodruff keyways in the gear fit *f*, Fig. 3, and the fan pulley fit *g*. Fig. 6 shows a special duplex milling machine which was built for this operation, and two crankshafts are shown standing on end beside the machine, in which the keyways to be milled are clearly shown at *s* and *t*. As the work is received at this miller, it has been practically completed, and the holes drilled in the flange *b* are utilized as locating points, pins on the supporting member *A* on the fixture entering the flange holes to locate the work. The No. 1 crankpin enters a V-block and is held in place by strap *B*. Supported in this manner the two keyways are milled in the work simultaneously by cutters *C* and *D*. The operation is completed in 1.18 minutes.

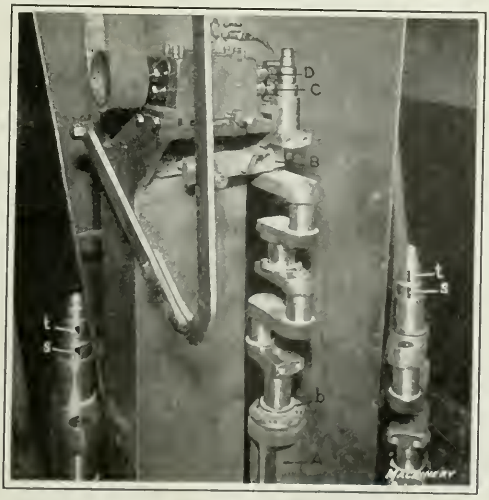


Fig. 6. Special Duplex Milling Machine for Use in milling Keyways s and t in the Essex Crankshafts

A System of Fit Allowances

By SYDNEY B. AUSTIN, Inspection Engineer, The Eisemann Magneto Corporation, Brooklyn, N. Y.

IT has been common practice in many drafting-rooms to use the notations "drive fit," "force fit," etc., in connection with dimensioning drawings. This nomenclature frequently leads to confusion and misunderstanding, as there is no definite standard for establishing the meaning of these terms, and to provide for interchangeable manufacture it is necessary that definite dimensions be given in place of these indefinite expressions.

In order to arrive at some understanding of the meaning of these various expressions, and in an effort to determine proper fit allowances and tolerances a study was made of the data given in various mechanical handbooks. The two systems given in most handbooks which seem more nearly to fit the case in point are those of the Brown & Sharpe Mfg. Co. and of the Newall Engineering Co. A study of these two systems shows that in a great many particulars they do not agree, and in some places are quite inconsistent in themselves. However, they were used as a general guide in conducting the investigation, the results of which are presented in this article.

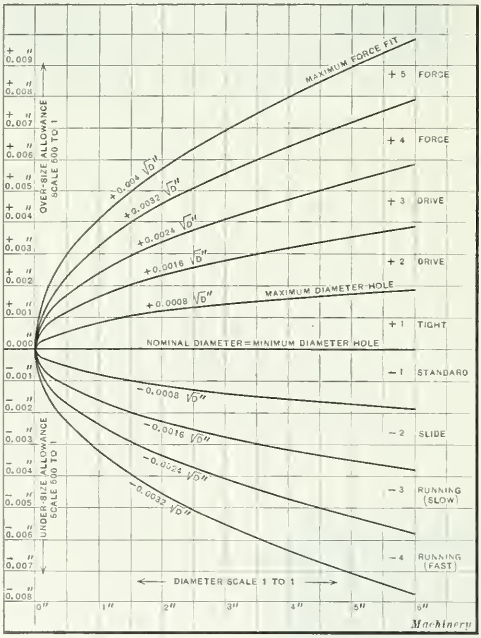


Fig. 1. Curves showing the Relation of Allowances for Fits to Various Diameters

The Hole as the Basic Size

The practice of the Brown & Sharpe Mfg. Co. of making the hole, in all cases, the nominal diameter with a plus tolerance was taken as the basis of the system here suggested. In the Newall system, the hole is given both a plus and a minus limit, but this was considered undesirable for two reasons: In the first place, a standard tolerance for the hole, when adopted for all classes of fits, simplifies the matter of dimensioning drawings considerably, and in the second place it was desired to develop a system of allowances in which the maximum metal dimension could be placed on the drawings with but one limit—plus in the case of holes and minus in the case of male parts.

Establishing a Relation between Fit Allowances and Diameters

In connection with the investigation, it was desired to arrive at a curve or law covering the relation of the allowances for fits to the diameter of the part. For various reasons it seems that this curve should be in the nature of a parabola approaching the horizontal as a limit. The law or equation of the parabola is $y^2 = 2px$, or $y = \sqrt{2px}$. This would indicate that the allowance for fits should be a function of the square root of the diameter; in fact, the Newall Engineering Co.'s tables give equations for the hole tolerances and limits for running fits based on this law of the parabola. It was also found that the values given in the Brown & Sharpe tables follow this law very closely.

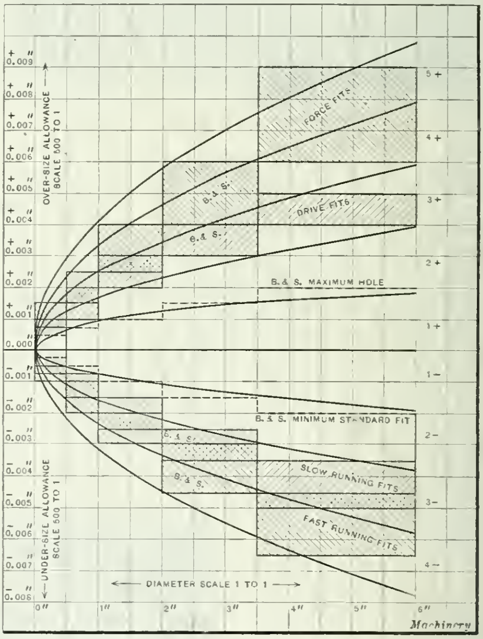


Fig. 2. Comparison of Theoretical Curves with B. & S. System of Fit Allowances

The equation for the tolerance on the hole, $y = 0.0008\sqrt{D}$, also taken as the basis, in which y represents the tolerance and D the diameter of the hole, corresponds almost exactly with the Brown & Sharpe hole tolerance and also very closely with that given by Newall. This curve, also other curves, the ordinates of which are multiples of the ordinate used in plotting the original curve, were laid out both above and below the horizontal axis. Each of these lines is intended to be the upper limit of one and the lower limit of another class of fit, and these fits, for the purpose of discussion, will be designated by plus numerals or minus numerals, as the case may be. These curves are shown in Fig. 1, and were originally drawn full scale for the diameters and to a scale of 1 to 500 for tolerance allowances, that is, ½ inch equals

0.001 inch. Although the original scale is reduced in the illustrations, the proportions, of course, remain the same. The same curves can be used for the metric system by using a scale of centimeters, in which case ½ centimeter equals 0.01 millimeter. The equation for hole tolerance when expressed in the metric system may be written $y = 0.004 \sqrt{D}$.

Comparison of Curves with Allowances Given in Brown & Sharpe Tables

The comparison of the curves shown in Fig. 1 with the values given in the Brown & Sharpe tables is shown in Fig. 2. The No. 1 plus fit, having the same limits as the Brown & Sharpe grinding limits for holes, will produce a size and size fit, or what is sometimes designated as a wringing fit. In extreme cases where the maximum limit is approached by one part and the minimum limit by the other, there will, of course, be produced an over-size or an under-size fit, but the clearance or interference, as the case may be, will be very slight.

The No. 2 plus fit might be called a very light drive fit, as it comes between the size of the hole and the minimum limit of the Brown & Sharpe drive fit. The No. 3 plus fit corresponds almost exactly with the Brown & Sharpe allowance for a drive fit. The Brown & Sharpe system allows but one value for a large range of diameters, and it is therefore necessary in the case of diameters from 3½ to 6 inches, to make the limits small in order to keep within the boundaries, that is, below the minimum for 6 inches or above the maximum for 3½ inches. This tolerance in the Brown & Sharpe tables is therefore only 0.001 inch for the ordinary class of work, whereas on the curves shown in the accompanying illustrations this allowance is nearly doubled.

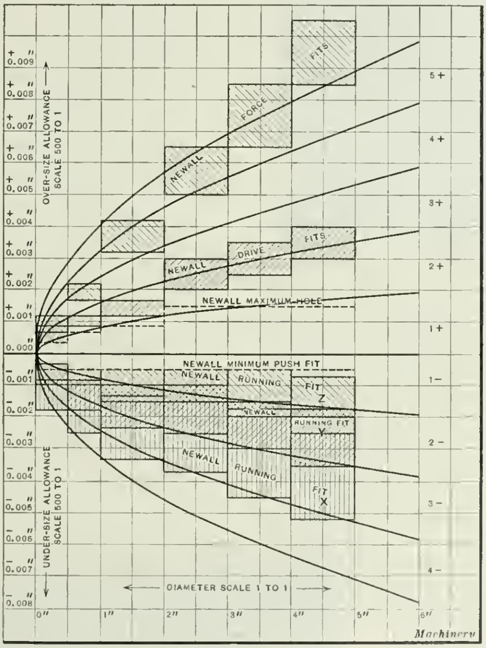


Fig. 3. Comparison of Theoretical Curves with Newall Engineering Co.'s System of Fits

The next two plus fits, Nos. 4 and 5, agree with the range covered by the Brown & Sharpe force fits, but do not go quite as far in the over-size allowance as the Newall force fits (see Fig. 3). In a similar manner, the clearance or minus fits of Fig. 1 are seen to correspond very closely with the Brown & Sharpe fits. No. 1 very nearly agrees with the Brown & Sharpe "standard," or what is sometimes classified as push fit; No. 2 represents a fit between the Brown & Sharpe standard and the "slow" or ordinary running fit, and might be referred to under the present nomenclature as "sliding fit"; Nos. 3 and 4 correspond with the regular Brown & Sharpe running fits. Brown & Sharpe also give a sliding fit which is almost identical with the slow running fit and therefore is not shown in Fig. 2.

Comparison of Curves with Newall Fit Allowances

The relation of the Newall nomenclature to these curves is shown in Fig. 3. In making this comparison on the same basis as was employed in comparing the curves with the Brown & Sharpe system, the Newall values were corrected by the amount of the minus tolerance. This was necessary, since the minimum size of the hole is taken as the basis both in the Brown & Sharpe system and in the system here described. The values shown in Fig. 3 are not therefore the values given in the Newall tables, but are the differences between the particular size in question and the minimum size of the holes; that is, since the minimum hole up to 2 inches in diameter has a low limit of —0.0002 inch and a low limit of —0.0005 inch for diameters over 2 inches, in plotting, the positive values are increased by the amounts of these minus values. For example, the Newall maximum hole for ½-inch diameters will have a tolerance of 0.0004 inch; for diameters up to and including 1 inch, a tolerance of 0.0007 inch; for diameters up to and including 2 inches, a tolerance of 0.0009 inch, etc. These are indicated on the illustration by dotted lines.

In similar manner, the negative values obtained from the plotted curves will represent a decrease for each diameter equal to these same minus tolerances on the hole. For example, the Newall limit for a minimum push fit is —0.0007 inch up to and including 2-inch diameters, and —0.001 inch for diameters greater than 2 inches, in all cases 0.0005 inch smaller than the minimum hole. This accounts for the minus allowance for a minimum push fit being 0.0005 inch throughout, as indicated by the dotted line. The plotted areas in the lower part of this illustration will be seen to overlap considerably and consequently are liable to cause some confusion unless it is borne in mind that the allowances, for the purpose of comparison, are re-established on a minimum hole tolerance basis. The Newall running fit *Z* has limits of —0.0005 inch and —0.0007 inch for ½-inch diameters and —0.0007 and —0.0012 inch limits for diameters up to 1 inch, and so on, so that in plotting the areas these values must each be reduced an amount equal to the minus tolerance on the hole, that is, 0.0002 inch for holes up to and including 2 inches in diameter, and 0.0005 for the larger holes. This accounts for the limits of 0.0003 and 0.0005 inch for the ½-inch diameters, and 0.0005 and 0.001 for the diameters up to and including 1 inch. By referring to the Newall tables and remembering that the values given are reduced in amount equal to the minus tolerance on the hole, the plotted areas may be readily checked. In the running fit *Y*, the minus limits 0.0007 and 0.0012 inch thus become 0.0005 and 0.001 inch, respectively, as the chart shows.

In using the curves shown in these charts, it is not intended to introduce a new system of nomenclature for fits (even though some confusion is liable to result from the use of the common method of referring to various fits), the purpose being merely to furnish a system that may be used as a guide in determining sizes and tolerances.

How Allowances should be Determined by the Draftsman

The method of using the charts is as follows: The draftsman should determine in a general way the approximate class of fit required, and should enter on the drawing simply the maximum metal dimension; this will determine the class of fit. In the case of the hole this will be the nominal diameter. The maximum diameter of the shaft or other male member will be determined by reference to these curves.

The drawing should be sent to the shop without the limit so that the amount of tolerance can be determined by practical manufacturing considerations and the functioning requirements of the apparatus. It is, of course, possible for the draftsman to use the limits taken directly from these curves, but it is believed that if this is done it will result in using, at least in a great many instances, closer limits than are required. For economical manufacture, the tolerance should be as liberal as possible, all requirements being taken into consideration.

The allowances shown in Fig. 1 are suitable for high-class accurate work, and correspond closely with those used by the Eisemann Magneto Corporation for parts of apparatus which have the more accurate requirements, such as the driving fit for ball bearings on shafts. In this system it is intended, as previously stated, that the maximum metal dimension should first be determined; or in other words, the fit should be classified by the initial clearance between the maximum metal dimensions. In cases of work not requiring such close tolerances, the allowances for both the holes and the shafts may be proportionately greater. It is suggested that for ordinarily accurate machine work about 50 per cent more tolerance could be allowed, so that the tolerance equation would be $y = 0.0012 \sqrt{D}$ for the English measurement system and $y = 0.006 \sqrt{D}$ for the metric system. In these equations, y represents the tolerance and D the diameter in inches, or millimeters, according to the system in use. For the general class of machine work this tolerance may be still further increased.

In all cases when determining tolerances, the method of doing the work and the machine on which the work is to be done should be taken into consideration. In many instances where small diameters are involved, it will be found that the capability of the methods or machines used will require tolerances so large that the variations of the parts within the tolerances cover two or more classes of fits, as ordinarily understood, whereas if the fits are classified by the initial clearance or difference between the maximum metal dimensions, something more definite is available from which to work when establishing the fits. This method seems to be the correct one of classifying fits, because the maximum metal dimensions are the vital ones; that is, it is understood if a dimension is given as 1 inch, plus 0.005 inch tolerance, that a 1-inch hole is what is wanted, but that it may be over size not exceeding 0.005 inch.

A comparison between the results as given by these curves and the values given in the handbooks for rougher classes of work is difficult to make, as there is a wide variation in the allowances given for drive fits, force fits, etc. However, a comparison of a few of the values for the larger diameters with the practice of C. W. Hunt Co., Russell Engine Co., General Electric Co., etc., shows that none of these practices disagree more with the system here described than they do with each other.

* * *

FRENCH FOREIGN TRADE BUREAU

The French Foreign Trade Bureau, known as the "Office du Commerce Exterieur" has recently been reorganized to increase its scope. This department controls the service of French commercial agents, and is responsible for organizing trade exhibits in France and other countries. It supplies trade information in the form of loose-leaf pamphlets or in response to inquiries, and helps foreign traders who are seeking information as to the French market. Plans are being made to hold a commercial exhibition in Canada, a colonial exhibition at Marseilles in 1922, and an inter-allied exhibition in Paris in 1925. Permanent exhibitions are being provided for branch offices of the department in the principal countries of the world, exhibitions already having been opened in Spain, Switzerland, Czecho-Slovakia, the Balkan States, and in London, England. The department intends soon to begin the publication of a periodical similar to the British Board of Trade Journal.

ADAPTING THE SHAPER TO PLANER WORK

The possibility of equipping a shaper for operations ordinarily handled on a planer is brought out in an interesting manner in Fig. 2, where a shaper is shown in use in the Gould & Eberhardt shop at Newark, N. J., for machining the slides for the outer support castings of gear-hobbing machines. This is a 28-inch shaper equipped with a heavy outboard support *A*, which is bolted to the base of the machine and which affords rigid support for the large box fixture in which the work is secured while the shaping operation is being performed.

The fixture is bolted to the saddle of the shaper, utilizing the regular T-slots in that member, and has a foot with a V-groove for the supporting casting rail. This enables the fixture to be adjusted laterally on the saddle while the different surfaces of the slide are being finished, and insures the fixture being held parallel with the travel of the shaper ram. The work may thus be located in this box fixture without danger of inaccuracies occurring through sag of the fixture. The work *B* is secured in place by means of binder screws which hold it sidewise. These screws are located on the opposite side of the fixture and so cannot be seen in the illustration, but it will be noted that a draw-bolt *C* at the foot end of the fixture is provided for securing the work at the base.

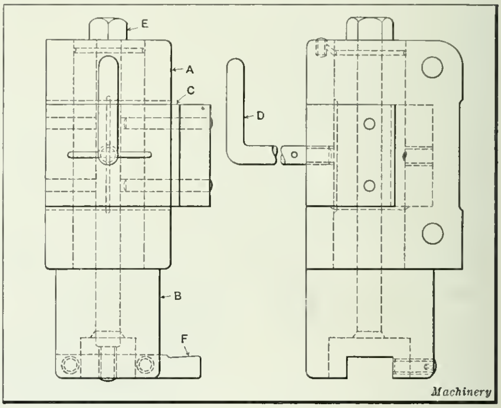


Fig. 1. Side Swiveling Toolpost for Use in planing Under Surfaces

A master gage-block *D* is provided for obtaining the proper distance from the cutting edge of the tool to the finished surface of the work. The gear-hobbing machines on which these outer supports are used are built in a number of sizes, so that it was necessary to design the fixture so that all castings of this type could be machined in it. To this end the fixture is made long enough to accommodate the largest outer support casting and has a removable base *E*, the inside of which is machined to fit the previously finished base of the work. To accommodate shorter castings it is merely necessary to change the base for one having a longer finished projection or block, which will fit the machined base of the smaller size outer support casting.

Aside from the features of the fixture described in the foregoing, and the fact that work of this type is not commonly machined on a shaper, the only other point of especial interest that might be referred to in connection with this job is the use of a special tool-holder for finishing the under side of the slides. Ordinarily, a hook tool would be used for an operation of this kind, but in this case a special side-swiveling tool-holder or "flapper" is employed. This tool-holder, which is shown in Fig. 2 at *F*, is carried on the tool-head of the shaper, being hung to the regular toolpost block by means of two pins. Fig. 1 is an assembled view of this tool-holder, which consists of a holder *A* secured to the toolpost block of the shaper, a toolpost *B* which is free to swivel in the holder, a yoke *C* which is fastened by pins to the toolpost, a handle *D* carried in the yoke by means of which the tool is swiveled, a draw-bolt *E*, and a side cutting planer tool *F*.

The operator sets the tool by means of the master block or gage *D*, Fig. 2, regulating the stroke of the machine so that it will clear the work at both ends and at the same time allow a sufficient space on the back stroke between the end of the slide and the master block to enable the tool to be swiveled 90 degrees. During the finishing of this under surface, the operator stands with his hand on the handle of the tool-holder with the tool in the position shown in the illustration. At the end of the forward stroke he quickly swivels the tool to the front 90 degrees, enabling it to clear the work on the return stroke, at the end of which it is swung back to the right, and this procedure is followed throughout the operation, or until the tool has fed in to the full depth of the under surface of the slide. This type of tool is more satisfactory than a hook tool for work of this kind, since the stiffness of the tool prevents it from springing away from the surface while in operation.

In addition to the master gage *D*, three working gages are used to test the accuracy of the work as it is being machined. Two of these gages are shown lying on the casting at *G* and *H*. Gage *G* is used to test the angle of the side in respect to a horizontal plane. Gage *H* tests the angularity of the two sides of the slide with respect to each other, that is, the included angle, and is simply laid on the work like an ordinary profile gage. Another gage which is shown lying across the top surfaces of the slide enables the parallelism of the top surfaces and the angularity of the two side surfaces to be inspected.

This shaper is one of Gould & Eberhardt's manufacture, and was originally pressed into service to relieve the planing department. However, as the results obtained, both in regard to quality of work and saving of time, were so satisfactory, the job is now regularly performed on the shaper. It requires about fifteen minutes to swing the casting from the floor into the fixture, fasten it in place, and adjust the fixture on the supporting rail preparatory to machining the top surface. In machining the work prior to shaping the under side, a roughing and a finishing cut are taken on the top and angular surfaces of the work with regular tooling equipment. The total time from floor to floor is about three hours, which is a saving over the planer method of about two hours per casting.

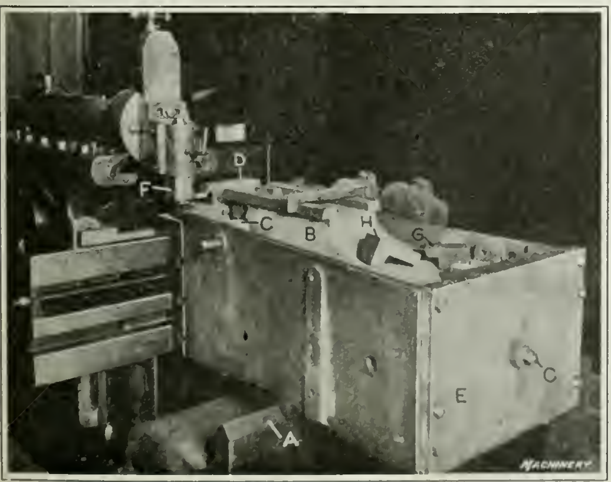
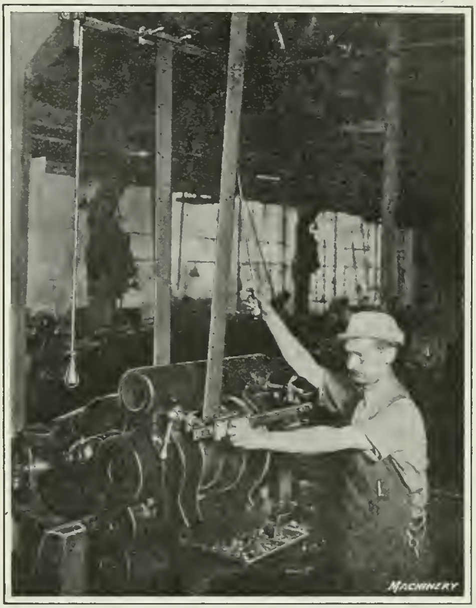


Fig. 2. Shaper equipped with Special Fixture for planing Heavy Castings

MECHANICAL BELT SHIFTER

The difficulty of shifting a belt from one step of a cone pulley to another without some form of belt-shifting device is well known to machinists and machine operators. The use of a belt pole is awkward, but is often necessary when nothing better has been provided. An excellent type of mechanical belt shifter is shown in the accompanying illustration applied to a milling machine. This belt shifter was designed for use in the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., by the tool design section. It has a lower member for shifting the machine end of the belt, and an upper part for shifting the countershaft end. The lower member consists of a rectangular bar that is fixed in its supports and carries a sliding yoke through which the belt passes. A knob or handle is provided for sliding this yoke when shifting the belt. The upper belt yoke has attached to it cords which hang down within reach of the operator and have handles at the lower ends. By pulling one of these cords, the upper yoke is shifted either to the right or the left, depending upon which cord is pulled. The illustration shows a workman about to shift the belt from the largest and the smallest steps of the two cone pulleys to the intermediate steps. By pulling the right-hand cord, the belt is first run off the large step above, and then by sliding the lower bar to the right, the belt is pushed on the intermediate step of the lower cone pulley. To place the belt back in the high-speed position, this order is reversed; that is, the lower end is first pushed from the intermediate step to the smallest step, and then the upper end is run on the largest step by pulling the left-hand cord. These movements, which are controlled by both hands, follow quickly, and the belt is shifted easily and without danger, to any desired position. The shifter is made of standard cold-rolled stock and simple castings which require little machine work.



Mechanical Belt Shifter applied to a Milling Machine

Machining Car-wheel Borer Frames

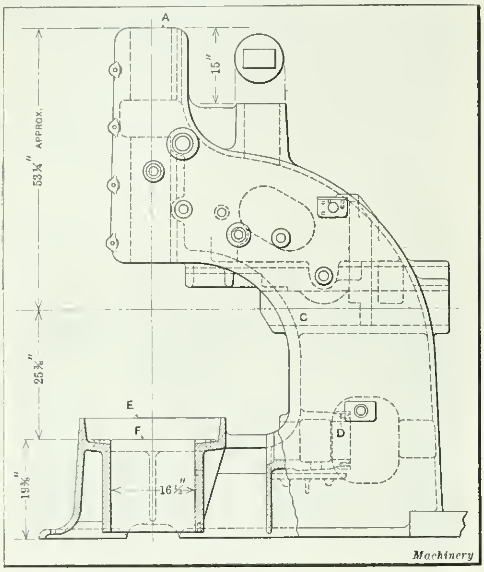


Fig. 1. Car-wheel Borer Frame machined on Floor Platen with Portable Motor-driven Tools

THE large car-wheel boring machine frame shown in detail in Fig. 1 is approximately 98 inches high and of such bulk that it cannot be conveniently handled when machining except by the use of portable tools. Figs. 2 and 3 show the casting set up for the boring, reaming, and rough-facing operations, while Fig. 4 shows the method of finish-facing surface *F*, Fig. 1, with the work anchored in a vertical position. The operations performed in the set-up illustrated in Figs. 2 and 3 consist of boring and reaming the vertical spindle hole *A*, Fig. 1, the facing-ram hole *C*, and hole *D*, as well as rough-facing surfaces *E* and *F*. The work is set up on a floor platen supported by screw-jacks and braced by angle-plates, being anchored in place by means of a number of U-clamps, as clearly illustrated in Fig. 3.

The boring-bar and feed-screw, by means of which the boring tool is traversed along the bar, are shown in Fig. 2. This bar is employed in boring the vertical spindle hole to a diameter of 8 inches. The bar is driven by a motor located near the base end of the frame. This boring-bar is also utilized when reaming this hole, a shell reamer being employed so that it is not necessary to change the set-up. Simultaneously with the boring of the main spindle hole *A*, holes *C* and *D*, Fig. 1, are bored as shown in Fig. 3. In this illustration the boring-bars are shown set up in readiness for performing this operation. A separate motor is employed to drive each of the boring-bars used in boring these two holes, so that there are three motors in simultaneous operation during the boring of these three holes *A*, *C*, and *D*. These holes are also reamed with shell reamers carried on the boring-bars, after the general method employed in reaming the vertical shaft hole. The well-known star-wheel and feed-screw arrangement is used for traversing the boring tool along the bar.

Referring again to Fig. 2, it will be seen that the boring-bar carries a worm-driven cross-screw arm *A*, for performing the rough-facing operations on surfaces *E* and *F*, Fig. 1. This arm carries a cross-feed screw with a star-wheel (clearly shown in the illustration) at each end, the screw being turned sufficiently by engaging finger *B*, to feed the facing tool radially outward from the center at the proper feed per revolution of the arm. During these facing operations another motor is used to drive the facing arm *A*. This illustration also shows the method used to locate the casting from this side, there being a large angle-plate employed to furnish a rigid abutment for the work. The time required to perform these operations, including setting up the work, is eighteen hours.

The finish-facing of surface *F*, Fig. 1, which must be machined accurately and at 90 degrees to the vertical spindle hole *A*, is performed on the erecting floor, the operation being illustrated in Fig. 4. The regular boring machine spindle, which accurately fits the previously machined hole *A*, is employed. A facing ram carries the cross-feed head with its feed-screw and star-wheel, as shown in the illustration. By this means the desired degree of accuracy is established. The spindle carrying the facing ram and head is driven by a motor, as indicated by the driving belt and the pulley attached near the top of the spindle. The degree of accuracy resulting from this method of finish-facing the important surface *F*, which is the seat for the member in which the table of the machine rotates, reduces the amount of fitting and scraping, necessary in assembling, to a min-

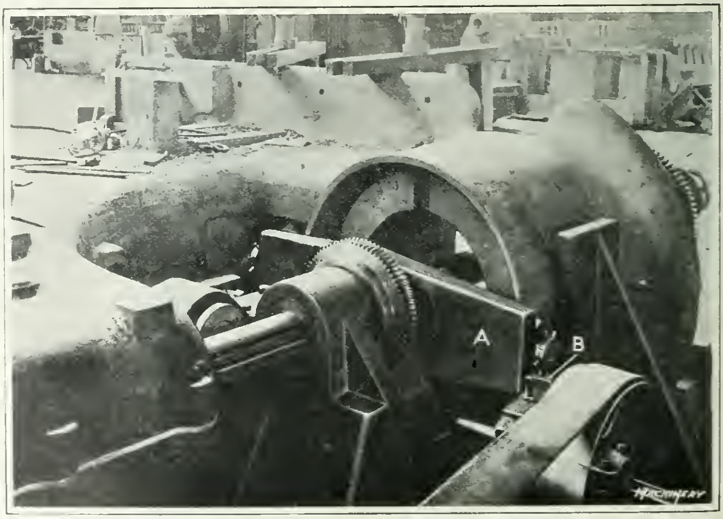


Fig. 2. Star-wheel Feed Mechanism set up for facing Seat on Frame Casting

imum. The methods of performing the several operations here described assure the proper relationship of the finished surfaces, and illustrate the fact that where it is required to handle unwieldy work that cannot be accommodated on standard machines, satisfactory results may be obtained by employing some such out-of-the-ordinary set-ups as those described in this article. The car-wheel boring machine here illustrated is manufactured by the Putnam Machine Works, Fitchburg, Mass.

* * *

CUTTING CAST IRON BY THE TORCH

The Oxweld blowpipe was not originally designed with a view to cutting cast iron, but after exhaustive experiments, a method of operating the torch for cutting cast iron was developed, and it can be mastered, it is stated, by the average operator almost as easily as the method employed for cutting steel. There is, however, a decided difference in respect to procedure. In practice, the cutting of cast iron with the Oxweld blowpipe differs from the cutting of steel in that: (1) It is necessary to use heating flames having an excess of acetylene; (2) it is necessary to hold the blowpipe nozzle farther away from the metal; (3) it is necessary to preheat for a longer period for cast iron than for steel, since the cast iron must be almost molten before the cutting reaction will start. Steel ignites at a temperature well below its melting point; (4) it is necessary to oscillate the nozzle continually to maintain the cut.

A cut in cast iron, if properly handled, and if the material is of good quality, will have an appearance about equal to that of a fair cut in steel. The time required for cutting a given section of cast iron is about twice that required for cutting a similar section of steel. This makes the cost considerably higher in the instance of cast iron and tends to restrict its applications in many places where one might suppose it would be generally useful. For example, the inexpensive methods employed for removing risers from castings in iron foundries preclude the use of oxy-acetylene as an economical means of performing this class of work. Further, the cutting off of risers from chilled castings is usually not practical because the surfaces cut are likely to crack or check, due to local heating. Cast-iron cutting is now used in several industries for removing broken machinery parts such as pinions, gears, flywheels, housings, etc.

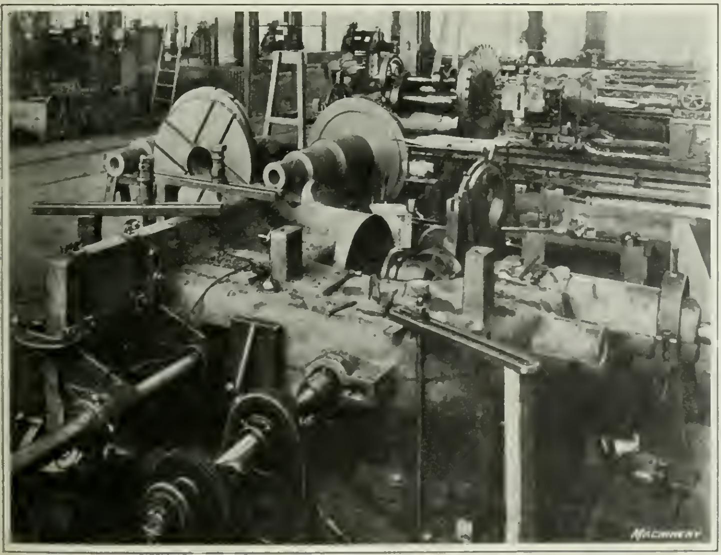


Fig. 3. View showing the Casting in Readiness to be machined, and the Three Boring-bars used

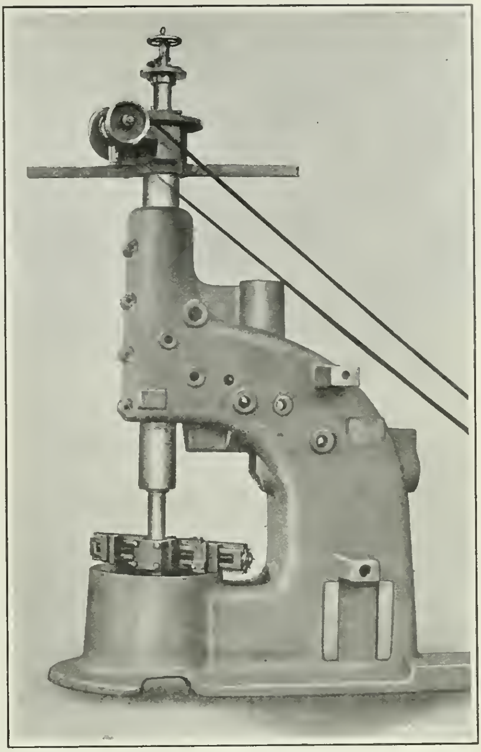
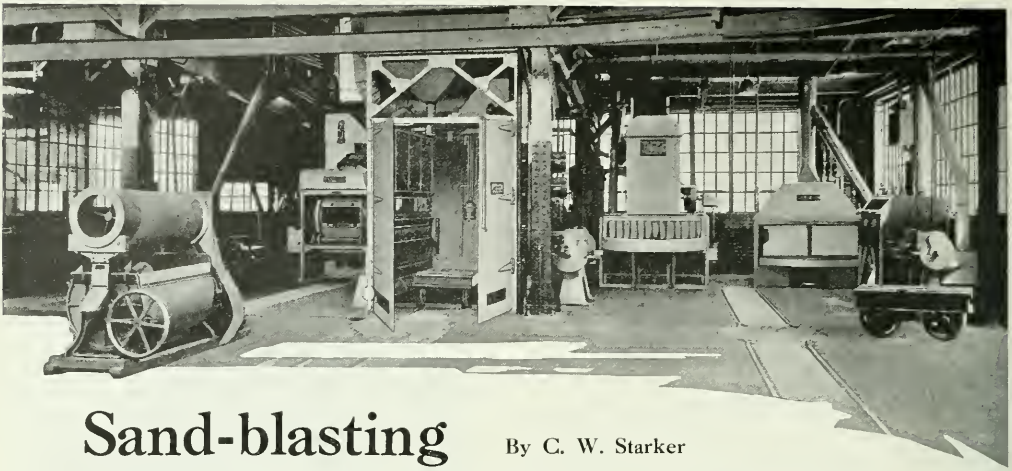


Fig. 4. Finish-facing Operation on Car-wheel Borer Frames, using Regular Machine Spindle for supporting the Facing Head

BRITISH INDUSTRIES FAIR

The greatest annual trade fair in the world, the British Industries Fair, is to be held at London and Birmingham from February 21 to March 4, and at Glasgow from February 28 to March 11. The procedure followed in other years will be the same, except that the fair is to be considerably enlarged. As usual at Birmingham will be exhibited, among other things, machinery and tools of all kinds from the most representative manufacturers of the United Kingdom. The Aerdrome at Castle Bromwich will be used again for this division. Special staffs are maintained to enable buyers to obtain authentic information on all points of importance such as tariffs, shipping and transport, most likely sources of supply, not only of articles included in the fair but also of all British products. Admission will be by invitation only so that bona fide visitors and buyers may have all the attention of exhibitors. The British Consulate General, 44 Whitehall St., New York City, will be glad to issue cards of invitation, and also to give all possible information and assistance to anyone who may desire to attend this fair.



Sand-blasting

By C. W. Starker

Types of Apparatus, Abrasives, Nozzles, Air Pressures, Dust Exhausting, etc.

SAND-BLASTING, while not a new process, still offers great possibilities for a wider application. In order to obtain satisfactory results, a clear understanding is required of a number of features peculiar to the process. In this article concrete data are given in regard to types of apparatus, abrasives, nozzles, air pressures, dust exhausting, etc. The sand-blasting process is best known as a method employed in the iron foundry for cleaning castings, but it actually finds a very much broader and ever-increasing application in all kinds of industries. It is successfully used, not only in cleaning iron and steel castings, but also for brass and aluminum, when the pressure and nozzles are properly adapted to these softer materials. Sheet-metal parts are frequently prepared for plating, galvanizing, enameling, or painting by sand-blasting. The process is also employed for matt-surfacing metals, roughing handles of instruments, lettering or frosting glass, lettering marble, blasting wood for the purpose of bringing out the grain, and many other uses too numerous to mention here.

There are several systems of sand-blasting. They all discharge the abrasive through one or several nozzles, but the manner of applying the stream of abrasive to the surface to be treated varies in different systems, so as to meet the varying conditions and requirements. From the viewpoint of the user, a selection should be made upon consideration of first cost and the cost of operation, in order to secure the best results with the greatest economy. Air, compressed to varying pressures, is commonly employed in all sand-blasting equipments, but the pressure is applied in different ways. The three systems in use are generally designated as the direct-pressure system, the suction or syphon system, and the gravity system. In the direct-pressure system the air and the abrasive are combined in and discharged from a closed tank through a nozzle. The most common example of this system is the hose sand-blasting machine illustrated in Fig. 4, made by the Pangborn Corporation, Hagerstown, Md. The abrasive, under pressure in the sand chamber of the machine, is discharged at full pressure together with the

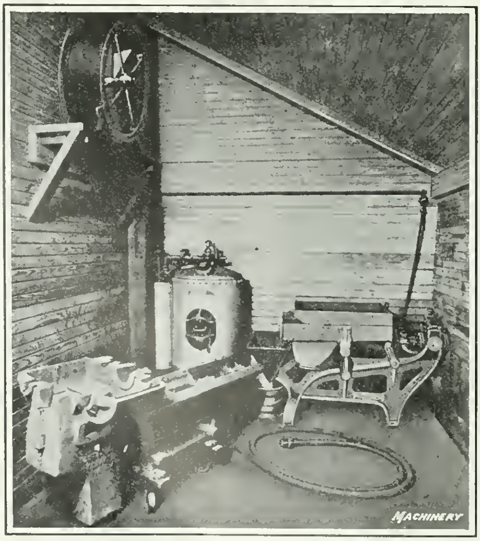


Fig. 1. Sand-blast Room with Hose Machine, Sand Separator, and Wall Fan

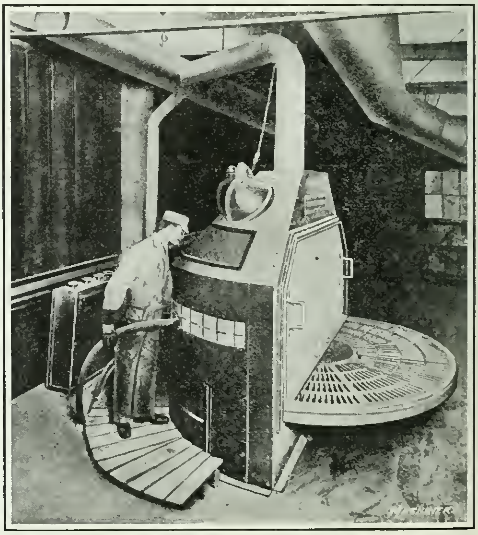


Fig. 2. Sand-blast Cabinet with Provision for operating Hose from Outside

air, thereby attaining the highest possible velocity. This machine will be referred to again in describing the sand-blasting equipment.

In the suction system, the abrasive is carried to the nozzle by a suction created by a jet of compressed air, which, in passing through the nozzle, carries the abrasive with it. The construction is shown diagrammatically in Fig. 5, this apparatus being known as a "sand-blast gun." This gun, as we will see later, may be stationary; may be operated by hand; or may be arranged to travel mechanically across the work to be cleaned, moving either in a straight line, in a circle, or in an oscillating manner, so as to permit the air to act on all sides of an article. A characteristic of this suction system is that the discharge pressure is below the full gage pressure, which results in decreased velocity of the abrasive. This is due to the fact that the air, upon coming out of the air orifice, expands in volume and as a consequence decreases in pressure, since the discharge nozzle of the apparatus must, of course, be larger than the air jet.

In the gravity system, the abrasive is carried by mechanical means to a place above the nozzle and is fed down by gravity. At the nozzle, the abrasive and compressed air combine and are discharged. The full energy of the compressed air is imparted to the abrasive, but in this system also the air jet is smaller than the discharge nozzle, and therefore expansion of the air takes place.

These three different systems naturally result in a variety of constructions, but before going into these it is well to take note of the basic factors that govern all forms of sand-blasting, and these should be carefully considered before selecting equipment. Familiarity with these factors and the proper application to installed equipment are necessary in order to secure the greatest economy and the best results.

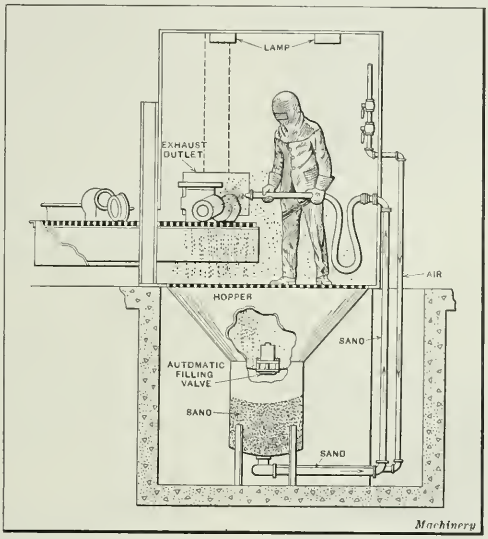


Fig. 3. Sand-blast Room with Machine located underneath the Room

TABLE 2. CYLINDER DISPLACEMENTS AND HORSEPOWER REQUIREMENTS OF AIR COMPRESSORS

Cylinder		Rev-olutions per Minute	Piston Dis-place-ment, Cu. Ft per Min.	Horsepower Requirements					
				Pressure (Cu. Ft. per Minute)					
Diam-eter, Inches	Stroke, Inches			50	60	70	80	90	100
6	6	300	57	7	7.5	8.5	9.0	9.5	10
8	8	260	118	14	15.5	16.8	18.0	19.0	20
10	10	235	210	24	27.0	29.0	31.0	33.0	35
12	12	220	340	45	50.0	54.0	58.0	62.0	65

Machinery

The pressure and volume of air are two factors of sand-blasting which should be kept in mind. It may be said, other things being equal, that the higher the air pressure used the stronger the force of the jet discharged against the surface to be treated and, therefore, the greater the amount of work done. Consequently, for hard scale on steel, a higher pressure is advisable, for example, than for cleaning a soft aluminum casting. It may be roughly stated that, according to actual practice, 50 pounds air pressure will perform twice as much work as 20 pounds, or 65 pounds will accomplish twice as much as 30 pounds, and 72 pounds twice as much as a 40-pound pressure. The air pressures used for different materials are as follows, and while only approximate, they nevertheless represent fair average practice: Steel castings or forgings, 80 to 100 pounds; malleable iron, 70 to 85 pounds; cast iron, 60 to 70 pounds; and brass and aluminum, 35 to 50 pounds.

The volume of air flowing through a nozzle opening at a given pressure is governed by the size of the nozzle. If the nozzle wears, due to sand passing through it, the opening becomes greater, the volume of air flow increases, and the pressure drops. This, of course, is undesirable, as the amount of work turned out decreases with reduced pressure, and the volume of air to be handled by the compressor becomes greater. The design of a nozzle should, therefore, be such as to reduce as much as possible the wear due to the friction of the rapidly moving sand. For economy in cleaning, a constant air pressure should be maintained, the amount of pressure being selected to suit the material to be treated and the abrasive employed.

For some classes of work a small nozzle opening, that is, a fine strong jet, may be desirable; for other work a broader stream, covering a larger surface but working at a lower pressure may be best. The amount of energy expended in both cases may be the same. With a nozzle 3/16 inch in diameter, and a pressure of 80 pounds per cubic foot, 47.50 cubic feet of free air must be compressed, requiring 8.65 horsepower; while with a ⅜-inch nozzle and 30 pounds air pressure, 90 cubic feet of free air is compressed and 9.27 horsepower is required. These values are given in Table 1, in which the relation between air flow in cubic feet of free air per minute at varying pressures, and the horsepower required to produce them by single-stage compression, is given for nozzles ranging in diameter from ⅛ inch to ⅜ inch, inclusive.

TABLE 1. FLOW OF FREE AIR FOR DIFFERENT SIZES OF NOZZLES

Diameter of Nozzle, Inches	Pressure (Cubic Feet per Minute) and Corresponding Horsepower Required							
	20 Pounds	H. P.	30 Pounds	H. P.	40 Pounds	H. P.	50 Pounds	H. P.
⅛	7.70	0.63	10.00	1.03	12.30	1.50	14.50	1.99
3/16	17.10	1.40	22.50	2.32	27.50	3.26	32.80	4.49
¼	30.80	2.53	40.00	4.12	49.10	5.99	58.20	7.97
5/16	48.17	3.95	62.89	6.48	76.60	9.36	90.70	12.43
⅜	69.00	5.66	90.00	9.27	110.00	13.42	130.00	17.81
Diameter of Nozzle, Inches	60 Pounds	H. P.	70 Pounds	H. P.	80 Pounds	H. P.	100 Pounds	H. P.
⅛	16.80	2.57	19.00	3.19	21.20	3.86	25.73	5.33
3/16	37.50	5.74	43.00	7.22	47.50	8.65	57.88	11.98
¼	67.00	10.25	76.00	12.77	85.00	15.47	103.00	21.32
5/16	105.00	16.07	119.00	20.00	133.00	24.10	161.00	33.82
⅜	151.00	23.10	171.00	28.73	191.00	34.76	232.00	47.90

Machinery

Compressed air is not as inexpensive as it is sometimes erroneously thought to be, principally on account of the air itself being cheap. All air leakages should, therefore, be carefully guarded against, and the pipe connections maintained in first-class condition.

Moisture in Air

Due to condensation or weather conditions, moisture may get into the air. This is troublesome because moisture in compressed air prevents an even flow of the abrasive and causes the sand to form lumps, so that the wet, heavy material adheres to all surfaces with which it comes in contact and clogs up all passages. Moisture is also detrimental to pneumatic tools which are operated from the compressed air system. Therefore, in cases where there is moisture in the air, it is well to make provision for the elimination of the moisture by installing a moisture separator or a suitable heater.

Air Compressors for Sand-blasting

In selecting the proper size of air compressor, several points should be kept in mind. There is a difference between the volume of air actually delivered and the theoretical volume based on piston displacement. The air actually delivered in single-stage compression varies between 50 and 75 per cent of the calculated piston displacement. Typical cylinder dimensions together with the displacement and the horsepower required to develop various amounts of air pressure are given in Table 2.

A given energy horsepower is required to compress 1 cubic foot of free air to a given pressure. The speed of the compressor, therefore, not only governs the volume of air compressed but also the power required to compress it. It is possible, then, to run a compressor at lower speed, with correspondingly reduced horsepower, as long as a small amount of air is required, and to speed up the compressor later to full rated output when additional air is required. In any case, it is well to select a compressor large enough to take care of possible leaks and the wear of nozzles, and to keep in mind that almost invariably other applications are found for compressed air around the plant as soon as it is available for use, such as for operating air hammers, air hoists, chucks, sand rams, molding machines, etc.

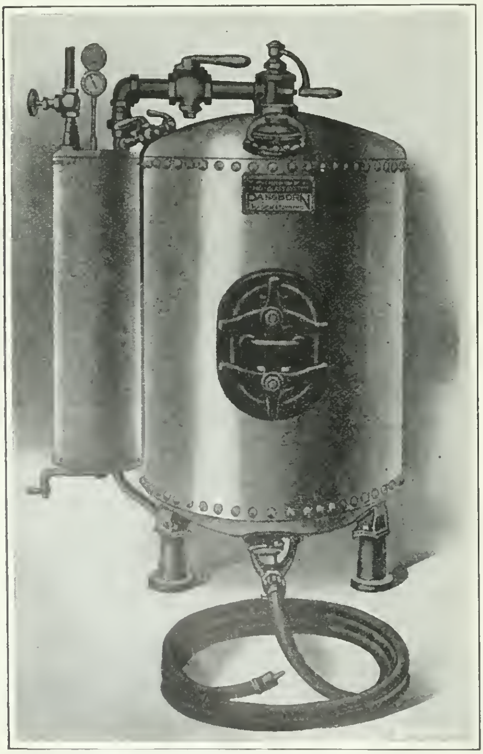


Fig. 4. Hose Sand-blasting Machine

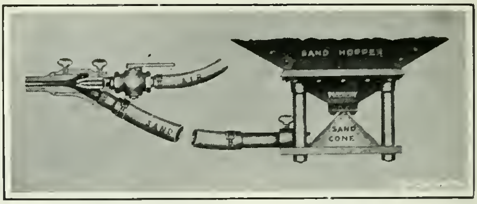


Fig. 5. Sand-blast "Gun" and Nozzle

Every compressor should be equipped with a governor (also called unloader or regulator), the function of which is to shut off the air intake automatically when the receiver is filled, allowing the compressor to run light, and thereby saving power until the pressure drops to a predetermined point. An air receiver should always be installed and should be located as near as convenient to the compressor. This receiver acts like the flywheel on an engine, preventing fluctuation in pressure due to the change in load caused by intermittent use of compressed air for various applications. Single-stage compressors are usually employed in the smaller plants requiring not over 200 or 300 cubic feet of air, but for greater volume a multi-stage compressor will be found to be more economical.

Different Kinds of Abrasive Materials

Sand is the most commonly used abrasive on account of its relatively low price. Ordinary lake or river sand is inferior to sea sand and silica sand, as the two latter possess greater hardness and are therefore more lasting. River sand results in more or less dust, and it disintegrates rapidly. Abrasives such as steel grit and shot are used to a certain extent, and the use of these more expensive abrasives is warranted under certain conditions. For classes of work such as electroplating or galvanizing, the metallic dust adhering to the work would make its use prohibitive, because it prevents perfect galvanizing, although no difficulty is experienced in this respect with sand.

There is no one abrasive that is best adapted to all classes of work. A selection must be made with due regard to reclaiming means, to greatest economy in operation and to maximum production. By making tests with various materials, and keeping accurate records of quality of work, output, life of the abrasive, etc., the one best suited for the individual application is readily determined. Such tests have shown metal abrasives to have about sixty times the life of sand. This apparently large percentage may, however, be offset to a great extent by losses of abrasive in operation or in handling. In good steel foundry practice these losses may be kept as low as 10 per cent, while the average loss due to disintegration, for different grades of sand, amounts to about 20 per cent per month. The reduction in cleaning time resulting from using metal abrasives instead of sand varies, of course, but a gain of about 15 to 20 per cent in time appears to be in line with actual practical experience. Metal abrasives do not require large sand-storage bins and have the added advantage of producing less dust, thereby improving the general working conditions.

All abrasives should be screened each time before using, to remove particles large enough to clog the nozzle, and also to eliminate fine particles which only produce dust and have no abrasive quality, but which consume some of the pressure. Screen separators, frequently operated by compressed air, may be used for this purpose.

Sand-blasting Machines

The hose sand-blasting apparatus already referred to, and shown in Fig. 4, is one of the earliest applications of the sand-blasting idea, and is at the present time very extensively used. It is an inexpensive machine, particularly adapted for doing miscellaneous work and for cleaning large surfaces, rather than for use in the quantity manufacture of medium-sized articles. The hose machine (except where a portable outfit is used for outdoor work, such as cleaning bridges or stone-work) demands some kind of enclosure, with ventilation to carry off the dust. The size and volume of the work determine the type of the enclosure. A room made of rough lumber with a wall fan discharging in the atmosphere or into a separate dust chamber is the simplest form. Such an arrangement is shown in Fig. 1, this being the enclosure for the sand-blasting equipment provided at the plant of the Concord Foundry Co., Elkhart, Ind.

Steel rooms are, of course, preferable where manufacturing environment justifies such protection. The hose machine may be set up either inside or outside the room. The rooms frequently are provided with grated floors through which the sand falls into a sand-bin or into a conveyor; or the sand-blasting machine may be placed directly under the room as shown diagrammatically in Fig. 3. The articles to be cleaned may be placed on a rotary table, one-half of which is being loaded and unloaded outside the enclosure.

This construction leads directly to the sand-blast cabinet design illustrated in Fig. 2 with the so-called "hygienic" or "humane" table on which the operator stands on the outside, manipulating the hose through a curtain and observing the work through windows. Suitable lamps with reflectors are provided. Instead of manipulating the hose, the sand-blast cabinet can be arranged with one or more sand-blast nozzles inside the cabinet, so that the operator can manipulate the work-piece by reaching into the cabinet and holding the work. Hands and arms are protected by gloves and suitable sleeves, and an observation window and lamps are provided to aid the operator. This type of machine is well adapted for sheet-metal goods, carburetors, milling cutters, etc., because each piece is handled individually, so that the danger of breakage or denting is obviated. The blast may also be directed upon those points where it is most needed.

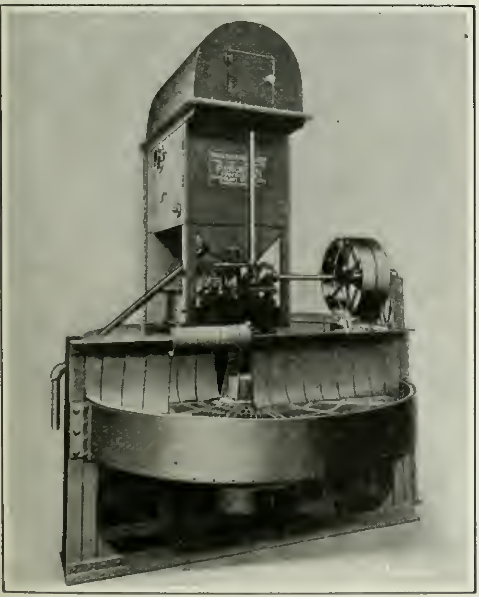


Fig. 6. Automatic Rotary-table Sand-blasting Machine with Gravity Feed

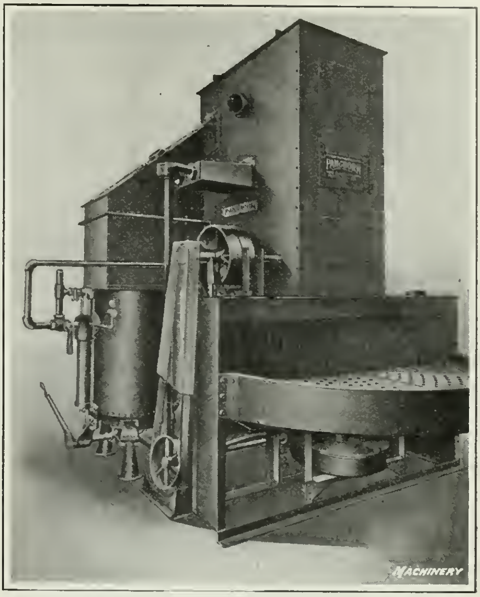


Fig. 7. Automatic Rotary-table Sand-blasting Machine with Direct-pressure Blast

This leads to the automatic rotary table in which the work is placed on a slowly revolving table, and upon entering the cabinet is exposed to jets of air and sand from one or more nozzles. To cover all sides of the work and all parts of the table-half, these sand-blast guns are arranged in various ways. The stream may be directed from different sides, or the nozzle holder may be designed to oscillate the nozzle automatically or to cause it to travel over the table in a circular motion or in a straight line. Figs. 6, 7 and 8 illustrate three designs of the automatic rotary-table sand-blast as built by the Pangborn Corporation; the one shown in Fig. 6 has a gravity-feed action; the one in Fig. 7, a direct-pressure and hose type blast; and the one in Fig. 8, a suction feed with swinging nozzle. Machines of the rotary-table type are well adapted for sand-blasting in the regular manufacture of smaller parts in large volume, and for fragile articles not suited for cleaning in a tumbling barrel.

Screw machine parts, hardened steel parts, pulleys, gears, and small automobile parts are frequently treated in sand-blast tumbling barrels of the type illustrated in Fig. 11. These barrels may be of the gravity type, the pressure type, or the suction type, the one illustrated being equipped with gravity feed. These tumbling barrels consist of a dustproof steel casing in which a steel drum *A* slowly revolves. Jets of sand enter the drum from the mixing chamber *B* after being admitted from the sand-box *C* through gate *D*. These jets effectively reach all sides of the articles contained within the revolving barrel. The air valve through which the compressed air is admitted to the mixing chamber is shown at *E*. The pressure type barrel differs from the gravity feed barrel particularly in that the sand under air pressure is contained in a steel tank beneath the machine. In the suction type tumbling barrel, the sand is delivered from a hopper above the machine and is caught at the nozzles by the air jet which forms the blast, being drawn in by the suction so created.

Exhausts and Dust Arresters

Sand-blast rooms should be well ventilated in all cases, by installing an exhaust fan, the size of which depends on the size and kind of work. It will be seen that the room shown in Fig. 1 has such a means of ventilating. The air in the room should be changed from four to ten times every minute. Sand-blasting cabinets and rotary tables should always be equipped with piping connected to an exhaust fan in order to provide sanitary working conditions. Rooms, tables, and barrels may be installed in combination and ventilated by a single exhauster.

In isolated plants, or under any unusual condition it may be permissible to exhaust the dust-laden air directly into the atmosphere, but ordinarily some method of partially or completely gathering and settling the dust should be provided.

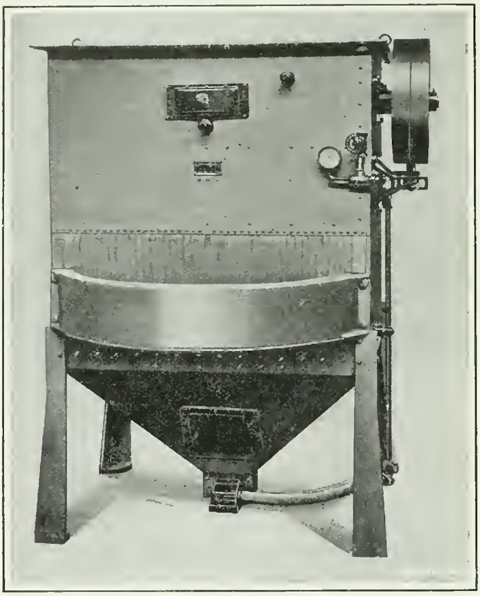


Fig. 8. Automatic Rotary-table Sand-blasting Machine with Suction Feed

The simplest method is a settling box or chamber into which the heavier particles fall by gravity, so that the particles light enough to be carried by the air are discharged into the open atmosphere by this simple method. About 95 per cent of the dust may be collected by an arrester, by means of which solids are caught by the centrifugal action of the device. The small percentage of fine dust which is not thus gathered by the arrester is carried out by the air current through a smokestack.

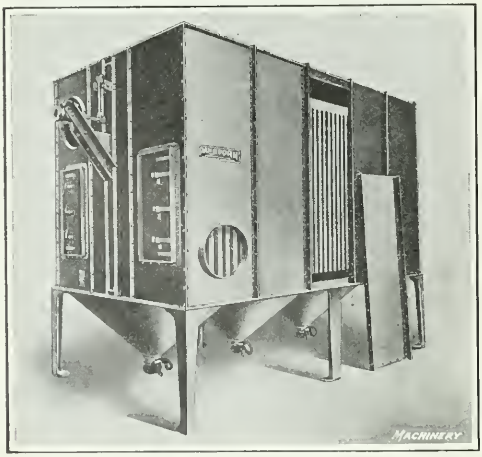


Fig. 9. Cloth Screen Dust Arrester

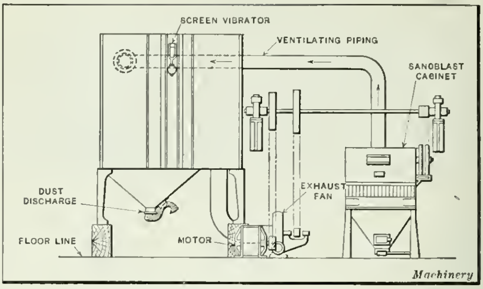


Fig. 10. Diagrammatic View of the Cloth Screen Dust Arrester

For plants in cities or, in fact, in all modern plants, more complete confining of the dust is necessary. This is accomplished by a cloth-screen type of dust arrester, Fig. 9, in which the dust-laden air is drawn into the sheet-steel cabinet by the exhaust fan, through a series of finely woven cloth screens, reinforced with a backing of copper wire. These screens are fitted tightly into the compartment so that all the dust is retained within the arrester. The dust is daily shaken off the screen by a rapping device, operated either by an electric motor or by air, and is then deposited in a hopper provided with discharge spouts. The typical installation here shown consists of a sand-blast cabinet with exhauster, dust arrester and rapping device. Fig. 10 illustrates diagrammatically the construction of a cloth-screen dust arrester.

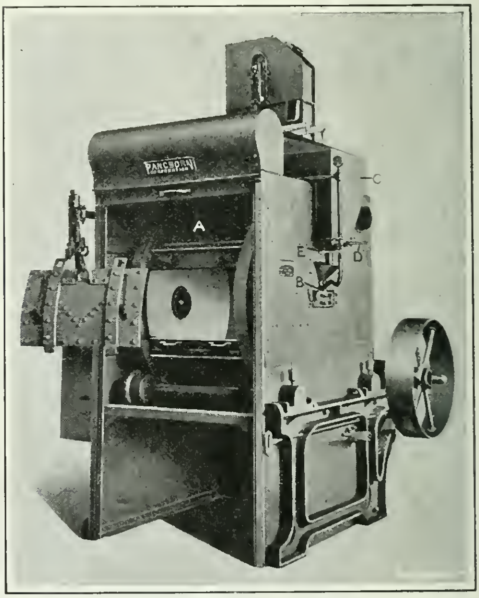


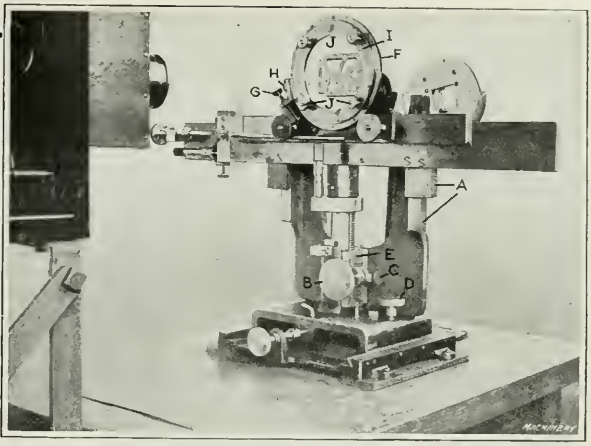
Fig. 11. Sand-blast Tumbling Barrel equipped with Gravity Feed

* * *

Although Sheffield has long been an important center for the manufacture of cutlery, England has been in recent years one of the best customers for American cutlery of all kinds. According to statistics supplied by Consul Washington, the imports of American cutlery into Liverpool amounted to $342,000 during the year 1918, and $473,000 during 1919, or about 30 per cent of all the cutlery imported into England. The total English annual purchase of American cutlery during 1919 was valued at $1,258,000.

Increasing the Scope of Projection Apparatus

By L. E. KING*



IMPROVEMENTS added to the gage-holder of the projection apparatus manufactured by the United States Bureau of Standards have made possible the employment of this device for accurately measuring distances on comparatively thin flat work such as templets, and punched parts for watches, clocks, typewriters, adding machines, etc. Small turned parts for the products mentioned can also be measured. In addition to the modifications made on the machine, a chart has been developed to facilitate measuring the distance between the center of a hole or arc, and the center of another hole or arc, or an edge of the work.

Improvements on Projection Apparatus

The heading illustration shows the manner in which the gage-holder was improved to accommodate work of the nature mentioned. The guides *A* are provided to prevent the swinging of the work about the vertical adjusting post when making a vertical adjustment of the work. This tendency formerly prevented the taking of satisfactory coordinate measurements. A device has also been added to permit very accurate vertical adjustments of the work to be made quickly. Rough vertical adjustments are made in the usual manner by turning handwheel *B* and then clamping it by means of screw *C*.. Final adjustments are made by revolving handwheel *D* which actuates a lever underneath the base of the gage-holder. This lever slowly raises or lowers (the movement depending upon the direction in which the handwheel is rotated) part *E* on which are mounted handwheel *B* and the clamping screw *C*. The raising of the work by this arrangement is positive, but the lowering is dependent upon the weight of the gage-holder parts that are being lowered. However, the functioning of this adjusting device has been found satisfactory.

Attachment *F* is provided for conveniently holding flat work so that it can be adjusted to various positions as desired. A slow adjusting motion is provided by means of the tangent screw *G* and the clamping screw *H*. The work is mounted on the fixture by means of the clamping ring *I* and four thumb-screws *J*. For small work which must be held at or near the center of fixture *F*, an auxiliary clamping device is employed. This device consists of two thin metal strips of different lengths which are held together and adjusted by means of screws. The ends of the long strip are clamped under ring *I* and the work is held between this strip and the shorter one.

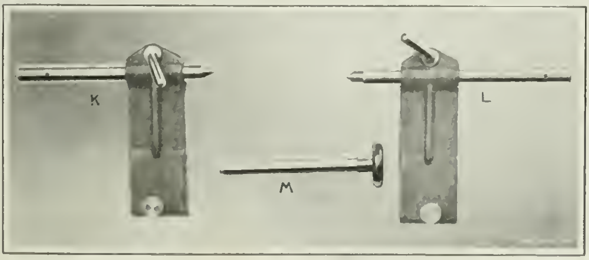


Fig 1. Centers for mounting Round Work on Gage-holder

Centers for Supporting Work

Various styles of centers for holding turned work and other round parts on the apparatus for measuring when fixture *F* is not being used are illustrated in Fig. 1. The centers *K* and *L* are each provided with a male and a female center. On center *K* these are solid, but on center *L* they are of the spring type. The female centers are made removable so that centers of various sizes and different included angles can be substituted as required. A hollow center with a draw-in spindle and chuck is shown at *M*. This hollow center and the spindle are made to suit small standard split chucks for wire and drills. These centers are especially useful for holding small round parts when it is desired to have one end exposed.

Chart for Measuring to Centers of Holes and Arcs

The chart illustrated in Fig. 2 consists of a piece of heavy paper ruled with two sets of parallel lines at right angles to each other, and a series of concentric circles. This chart is securely and smoothly fastened to the top of the table on which the shadow projections of the work obtained by means of the apparatus are thrown. The chart should be so placed on the table that one set of the lines will be parallel to the direction of the travel of the shadow when making horizontal adjustments, and the other set will be parallel to the direction of the travel of the shadow when making vertical adjustments, when these directions are at right angles to each other. It is preferable to draw the sets of parallel lines to represent decimals of an inch. In the case in which the chart illustrated was used, the apparatus was set for a magnification of 75, and as the large divisions on the chart are laid out to 0.75 inch, they, therefore, represent 0.01 inch on the work. It will be noted that the large divisions on the chart are subdivided into five parts; each subdivision, therefore, represents 0.002 inch on the shadow, and one-half of a subdivision, 0.001 inch. The divisions described serve as a rapid check against errors for all measurements lying within the available field. They can also be used as a scale when the highest

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*Address: 737 Wright St., La Salle, Ill.

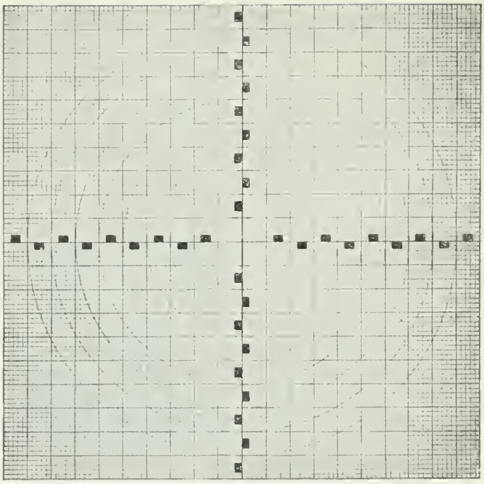


Fig. 2. Chart on which a Shadow of the Work is thrown for Measurement

accuracy obtainable is not required; otherwise it is best to rely on a similarly graduated scale having the main divisions numbered, or on the gage-holder micrometers.

The circles on the chart are useful in taking measurements from centers of holes or arcs to the centers of other holes or arcs, or to edges of the work, as the case may be. In operation, the center of the hole or arc shadow is made to coincide with the center of the chart by matching the edge of the shadow with the nearest circle. This is accomplished by the aid of the horizontal and vertical adjustments provided on the gage-holder. The difference between the corresponding micrometer readings for two such settings on a given piece of work will give the measurement desired. It is to be understood, however, that the circles are limited in their use to holes or arcs with radii, the shadows of which are not greater than the radius of the field available. In the case illustrated, the available field is equal to the size of the chart, the radius of which is ten large divisions which represent 0.1 inch on the shadow of the work.

The use of these circles for holes and arcs has been found to give more accurate results and to be a much more rapid procedure than the practice of working to the edges of holes or arcs. It will be noticed that the center lines of the chart are marked with small black rectangles so as to render them readily distinguishable. The lines of the main divisions are black while the subdivision lines and the concentric circles are red, these colors having been found to be the most suitable for observation in the semi-darkness in which the apparatus is operated.

* * *

COMPARISON OF SCREWED AND WELDED PIPE CONNECTIONS

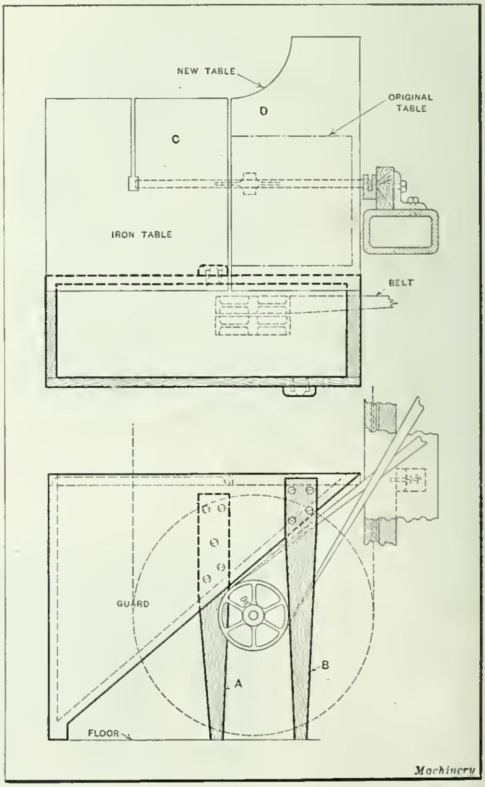
Comparative tests made by the University of Kansas of screwed and oxy-acetylene welded pipe connections are of interest in view of the fact that it is occasionally thought that piping should only be welded under unusual conditions and that the cost is greater than screwed connections. The results of these tests are given as follows: The cost of welded pipe connections is less than the cost of screwed connections; the larger the size of pipe, the greater the difference in cost. The time required to make screwed connections is about the same as that necessary to make welded connections. The strength of a welded pipe connection is practically the same as that of an unwelded pipe; by reinforcing or building up, the weld is said to be even stronger than an unwelded pipe. The elasticity of a pipe is not much affected by welding.

COMBINATION BELT GUARD, SCRAP BOX AND LUMBER REST FOR A BAND SAW

By M. E. DUGGAN

A combination belt guard, scrap box, and lumber rest for a band saw is shown by the heavy lines in the accompanying illustration. As the name implies, this device serves the purpose of a guard for the driving belt, a box for scrap lumber, and a support for long stock. The illustration also shows how an improvement over the original table shown by the dot-and-dash lines, was made by substituting a new table of larger size. This table was made flush with the top face of the iron table, and it proved to be of great advantage over the smaller table, especially when sawing large pieces. The additional table surface also forms a convenient place on which to put stock in cases where a number of pieces are to be sawed.

As shown in the lower view of the illustration, one side of the guard extends to the floor, while the opposite side, supported by two legs *A* and *B*, is made at an angle in order to clear the driving belt. The top edge of the guard next to the table is cut down to fit under the tables *C* and *D;* this prevents scrap from dropping on either the belt or the pulleys. The outer edge is made flush with the top of the table, and acts as a support when splitting long stock. When crosscutting long stock, the guard or scrap box is moved to a place on the floor where it will support the end of the board or stock to the best advantage. This feature makes the guard especially useful when a number of pieces are to be cut from the end of a very long board. It will be apparent that this guard can be quickly removed and replaced, thus making it convenient for the oiler to reach the mechanism.



Combination Belt Guard, Scrap Box, and Lumber Rest for a Band Saw

The German Machine Tool Industry

From MACHINERY'S Special Correspondent

Berlin, December 9

THE position of the machine tool industry in Germany is wholly unsatisfactory. Reports from machine tool shops employing nearly 14,000 workmen indicate that the degree of employment in about 10 per cent of these plants is good, with sufficient orders on hand; 79 per cent of these plants reported unsatisfactory conditions and lack of new orders. Many shops work only from thirty-two to forty hours per week, while a few work from forty-six to forty-eight hours per week. In the locomotive building industry, conditions are fairly satisfactory, and there is no serious unemployment; in the shipbuilding industry, the conditions of employment are also good, only a small percentage of the shipbuilding plants reporting an unsatisfactory condition.

The automobile industry suffers from a lack of new orders and from cancellations of old ones. The automobile plants are now working on stock, and different shops report weekly working hours from twenty-four all the way up to forty-eight. The same condition applies to the bicycle industry, where only a few shops report that they have a sufficient amount of work on hand to keep their shops going in a normal manner. The instrument makers report an unsatisfactory situation.

Scarcity and High Price of Raw Materials

During the past year various raw materials rose to such a price level that it was impossible for prices of finished products to keep pace with the increased prices of raw products. There has been a great deal of profiteering in the sale of iron and steel. German blast furnaces and steel mills charged home consumers more than they did foreign buyers, and the prices in the German home market are now higher than those in the world's markets. At the present time a Wotan shaper, having an 18-inch travel of the ram, is quoted at 33,000 marks, and a Samson shaper, with 23 inches travel of the ram, at 40,000 marks. Cast iron, in 1914, cost 0.32 mark per pound; today it is about 2.75 marks per pound.

Many of the machine-building plants employing thousands of workmen were placed in a very difficult position because they took orders at prices which became entirely too low when the raw materials rose on an unprecedented scale. Again, as the raw materials that they had bought were higher than those in the world's markets, they did not find a ready sale for their machines. Now, many of these machine-building plants are being absorbed by the large concerns in the iron and steel industry that were partially responsible for their difficulties because of the excessive prices that they charged for raw materials. Many of the mining and iron and steel companies had property in Alsace-Lorraine and met with losses on account of the provisions of the peace treaty. Many of these concerns have received compensation from the German government, and the liquid assets thus obtained were used for absorbing the smaller machine-building plants.

General Economic Situation

The economic situation of the country is far from satisfactory. In 1920 the governmental expenses amounted to over 90,000,000,000 marks, while the receipts were only about 24,000,000,000 marks, leaving a deficit of approximately 66,000,000,000 marks. To cover this deficit paper money has been issued, which has depreciated the value of the mark.

The operation of the German state railways in 1920 resulted in a deficit of 20,000,000,000 marks. All the large state undertakings have also resulted in deficits. The big works at Spandau, which were changed from the manufacture of guns and ammunition to a peace-work basis, suffered in 1920 a loss of 150,000,000 marks.

The political situation seems to be somewhat improved. No trouble is expected from the workers except possible demonstrations on account of the scarcity of food. Reports from the industrial centers show a greater willingness to work, although the efficiency remains low. The radicals, mostly younger men, have been shaken off by the older workers and the "Russian danger" also seems to be past. The socialistic party has been split into seven minor bodies.

Strikes and Lockouts

The statistics of strikes and lockouts which have recently been published for the years 1917, 1918, and 1919 show that in the latter year the number of strikes in Germany reached a figure hitherto unknown in the history of strikes in that country. The strikes took place mainly in the mining and metal-working industries, in the building trades, and on the transportation systems. The number of working days lost in 1918 was 4,900,000; while in 1919 this figure rose to 43,600,000. Strikes were more numerous in Berlin than anywhere else, and of the total number of days lost 41 per cent was lost in the city of Berlin in 1918, and over 50 per cent in 1919. The struggles between capital and labor have been most severe in Berlin, in Westphalia, and in the Rhineland. In 1918 there was not a single case of lockout, but in 1919, out of the total working days lost, 1.7 per cent was due to lockouts, while 98.3 per cent was due to strikes. Of the strikes during 1919, 14 per cent resulted in victory for the workmen, 68 per cent were partly successful, and 18 per cent resulted in failures. Altogether over 20 per cent of the workers of Germany were on strike at one time or another during the year.

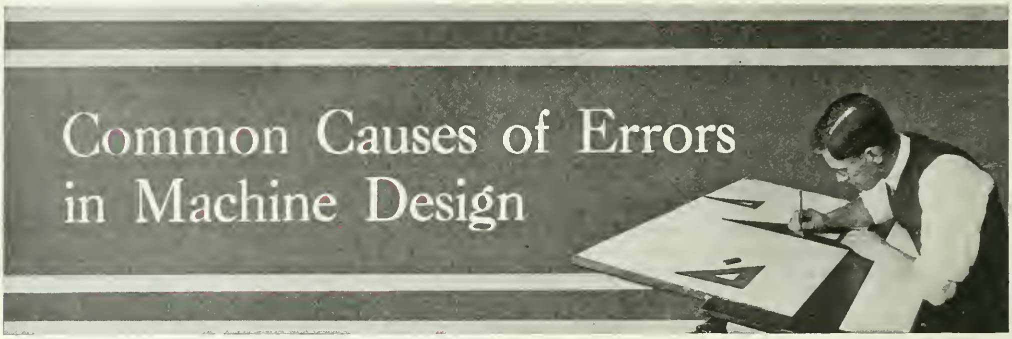
The official census distinguishes between political strikes and economic strikes. In 1919 the political strikes accounted for 12,900,000 lost working days as compared with 32,500,000 lost working days due to economic strikes. Strikes on the part of office workers for higher salaries resulted in nearly 2,000,000 lost working days.

German Foreign Trade

The German foreign trade for the first six months of 1920 assumed a considerable volume. Exports from Germany to the United Kingdom in the period mentioned were valued at nearly £12,000,000; to France at nearly £33,000,000; and to Belgium at over £13,000,000; while the exports to the United States were less than £7,500,000. The imports from the United Kingdom amounted to nearly £11,000,000; from France, over £16,000,000; from Belgium, nearly £23,000,000; and from the United States nearly £25,000,000.

* * *

A new customs tariff to prevent dumping and to protect new Japanese industries went into effect August 1, 1920, in Japan. Several changes were made in the tariffs relating to metal- and wood-working machinery, different tariff duties being imposed upon machinery according to its weight, the number of classifications being ten. Complete information as to the provisions of this new customs tariff inasfar as it affects metal-working machinery may be obtained from the foreign tariff division of the Bureau of Foreign and Domestic Commerce, Washington, D. C.



Common Causes of Errors in Machine Design

Basic Causes of Errors—Authority Affecting Design—Completeness of Information Required
First of a Series of Articles

By R. H. McMINN

WHEN a machine is designed and built by a manufacturer to fit certain prescribed conditions of space and capacity, with perhaps a few special features, but operating on the same general principle as machines previously built by this manufacturer, one or more errors are sometimes made by the drafting-room and become evident during the manufacture, assembly, shipping or operation of the machine. The following examples are cited to illustrate the kind of errors that are often made under such conditions:

1. Several cored holes in one casting are wrongly located due to incorrect dimensions. These must be plugged and new holes drilled.

2. One casting is a little too large to be machined by the largest planer in the shop. This casting could have been modified in design so the planer could handle it, if the necessity had been discovered in time, but it now must be sent to a jobbing shop for planing.

3. One part will not go in place during assembly without machining off a portion of a rib on another part.

4. Some structural material, which is a part of the machine, has been shop-riveted in its entirety, but in being loaded it is found to be too large in one direction to allow for proper clearance in shipping. The drawings failed to show that certain joints should have been field-riveted. The rivets in these joints must be cut off and the joints reriveted in the field.

5. One of the doors in the purchaser's building, through which the machine parts must be taken to the place of erection, is too narrow to admit the largest casting due to a projecting arm on the side of the casting. There is no reason why this arm could not have been bolted on instead of cast on. A portion of the wall at the side of the door must be cut away to allow the casting to pass through. The purchaser's building drawing showing the width of this door had been given to the manufacturer.

6. The state factory inspector notes that certain gears, comprising a part of the special added features, are not properly guarded. The manufacturer of the machine has to provide guards. Means could have been devised to attach them much more easily if the matter of providing guards had been given attention at the time the machine was being designed.

7. After operating the machine for several weeks an air cylinder with a piston having a leather cup packing will scarcely perform its function because of leakage past the piston. Examination shows that the leather cup is damaged due to working in a temperature too high for leather. This cylinder is on the back of the machine and comes very near one of the walls of a furnace, the heat from which has affected the leather. The location of the new machine in reference to this furnace had been indicated on the building drawing submitted by the purchaser to the manufacturer, but its significance had not been sufficiently considered. The manufacturer must now provide a piston with metallic rings.

There was nothing particularly new about the machine taken as an example. Its design involved no untried or unknown principles. Yet probably some concerns never made a new machine under the conditions described without encountering at least one error and sometimes many errors traceable to the engineering department. In some cases these errors are trivial and in others they are serious.

However, the degree of accuracy attained in comparison to the chances of error involved may not be low. Let us consider some of the chances of error in merely writing a bill of material for a bolt used on a machine. An error may be made in the type of head, diameter, length under head, kind of thread, length of thread, locking means, kind of material, and quantity of bolts needed. In a complicated casting there may be dozens of simple geometrical forms combined, involving the selection of their shape to perform certain functions, determination of their location for certain purposes, and their size for strength, wear, clearance, and other reasons. In addition to the actual considerations of correct design of such a casting, which involve scores of chances of error, is the matter of correct dimensioning which offers several score more chances on one complicated casting only. Any well filled 24- by 36-inch detail sheet offers from several hundred to a thousand chances for engineering department errors. A machine, such as a traveling crane, may have from ten to twenty or more such sheets. The first step in eliminating errors must lie, therefore, in a full recognition of the liability for their occurrence.

A succession of even comparatively minor errors discovered during the process of

The author of the series of articles on "Common Causes of Errors in Machine Design" has made a careful study of drafting-room errors, their underlying causes, and the reasons why designs are not always what they should be. Draftsmen as well as experienced designers will benefit by studying these fundamental causes, which have been analyzed and recorded after a long series of observations backed up by years of diversified experience. While all designers realize the importance of preventing errors as far as possible, it is not generally appreciated that these errors can be reduced to a minimum by making a study of the fundamental reasons for them and by systematically applying such methods as are likely to prevent the occurrence of common errors.

building a machine tends to disrupt the smooth running of both engineering department and shop. It is only by striving for the highest possible standards of accuracy that an engineering department can hope to avoid an error at some time which may cause loss of life or property. For an individual or a concern which is striving to eliminate errors, it is a good plan to attempt to find the basic cause underlying each error discovered, to classify all causes of errors found, to record the number of errors attributable to each cause, and to attempt to devise methods to reduce the number of future errors in each class. It is the intention of the author to present information that will enable such a procedure to be followed. The first step is to determine the basic causes of errors.

Basic Causes of Errors

A large number of errors that are frequently made are traceable to a few basic causes. A survey of some important facts that affect design with some suggested methods of procedure for draftsmen may help to guard against errors due to these causes. Following are some of the common causes of errors made in designing a machine or structure: Ignorance of the necessity for considering some factor that should partially determine design; changes in design half considered and incompletely made; too liberal use of memory; lack of concentration; reasoning too far from slight experience or knowledge; lack of systematic methods of applying full knowledge and experience.

A succession of even comparatively minor errors discovered during the process of building a machine tends to disrupt the smooth running of both engineering department and shop. Only by striving for the highest possible standards of accuracy can an engineering department hope to avoid serious errors. For an individual or a concern which is striving to eliminate errors, it is a good plan to attempt to find the basic cause underlying each error discovered, to classify all causes of errors found, to record the number of errors attributable to each cause, and to attempt to devise methods to reduce the number of errors in each class.

The following list gives some of the important factors which should be considered in the design of a machine. It is here assumed that it is an error to neglect not only those aspects of design that affect operating results but also commercial considerations. Each of these factors and its relation to the design of machinery in general, will be considered in this and subsequent articles in this series, the various subjects being dealt with according to the successive order in the following list. The present article deals with the first two points.

1. Authority affecting design of a machine
2. Completeness and accuracy of information
3. Physical and chemical laws affecting design
4. Functioning of parts
5. Speed and timing of relative motions of parts
6. Positiveness of action
7. Clearance between parts
8. Suitability of materials
9. Strength of parts
10. Durability
11. Adjustment
12. Simplicity
13. Accessibility of parts
14. Lost motion
15. Friction
16. Lubrication
17. Balancing parts
18. Manufacturing operations
19. Assembly
20. Erection
21. Disassembly
22. Transportation
23. Safety
24. Cost
25. Compactness
26. Appearance
27. Influence of working environment of a machine
28. Reaction of a machine on its environment
29. Correctness of drawings and bills of material

Authority Affecting Design of a Machine

One of the first things to be considered in designing a machine is any authority above the designer which places restrictions or imposes modifications on the design. There are a number of sources of authority which prevent a designer from using his own judgment about some features of design. The principal sources of such authority in this country are: (1) United States Government laws; (2) state laws; (3) municipal laws; (4) Fire Underwriters regulations; (5) purchaser's specifications; (6) special instructions of a superior; and (7) plant standards.

One authority which the National Government imposes upon the design of a machine is the Patent Laws. It is necessary for one to confine his designs to combinations that do not infringe on patents still in force. If a designer is working independently and is not thoroughly familiar himself with the state of the art in reference to the kind of machine he is designing, there is no way to tell whether the machine does infringe without a thorough search of patent records. An application for a patent will eliminate further chances of doubt regarding infringement, and an infringement search still others. In some cases the future alone will show whether a machine will be held to infringe a prior one, but the designer should at least make an earnest endeavor to avoid infringement. If he is working for a manufacturer, this responsibility rests partly upon the company. Up-to-date companies attempt to keep thoroughly posted on all patents affecting the line of manufacture in which they are engaged.

All boats of American registry must be approved by United States inspectors as to hull design, boilers, life-saving equipment, and other machinery affecting the safety of the ship and passengers. The design of railroad train brake-control apparatus, locomotives, car couplers, and some other car equipment is subject to the approval of the national government. It is probable that the design of airplanes and dirigibles will be brought under United States Government approval, since they will be engaged in interstate flying and their use is hazardous.

The various states exercise authority over some of the hazardous industries within their boundaries, such as in the construction of mines and factories and the design of certain machines used therein. Some of the laws affecting mine construction and machinery cover means of exit, drainage, ventilation requirements, boilers and accessories, hoisting equipment, signal systems, fire-fighting apparatus, and maximum voltage allowed. Factory laws may cover ventilation, sanitary provisions, fire protection, fire escapes, elevators, emergency stopping of power-driven machinery and the safeguarding of certain machines by special guards or restrictions as to location. In some states the laws are more rigid and place restrictions upon a larger number of kinds of industries and machines than in others, so that one should become familiar with the laws which affect a certain industry or machine in this respect, in the particular state under consideration.

A restriction, in effect, is placed upon the design of all buildings within a state (except sometimes those built by an owner for his own use) by requiring that the plans be supervised by a licensed architect or structural engineer who has passed an examination as to his capability. A licensed structural engineer must supervise the plans for other structures such as grain elevators, docks, bridges, blast furnaces, gas producers, reservoirs and dams.

The larger municipalities have ordinances governing the design of buildings or other structures within their city limits. The design of a building must not only be approved, but in many cases certain types are confined to certain prescribed fire zones. Allowable unit stresses are definitely established and restrictions cover practically all elements entering into a building, including heating systems, plumbing, and electric wiring. Cities also have laws governing design of boilers, elevators, tanks or piping under pressure, and all electric transmission systems outside of buildings. Since the laws of the various cities are not uniform, it is necessary to know the ordinances governing the design of any building or equipment of the classes mentioned, which is to be erected or used in a particular city. If any other kind of equipment or machine the use of which involves possible dangers to life or property is being built for use in a certain city, it is well to see if there are ordinances restricting its design.

Fire Underwriters' Regulations

The fire insurance companies have adopted as their regulations and requirements the recommendations of the National Fire Protection Association, whose membership is composed of representatives of fire insurance companies and various engineering societies in the United States. Any building, street-car, boat, or other structure carrying fire insurance should conform, in its design and in the design of any equipment used therein, to the regulations of the fire insurance companies in order to obtain insurance at the lowest possible rate. If these rules are ignored, a higher rate will be placed upon the structure than would otherwise be imposed, or if there is a radical departure from the rules, a continuation of insurance may be refused.

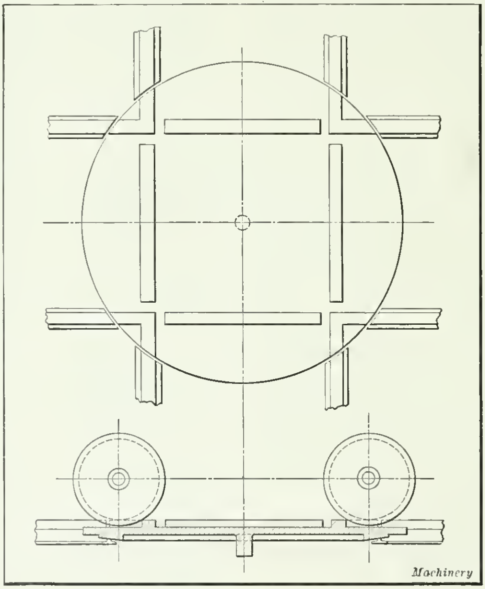


Fig. 1. Diagram of Industrial Truck and Turntable, illustrating Error in Purchaser's Specifications

The National Board of Fire Underwriters has issued a large number of pamphlets containing regulations on the design and installation of equipment affecting fire hazards. The best known of these is probably the "National Electric Code," which relates to electric wiring and equipment. Other pamphlets contain regulations for standard mill type construction of buildings; skylights; protection of openings in walls and partitions against fire, including the design of shutters and doors and protection of openings for passage of driving belts or shafts; oxy-acetylene heating and welding apparatus; acetylene gas machines; kerosene oil pressure systems; gasoline lighting systems and equipment; fuel oil storage and burning equipment; containers for storing and handling of hazardous liquids; storage and handling of nitro-cellulose motion picture films; construction and installation of dip tanks containing inflammable liquids; stationary internal combustion engines and coal gas producers; and blower systems for heating and ventilating or for conveying stock or refuse material. Still others relate to the approved design of strictly fire protective equipment, such as vaults, gravity and pressure water tanks, standpipe and hose systems, gas shut-off valves, sprinkler equipment, alarm systems, fire pumps, hydrants, valves, and hose fittings. The National Board of Fire Underwriters states that any new materials or equipment affecting fire hazards or for fire protective uses should be submitted to the Underwriters Laboratories, located at Chicago, for examination and test before being introduced for use.

Purchaser's Specifications

When a purchaser orders a machine for a certain purpose, which is to have a specified output, he may radically affect the design of the machine the manufacturer would normally build for the output required, by demanding certain modifications in accordance with his own ideas or to suit certain special conditions. It is necessary to watch such instructions carefully. If they conflict with any higher authority or appear impracticable, the purchaser's consent must be obtained before deviating from them.

Sometimes a purchaser orders a machine which is to be a duplicate of one previously ordered. If the manufacturer has made improvements in the design of this machine since it was sold to the purchaser, the purchaser's consent should be obtained to embody the improvements in the new machine. If the improved machine is not identical in manner of operation with the old one, or if separate sets of emergency repairs would have to be carried in stock by the purchaser, he may prefer an exact duplicate of his first machine. This is especially true if the purchaser was entirely satisfied with the performance of the original machine.

Special Instructions and Plant Standards

The design of a machine must always be in accordance with any special instructions given by the designer's superiors. If these instructions are contrary to any of the authorities previously mentioned, this should be pointed out by the designer. If the carrying out of any of the instructions would conflict with recognized good practice or the designer's experience, it is his privilege and duty to make this known to his immediate superior. Not only must the definite instructions relating to any particular design be followed, but most plants have certain standard patterns, parts, and methods, which must be used, unless it is impossible to utilize them in a special design, or unless their use conflicts with a higher authority.

Completeness and Accuracy of Information Required

An important part of engineering work consists in the gathering, interpreting, distributing and acting upon information relating to the job at hand. Designers and draftsmen must learn to act only upon the best obtainable evidence. The best evidence as to how a machine or part must be made is that shown by a specification, letter, or drawing submitted or approved by a purchaser as indicating his requirements. The best evidence of how a machine or part has been or will be made by a manufacturer is the drawing which has been or will be used to make it. This assumes that the shop is not permitted to deviate from drawings without the consent of the engineering department, and that when a change is decided upon that the necessary drawings are immediately corrected.

Correspondence from Purchaser

The design for a machine is often based upon the specifications or drawings submitted by a purchaser to a manufacturer, indicating special features or dimensions desired on a type of machine made by that manufacturer. From these the manufacturer may prepare more detailed specifications, and possibly a preliminary drawing, outlining what he expects to furnish if he receives the order. Frequently a voluminous correspondence is carried on after the placing of an order for a machine and even during the process of design.

Statements and dimensions given in some of these letters may annul or amend portions of the original specifications. Revised blueprints may also be sent in by the purchaser to supersede former blueprints submitted to the manufacturer. While a digest of the information definitely relating to design could be made from the correspondence as it comes in and be given to the man working on the design of the machine, this admits the possible error of failing to transmit to the designer some necessary information. The best plan is to have all correspondence relating to the order for a new machine bound together and submitted to the designer or draftsman who is to work up the drawings. It is important that all oral instructions given by the purchaser should be confirmed in writing.

When Purchaser's Specifications are not Complete

All correspondence must be carefully read by the designer, and notes made of information affecting the design of the machine. If there are any discrepancies in statements made or dimensions given, it is necessary to take up with the purchaser which ones shall be taken as correct. Failure of the purchaser to give information about some feature or dimension that usually is given by purchasers of that particular kind of machine does not justify the assumption that the point left open may be settled by the manufacturer. If a purchaser ordered a foundry cupola and failed to give the distance from the ground line to the bottom of the charging door, the manufacturer is not justified in locating the door at a distance above the ground which is average for the size cupola ordered. The question of this height is related to the particular foundry where the cupola is to be installed, and this distance must be specified by the purchaser.

When Purchaser's Specifications are Evidently Incorrect

If a designer should believe from all the information in his possession that the machine as definitely specified by the purchaser will not be suitable for the latter's requirements, he should call the attention of a superior to the apparent difficulty. Let us say that a number of small industrial trucks of a certain size, wheel-base, and track gage are ordered, together with some turntables of a certain diameter and the same track gage as the trucks, and that examination shows that the wheels will extend over the ends of the track on the turntable when the truck is centrally located, as shown in Fig. 1, and thereby interfere with the rotation of the turntable. Even though the order may not specifically state that they are to be used together, it is presumable that they are so intended, and the designer should call the circumstances to the attention of a superior so the purchaser can be notified of this possible discrepancy. It is probable that if the turntables are made as ordered and are intended to handle the trucks, the manufacturer will be censured for not noticing the difficulty, and will be asked to take back the turntables or the trucks (whichever will inconvenience the purchaser the least) even though they have been made specially to his order. It is not always good business policy to go into the legal phases of such requests, and therefore the designer should use all the information he possesses regarding the particular conditions that may influence acceptable designs, so as to determine whether a machine as ordered and specified will be satisfactory to the purchaser.

Reference to Previous Designs

If there are points in design that should be settled by the designer's superiors these should, in so far as possible, be decided upon before the drawings are started. Not only must up-to-date drawings be selected for reference, but any particular drawing, part, or dimension must be positively identified as being the one wanted before it is used. Probably more errors result from improper identification than from wrong reasoning. One may select the wrong drawing, if there are two machines alike save in size; the wrong part, if there are two parts on a machine somewhat similar in appearance; or the wrong dimension if there are two near each other that do not differ greatly. The exact dimension line and dimension that designates the distance between the holes, surfaces or parts under consideration must be positively identified. Looking up a dimension may be done almost automatically, and yet a rigid check should be kept on one's work by constant and critical attention to each step.

Checking Specifications

When the design of a machine is complete, the designer should again read in full all information submitted by the purchaser relating to the machine, in order to see if all requirements have been embodied in the drawings. It is possible that some of the statements made in the correspondence will have a clearer significance, since the designer will now be thoroughly familiar with the machine, and he will frequently discover by this second reading that some of the specifications have not yet been properly complied with, due to oversight or misinterpretation at the first reading.

It may happen that a letter or blueprint sent by the purchaser specifying certain changes may not reach the manufacturer. In such circumstances the failure to acknowledge it would, in most cases, cause the purchaser to ask for an acknowledgment, and thus its non-receipt would become evident. But, the purchaser might fail to notice that a letter or revised blueprint was unacknowledged; or one might be received by the manufacturer, which was acknowledged, but was not properly transmitted to the designer, and hence an important modification might be overlooked. In order to avoid errors due to such circumstances or possible misinterpretation of any data submitted by the purchaser, and in order that he may have the fullest possible understanding as to just what will be furnished, it is the best plan to submit to the purchaser a revised set of specifications in conformance with all the changes made in the correspondence, together with a set of blueprints showing the machine as it will actually be made. These specifications and blueprints, properly approved by the purchaser, form the best authority that can be obtained as to what will be acceptable in a machine that must be built specially.

Subsequent articles in this series will deal with further important factors in the design of a machine, among which are physical and chemical laws affecting design, functioning of parts, timing of relative motions, clearance between parts, suitability of material, strength of parts, durability, and many other points that must be carefully considered to avoid errors in the completed mechanism.

* * *

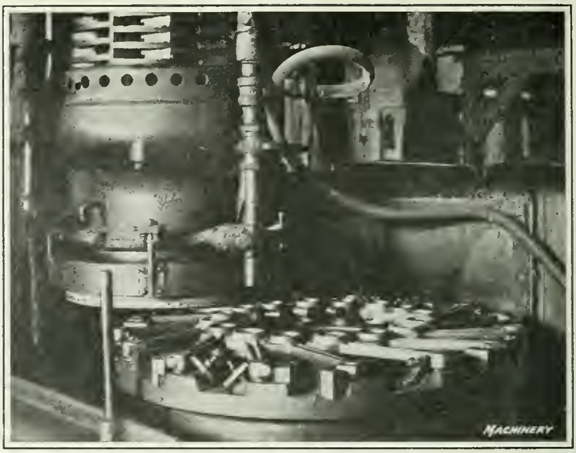
REMARKABLE SAFETY RECORD

A remarkable record for safety of machine shop operation has been made by the Geuder, Paeschke & Frey Co., Milwaukee, Wis., and in view of the efforts made everywhere to reduce accidents in the industries, some details relating to the accomplishment of this company will prove of interest. In the company's sheet-metal working plant, 50 punch presses were run 104 continuous days with no accidents, and 800 machines of various kinds were employed in the other departments of the company for 90 consecutive days with but two accidents. These results were accomplished by making the foreman the backbone of the safety organization, and in this way the company obtained not only safe production but maximum production at the same time. Every foreman accepted full responsibility for his department. One of the fundamental means for the reduction of accidents, the foremen say, was the careful instruction of new employes. Special attention was also given to providing proper mechanical safeguards wherever these could be advantageously applied. The management of the plant is convinced that it has demonstrated the possibility of running punch presses without accidents; that a factory endowed with the spirit of preventing accidents can do so; and that increased production and safety can go hand in hand.

Making Connecting-rods for Franklin Cars

Machines and Fixtures Used at the Plant of the H. H. Franklin Mfg. Co., Syracuse, New York, for Drilling, Boring, Milling, Grinding, Reaming, and Gaging Operations

By FRANKLIN D. JONES



THE connecting-rods used in motors of Franklin cars undergo an interesting series of operations requiring the use of special machines and fixtures designed to insure extreme accuracy of size and alignment. These connecting-rods, which are made of nickel steel drop-forgings, first pass through certain preliminary operations such as annealing, inspection, sand-blasting, straightening (if necessary), heat-treating, and Brinell testing for hardness. The rough drop-forgings are annealed in mica, a temperature varying from 1400 to 1500 degrees F. being maintained for at least two hours. The forgings are then placed between flat dies under a drop-hammer and straightened if necessary. A second heat-treatment, which occurs before the first machining operation, consists in heating to from 1475 to 1525 degrees F., quenching in oil, and then drawing at a temperature of from 900 to 950 degrees F.

Grinding Faces of Connecting-rod Ends or Hubs

The forgings, after this heat-treatment, are ready for the first machining operation, which consists of grinding the faces of the large and small ends first on one side and then on the other. This is done on a Blanchard grinder. The fixture used (see the heading illustration) holds sixteen forgings at a time. The large ends fit over plugs, which are attached to the fixture and have radial clamping pins that are forced outward by a conical headed screw in the center of the plug. On this fixture there are eight locating surfaces for rough forgings, which alternate with eight locating surfaces for forgings ground on one side. The latter surfaces are higher than those used for the rough forgings, in order to allow for the amount that is ground off one side. When the operation is first started, only eight forgings are placed on the fixture; after these have been ground on one side, they are turned over and transferred to the positions having the higher locating surfaces. The eight vacant places thus left on the fixture are filled with rough forgings, so that the fixture is fully loaded. From now on the faces of sixteen forgings are ground on one side simultaneously. With this arrangement eight forgings that have been ground on both sides are removed from the fixture after each grinding, and those which have only one side ground are turned over to the finishing positions of the fixture and are replaced with eight rough forgings. As these finishing positions are high enough to compensate for the amount ground from one side, all the rough surfaces that are in the upper or grinding position are practically in alignment. The grinding wheel is located vertically by means of stops, for grinding the sides of the large and small ends of the forgings which are not on the same level. The total amount ground from the forgings is approximately 1/16 inch, and the limit for width is 0.003 inch. The time allowed for this operation is two minutes for each forging.

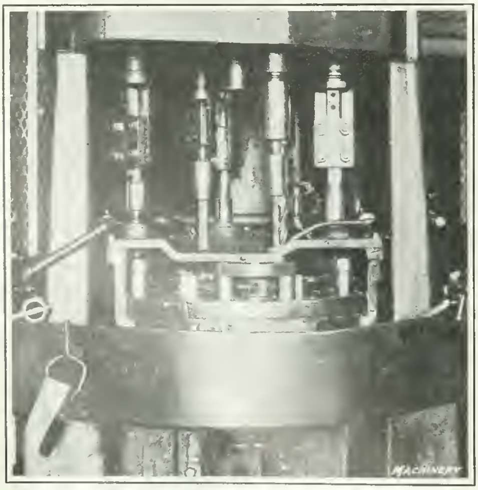


Fig. 1. Semi-automatic Machine of Special Design for drilling and boring Connecting-rods

Drilling, Boring, and Reaming Connecting-rod Forgings

The semi-automatic machine used for drilling, boring, and reaming the large and small ends of the connecting-rod forgings is illustrated in Fig. 1. The large end is finished in this machine to a diameter of 1⅞ inches, but the hole in the small end is left from 0.007 to 0.010 inch under size to allow for a final grinding operation. The special machine used is of the station type and has three working positions with a loading position in front. The large ends of the forgings are centrally located by cupped screw bushings, and the table feeds upward automatically, motion being derived from a cam at the lower end of the table slide. The indexing movement of the table is controlled by hand, the table being located in the different positions by a plunger operated by a small hand-lever.

The special fixture used for drilling the bolt holes in the small ends is shown in Fig. 2. This fixture, which is used in conjunction with a multiple-spindle drilling machine, holds sixteen connecting-rods, twelve being in the three drilling positions and four in the loading position. The machine is equipped with four tap drills for ⅜-inch bolts, and eight

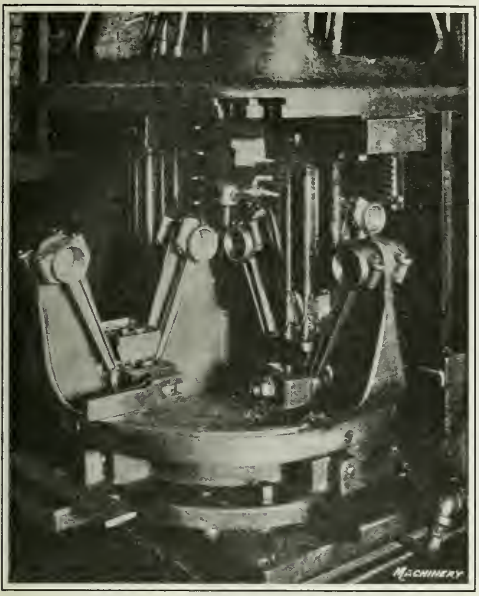


Fig. 2. Drilling Bolt Holes in Small Ends of Connecting-rods

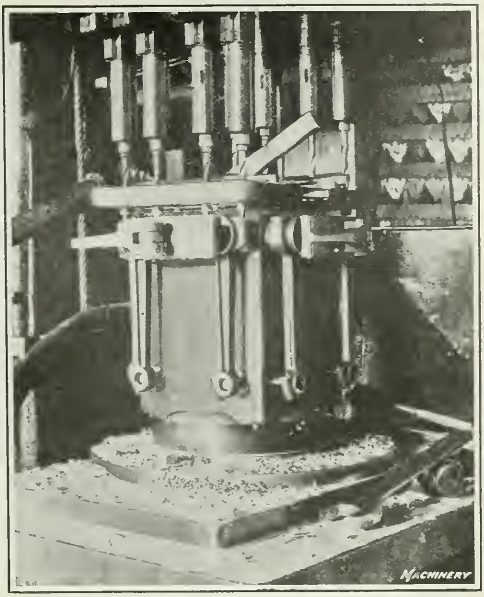


Fig. 3. Drilling Stud Holes in Large Ends of Connecting-rods

drills large enough to provide clearance for the body of the bolt. By having two groups of body drills operating at two different stations, the drilling of this part of the hole can be divided, which is desirable, since the clearance hole is longer than the part to be tapped. The large and small ends of the rods are located by plugs, and the small ends are clamped by straps. The base of the fixture has four equally spaced holes that are engaged by an index-plunger (not shown) for locking the fixture in the four drilling positions. Incidentally, the bolts which enter these holes in the connecting-rods are used for locking the wrist-pin by compressing the end which is afterward split. The idea of allowing the wrist-pin to oscillate in the piston is to obtain a larger bearing surface.

Another drilling operation on connecting-rods is shown in Fig. 3. This machine is equipped with eight drills and another fixture of the station type. There are four tap drills on one side and four larger clearance drills on the other. The holes produced in this operation are for the two studs which are used to hold the cap in place after the latter has been cut off, as explained later. The hand-lever seen at the top of the fixture operates the index-plunger for locating the fixture in the different positions. It will be noted that two rods are clamped at the large end by a single strap, which is tightened by simply pulling forward a lever having eccentric surfaces. This eccentric-lever method of clamping has been applied extensively to fixtures in the Franklin plant, as it provides a simple and rapid method of clamping parts for machining, as well as an effective means of holding them securely.

Special Attachment and Fixture for Milling Connecting-rods

The wrist-pin ends of the connecting-rods are split on one side and the caps are cut almost off by means of the special milling attachment and fixture shown in Fig. 4. The faces against which the bolt heads bear at the small ends and the nuts bear at the large ends are also milled at the same time. A gang of six cutters is used for this operation. The gang of four cutters at the left consists of two slitting saws, which mill ⅛-inch slots to within 1/64 inch of the bore at the large end, and two cutters in the center, which mill the faces for the nuts at the same time that the slots are being milled. At the opposite end there is a slitting saw and a cutter for facing the spots for the bolt head. After the forgings on the right-hand side of the fixture (as seen in this illustration) are milled, they are turned over and placed on the left-hand side in order to complete the slot-milling and spot-facing operation. The work-holding part of the fixture is supported by trunnions at the ends, and it is provided with an index-plate and plunger for locating purposes. While one lot of forgings is being milled, the operator unloads and loads the fixture. The two cutters that operate on the small end are driven from the main spindle through spur gearing and a shaft above the main arbor, which transmits motion through bevel gearing to the cutters mounted on the inclined arbor.

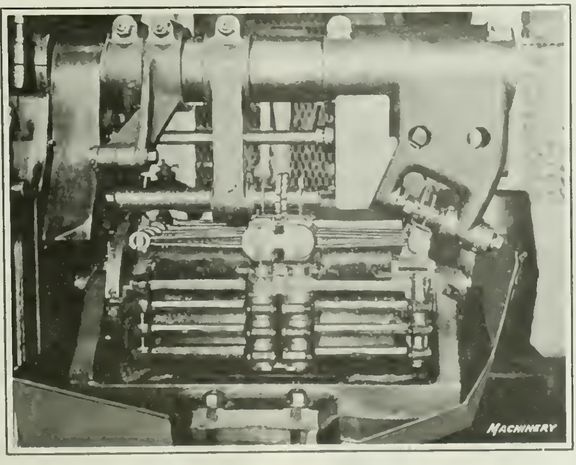


Fig. 4. Fixture and Special Milling Attachment for facing and slotting Large and Small Ends of Connecting-rods

The bolt and stud holes are next tapped on a commercial tapping machine and other minor operations performed, such as chamfering the inside edges of the large holes and removing all burrs from the outside of the rod. The caps are then severed from the main part of the rod by using a foot press equipped with a plug which enters the large hole and a shear blade which comes down and removes the thin section left by the slot-milling operation described in the foregoing.

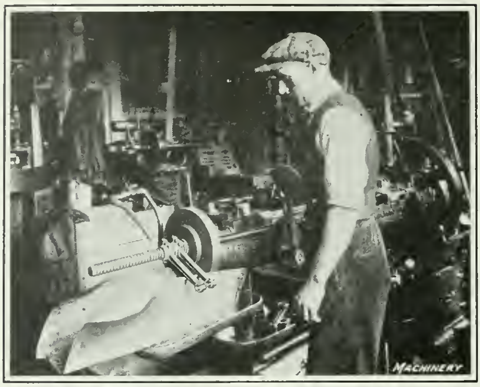


Fig. 5. Broaching the Main Bearings after Linings are in Place

Assembling Connecting-rod and Cap

After a preliminary inspection, the die-cast bearings are placed in position in the rod and cap, and the inner faces of the rod and cap joints are milled. After chamfering the stud and bolt holes, the studs are driven into the large end of the connecting-rod, an Errington stud-driver being used for this purpose. The cap and rod are then assembled, and the studs are locked by drilling pin-holes and driving in small pins which are riveted over.

Finishing the Bearing Surfaces

The first operation on the babbitt bearing surfaces is performed on a broaching machine. Two connecting-rods are broached at a time as illustrated in Fig. 5. These bearings are next accurately finished by reaming, as illustrated in Fig. 6. The small end of the rod is located by an accurately fitting plug. The large end is centrally located in the reaming fixture by another plug which is inserted temporarily through a bushing which is of the screw type and clamps this end of the connecting-rod for the reaming operation. The reamer used removes about 0.010 inch, and the teeth are without clearance so that the babbitt lining is finished very smoothly. The center-to-center distance between the large and small holes is held within a limit of 0.002 inch. This is not the final operation on the large end of the bearing, but it provides an accurate hole for locating the work while grinding the wrist-pin to size, as illustrated in Fig. 7. A Bryant chucking grinder is used for the latter operation. The work is located on the faceplate by pushing the large end over a close-fitting plug, after which an aligning plug is inserted in the small end and the latter is then held securely by means of the two clamps shown.

The final operation on the large end is illustrated in Fig. 8, which shows a special boring fixture designed for very accurate work. Before the connecting-rods are sent to this machine they are weighed so that the six rods which are used for any motor will weigh the same within close limits. While the variation in weight is not very great, this weighing of the rods in order to secure greater uniformity insures a more perfect balance, especially when the motor is operating at high speeds.

The reason for using the special boring fixture shown in Fig. 8 for taking a very light finishing cut with a single-pointed tool is to provide for fitting each rod as accurately as possible to the particular crankpin on which it is to operate. The general procedure is to first measure with a micrometer and then record the exact size of each crankpin on the crankshaft. The machine is equipped with five boring-bars varying 0.0005 inch in size, so that a bar can be selected for finishing each connecting-rod to exactly the diameter required.

The work is set up in the machine by first inserting through the wrist-pin hole an accurately fitting arbor *A*, which is supported in bearings at the ends. These bearings are carried by counterweighted slide *B*, which permits the

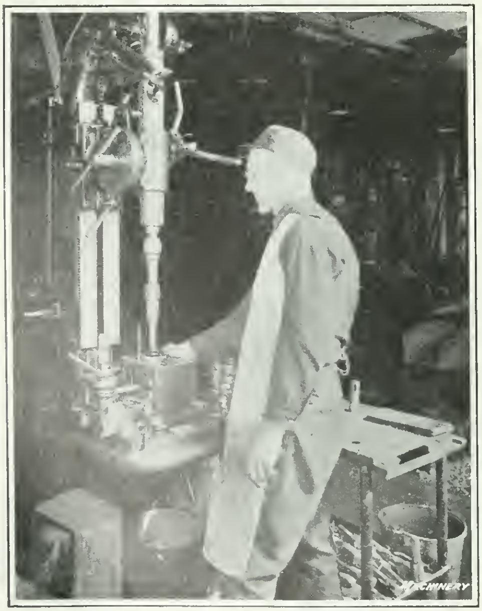


Fig. 6. Reaming Operation on Main Bearings

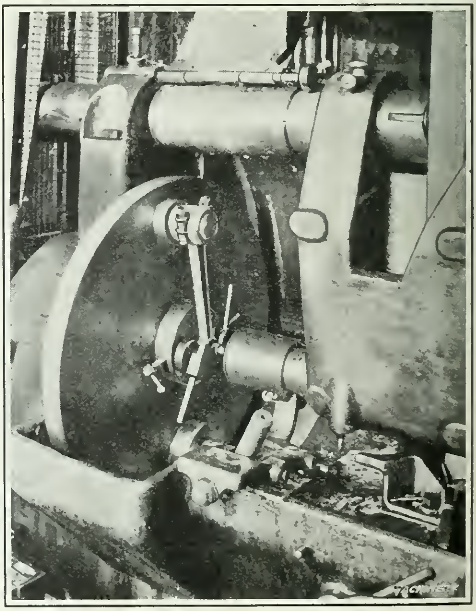


Fig. 7. Finishing Wrist-pin Hole by grinding

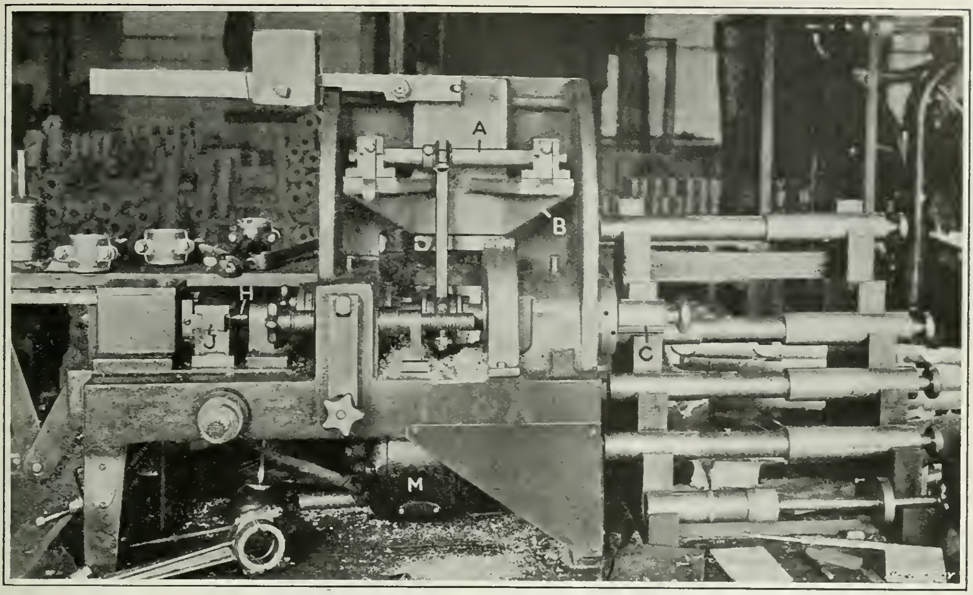


Fig. 8. Special Machine used for finishing Main Bearings of Connecting-rods

rod to be raised or lowered so that it can be accurately centered with the machine spindle, which is done by inserting a centering plug before placing the boring-bar *C* in position. The clamp used at the lower end of the rod is illustrated in Fig. 11, which is a sectional view in a horizontal plane. When nut *A* is turned, the clamping jaws *B* and *C* grip the connecting-rod *D*, but do not tend to force it out of alignment because the body *E* of the clamp is free to slide in bearing *F* and no unbalanced lateral pressure is exerted on the connecting-rod. After nut *A* has been tightened, the entire clamp is held in position by turning lock-nut *G*. The machine is driven by a small motor *M* (Fig. 8) beneath the bed, which is connected with a spindle through spur gearing. The feeding movement of the spindle is derived from a feed-screw *H* of fine pitch, which is connected with the end of the boring-bar and pulls the boring-bar forward whenever the feed-nuts or jaws *J* are thrown into mesh with the feed-screw through the operation of a foot-treadle.

Testing Accuracy of Connecting-rods

The method of testing the parallelism of the wrist-pin and crank-pin holes in the connecting-rod is illustrated in Figs. 9 and 10. Before making this test, the four dial gages on the fixture are adjusted by means of a master gage, which is placed in the fixture as shown in Fig. 9. This master gage has parallel plugs at each end. The two lower dial gages are set to zero, when they are in contact with the master gage as shown in the illustration. This master gage, which is supported by V-blocks at the inner end, is next swung upward to a vertical position so that the smaller plug is in contact with the upper dial gages, which are also set at zero.

The connecting-rod to be tested has plugs inserted through the large and small holes. These plugs are made to fit snugly by means of expanding bushings. The test is made by placing the connecting-rod and its plugs in the fixture in the same position as is occupied by the master gage. The plug through the large end rests in the V-blocks, and the plug

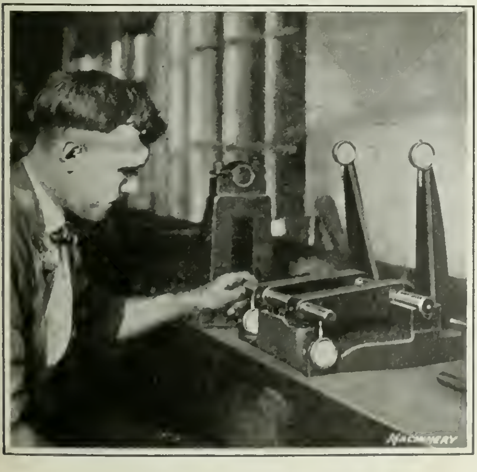


Fig. 9. Adjusting the Fixture used for testing Parallelism of Connecting-rod Bearings

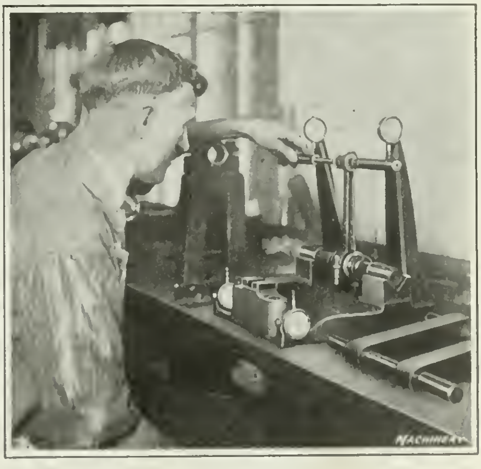


Fig. 10. Method of testing Parallelism of Connecting-rod Bearings in Fixture shown in Fig. 9

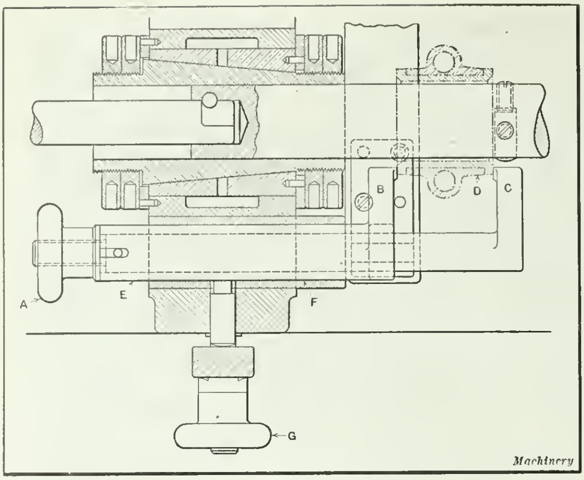


Fig. 11. Floating Clamp used on Machine shown in Fig. 8 to prevent springing Connecting-rods

through the small end is brought into contact with the two sets of dial gages, by placing the work in both vertical and horizontal positions. In this way the parallelism is tested in two planes, 90 degrees apart, and the test is a very severe one as there is a distance of 10 inches between the dial gages. A limit of 0.010 inch is allowed for the upper gages, and 0.005 inch for the lower gages, which means a very close limit in the length of the bearing itself. This gage also tests the alignment of the sides or faces at each end of the rod.

* * *

EFFECT OF RADIAL PLAY

In an article in *Mechanical Engineering*, Roland W. Sellew, research engineer of the Fafnir Bearing Co., New Britain, Conn., states that tests have recently been made by this company to determine the effect of radial play on the life of ball bearings. By radial play is meant the amount of shake or looseness between the inner and outer rings in a direction at right angles to the bore. This play is measured after the bearing is completely assembled ready for shipment, by the use of a special gage. Most users of ball bearings demand that the radial play be very small, some specifying that it shall not exceed 0.001 inch. They consider it sufficient that a bearing should run freely before being mounted and that no perceptible play exist. At first one would believe that the less play the better, as long as the bearing is free to turn. One must consider, however, that the examination or inspection of ball bearings is made before mounting and that the mountings call for a drive fit of the inner ring over the shaft, and sometimes the outer ring is also forced into its housing. Several tests were made to determine what effect this forcing of the bearings into place had. It was found that the inner rings expanded from 0.0003 to 0.0004 inch, and the outer rings contracted from 0.0002 to 0.0003 inch, these measurements being made when press fits were used.

These facts make it apparent that the radial play must be considered after the bearing has been mounted. It is of course impossible in most installations to measure radial play after the bearing is mounted, but it is quite possible to measure the expansion and contraction of the inner and outer rings. When an average value has been established for these two items, the problem is simplified. For instance, consider a bearing having a play of 0.0005 inch before mounting, and a mounting that causes an expansion of 0.0002 inch of the inner ring and a contraction of 0.0001 inch of the outer ring. The radial play after mounting will be the sum of the expansion plus the contraction (0.0001 + 0.0002 = 0.0003) subtracted from the play before mounting (0.0005 — 0.0003 = 0.0002). Hence the radial play after mounting is very different from that in the unmounted bearing.

It is quite evident that under certain conditions the bearing may be loose enough to turn easily before mounting and may be entirely too tight afterward. In order to determine whether or not a tight bearing wears out faster than a loose one a series of tests was made, the results of which are tabulated below. It must be remembered that the radial play of these test bearings was measured before mounting in the test block. The test mounting reduced the play in each case by about 0.0002 inch.

Bearing No.	Radial Play, Inches		Hours Run	Remarks
	Before Mounting	After Mounting		
1........	0.0000	Cramped	347	Failed at this time
2........	0.0000	Cramped	477	
3........	0.0002	0.0000	323	
4........	0.0002	0.0000	477	
5........	0.0004	0.0002	571	No signs of failure
6........	0.0008	0.0006	803	
7........	0.0012	0.0010	571	
8........	0.0012	0.0010	585	

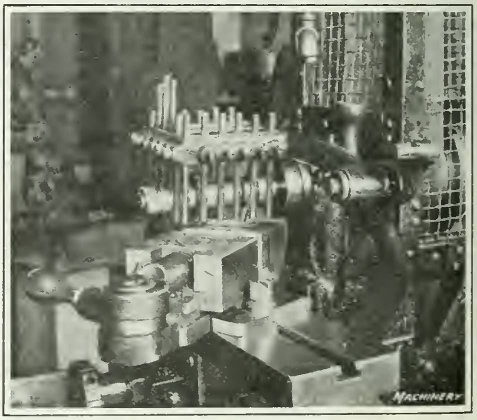
These results indicate that the play should be at least 0.0005 inch after mounting. The necessary play before mounting must be determined for each condition of installation. This must be done by the user under average conditions as he finds them.

In conclusion, it may be well to point out that there is a slight variation of play in all bearings. This is due to the fact that a slight tolerance or variation must be permitted to make bearing manufacture commercially possible. This variation in radial play is usually about 0.0005 inch but for large bearings may exceed this.

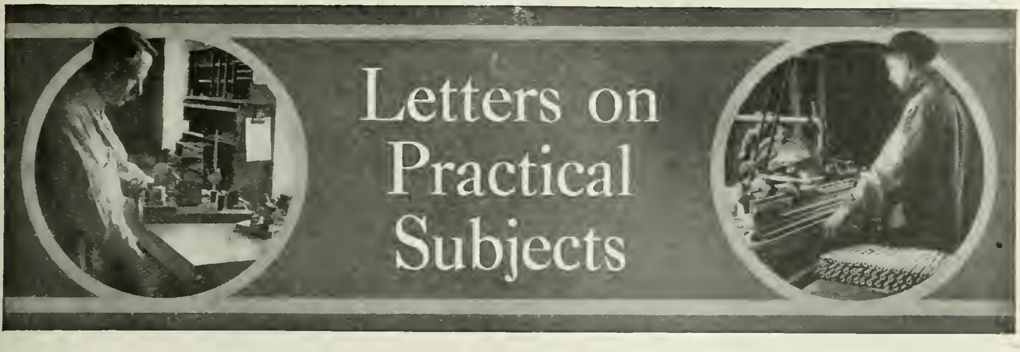
* * *

CUTTER GUARD FOR HAND MILLING MACHINE

At the Smith Premier Works of the Remington Typewriter Co., at Syracuse, N. Y., hand milling machines are used for certain short milling operations on typewriter parts. A simple but effective cutter guard designed by Joseph Holden, works manager, is shown in the accompanying illustration. This guard is in the form of an arm, which is pivoted at one end and has at the other end a cage surrounding the cutter, the cage being formed of vertical rods held in a frame by cap-screws. These rods can be adjusted for clearing any part, and when the cutter is not revolving the guard can be swung back out of the way, a stop being provided for holding the guard in a convenient position.



Adjustable Type of Cutter Guard for Hand Milling Machines



Letters on Practical Subjects

UNUSUAL METHOD OF HANDLING DRILL JIG

An unusual purpose for which a Wiard chuck is being used in an automobile plant is to assist in placing a heavy jig on work and in removing it upon the completion of an operation. The jig is shown in Fig. 1 at *A*, in place for drilling holes in the bottom of a cylinder casting. In designing this jig, the problem of lifting it on and off a casting gave considerable trouble owing to its weight. Finally the scheme described in the following was thought of, with the result that the handling of the jig is accomplished without difficulty.

A Wiard chuck holds the drills used in the operation, and stud *B*, having the same dimensions as the collets used for holding drills in this chuck, is placed at the center of gravity of the jig. This stud has a groove in which the rollers of the chuck are placed by means of the sliding sleeve used to obtain their movement, so that when the spindle of the machine is raised, after the stud and rollers have become so engaged, the jig is lifted with it. The completed work can then be removed from the bed and an unfinished casting substituted, after which the jig is lowered on the new casting, the rollers released from the stud groove, the spindle lifted, and a drill inserted in the chuck for the performance of the next operation.

Fig. 2 shows the jig in a position several inches above a cylinder casting mounted on the machine bed. The groove in the lifting stud permits the jig to be swiveled about the machine spindle. In order to clearly understand the method of locking the lifting stud in the chuck, it is essential for the reader to have a knowledge of the construction of the chuck under discussion.

Detroit, Mich. JOSEPH LANNEN

MECHANICAL MOVEMENT OF NOVEL DESIGN

The accompanying diagrams illustrate an unusual mechanical movement employed on a machine which manufactures flat steel heddles used in weaving cloth. Referring to Fig. 1, the problem encountered by the designer was as follows: The grooved end of lever *A*, which is carried on shaft *B*, was required to travel from *C* to *D*, a distance of 10 inches. In its travel, lever *A* must completely reverse its position, and it must be so guided during the last half inch of its travel that the groove in the end will pass over a wire carried at the height of center line *XY*. As lever *A* is only 3¾ inches long, a half revolution of shaft *B*, on its center, would cause lever *A* to fall 2½ inches short of the required distance. To overcome this difficulty, shaft *B* is made to travel, in addition to reversing its position.

This is accomplished by means of a pinion *E*, Fig. 4, which is keyed to shaft *B*. This pinion meshes with a gear segment *F*, carried on lever *G*. Lever *G* is carried on shaft *H*, but does not turn with it, being normally held in the position indicated in Fig. 1 by a heavy spring *I*. Lever *J* is keyed to shaft *H* and carries shaft *B* at its upper end. Shaft *H* is given a partial revolution, receiving its motion from a cam

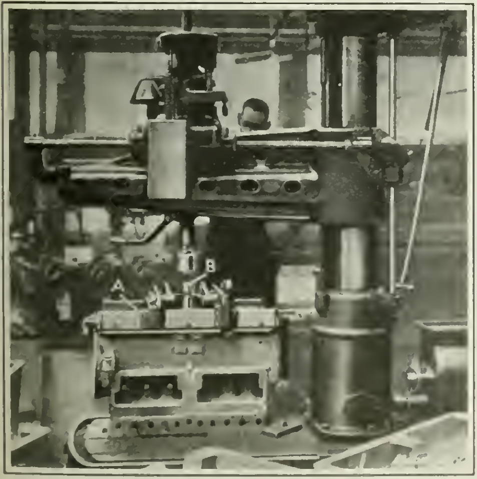


Fig. 1. Wiard Chuck in Use on Radial Drilling Machine to facilitate the Handling of a Drill Jig

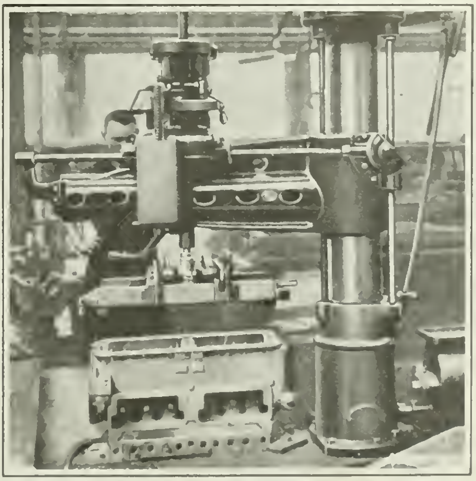


Fig. 2. Jig held by Chuck Several Inches above Finished Work to permit it to be replaced by an Unfinished Casting

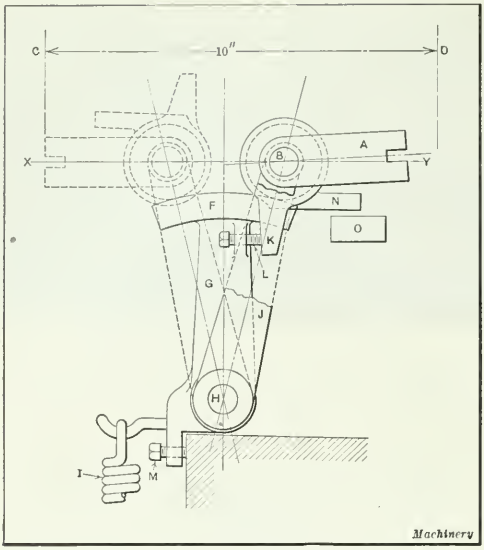


Fig. 1. Diagrammatic View of Unusual Mechanical Movement

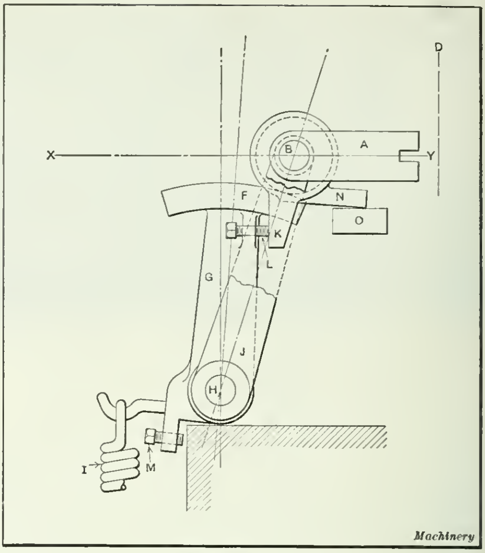


Fig. 2. Lever A in Position resulting from Initial Movement of G

at the back of the machine. This causes lever *J* to oscillate, and the forward motion of shaft *B* causes pinion *E* to rotate, tending to reverse lever *A* from the position indicated by the dotted lines to that indicated by the full lines in Fig. 1. Before lever *A* has completely reversed its position, the stop *K*, which is keyed to shaft *B*, comes in contact with set-screw *L*, which is carried on a lug on lever *G*. Lever *J* is partly broken away in Fig. 1 for clearness. The cam follower, however, has not reached its highest point when the stop comes in contact with the set-screw, and so causes a further rotation of shaft *H*. The continued motion of lever *J* tends to rotate shaft *B* further, but as this is prevented by stop *K*, the lever *G*, carrying segment *F*, is forced to oscillate with lever *J*. This is shown in Fig. 2, in which it will be seen that the set-screw *M* is lifted away from the bed of the machine.

In Fig. 1, the stop *N* is slightly above the bar *O;* while in Fig. 2, stop *N* has moved forward and lowered, until its end is in contact with *O*. This is caused by the oscillation of lever *G*. The slotted end of lever *A* is now one-half inch from its desired position and has completely reversed its position. Continued movement of levers *G* and *J* cause stop *N* to lower at the back until, at the end of the stroke, stop *N* rests flat on bar *O*, as shown in Fig. 3. From this illustration it will be seen that lever *A* is lower at the back end, though the center of the groove in the outer end of lever *A* has moved in a line parallel with the base of the machine, which is the essential point.

It should not be assumed that the entire lever *A* must travel in a straight line, as this is not necessary. The height of the wire which the slot is required to pass over never varies above or below the center line *XY*, though it may vary from line *D*. For this reason, the groove in the end of lever *A* must be in position to pass over the wire at any point in the last half inch of its travel. Fig. 4 is a front view showing the arrangement of the parts. The stop *N* cannot be

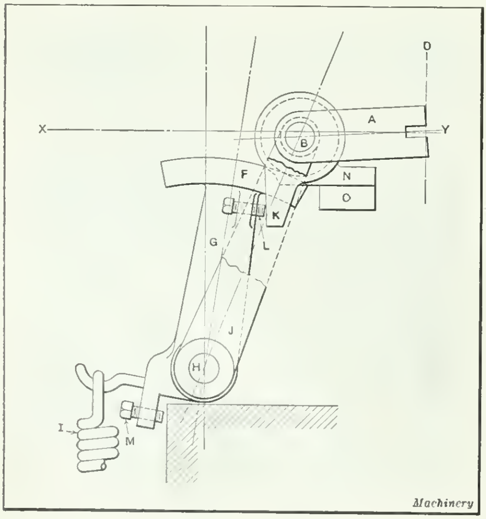


Fig. 3. Lever A at Extreme Right-hand Position

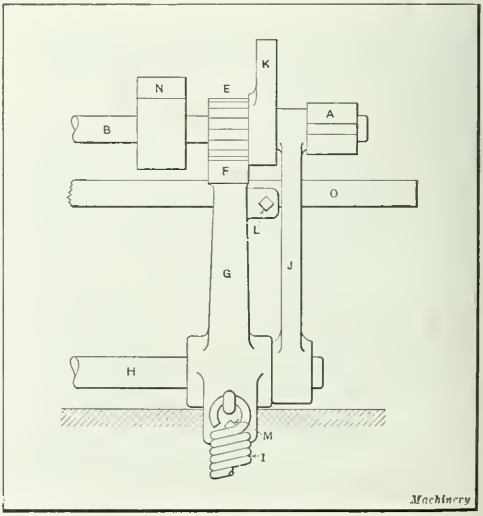
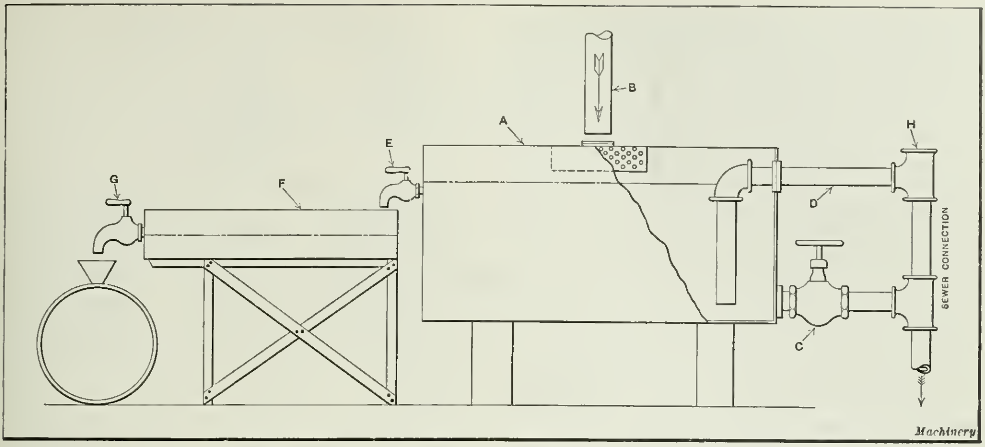


Fig. 4. Front View showing Arrangement of Parts of Mechanism



Apparatus for reclaiming Oil from Sal-soda Solutions used on Screw Machine Parts

keyed to shaft *B*, as it must be adjustable. Stop *K* is non-adjustable and therefore can be keyed. The rotation of shaft *B* is stopped by stop *K* so that the contact between *N* and *O* will be gradual. Were stop *N* permitted to prevent further rotation of shaft *B*, it would soon become loose or lose its setting.

Philadelphia, Pa. R. H. Kasper

RECLAIMING OIL FROM CLEANING SOLUTIONS

In the manufacture of parts in automatic screw machines there is always a certain amount of cutting oil that adheres to the parts; this is especially true in cases where cutting oils of the heavier variety are used in connection with the machining operation. It is desirable to remove this oil prior to inspection, and the method formerly followed for accomplishing this in the plant where the writer is employed was to immerse the parts in a hot sal-soda solution. The oil that rose to the surface of the solution was subsequently skimmed from it and used again. At the present time, however, the cleaning solution is contained in a washing machine provided with a conveyor for carrying the work through the bath. When it is desired to remove a dirty solution from this machine, it is emptied into the apparatus shown in the illustration, by means of which the oil is reclaimed.

The solution is discharged into the settling tank *A* from the drain pipe *B* of the washing machine. Prior to this step, any water in the tank is drained from it by opening valve *C* which permits the water to run into a sewer connection. When the solution being discharged into the tank reaches the level of pipe *D*, it begins to overflow through this pipe, but as the oil contained in the solution rises to the surface, it is not carried away by the pipe, because the latter has its inlet near the bottom of the tank. Faucet *E* is opened at intervals as oil collects at the top of the solution and so drains it into the oil settling tank *F* from which it is again drained into drums through faucet *G*. The oil is later run through filters to effect the removal of all chips which may still be contained in it.

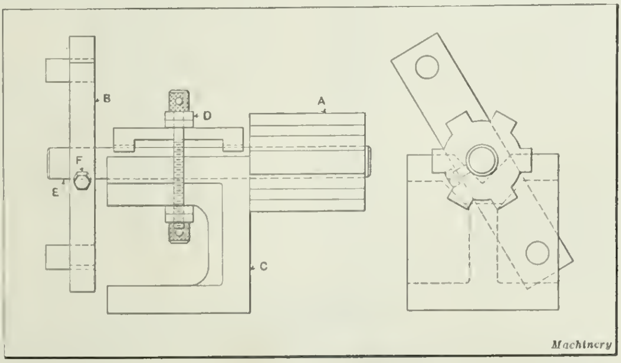
It was found necessary to place a screen beneath the outlet of drain pipe *B* to prevent excessive agitation of the solution as it enters tank *A*, which formerly caused the loss of a considerable portion of the oil. Pipe *D* is placed about 8 inches below the top of the tank to provide for a surplus of the solution in the tank during the settling of the water. The upper end of tee *H* is left open so that the solution will not be siphoned from the tank when it reaches a level above that of the overflow pipe. Tank *A* is cleaned of small chips and other refuse about once a month. The sal-soda solution used for cleaning tote pans, and the drippings from the washing machine are also run through this oil reclaiming apparatus. The arrangement described works satisfactorily and saves approximately three barrels of oil per week from parts manufactured on 200 automatic screw machines and 70 hand screw machines.

Flint, Mich. Charles E. Hendricks

SINE BAR INDEXING FIXTURE FOR GRINDING SPLINE GAGE

The fixture shown in the accompanying illustration is designed for use in grinding spline gages and work of a similar nature requiring a number of accurate divisions. In this instance gage *A* with six equally spaced splines is the work that requires grinding. At *B* is a sine bar bored in the center to fit the end of arbor *E*. The sine bar is clamped to the arbor by setscrew *F*. The angle-plate *C* is of the box type with a vee ground on its top surface. The sine bar can be made of any convenient length, but the longer it is, the greater will be the accuracy obtained by its use.

After the gage has been roughed out and hardened, the hole is ground and



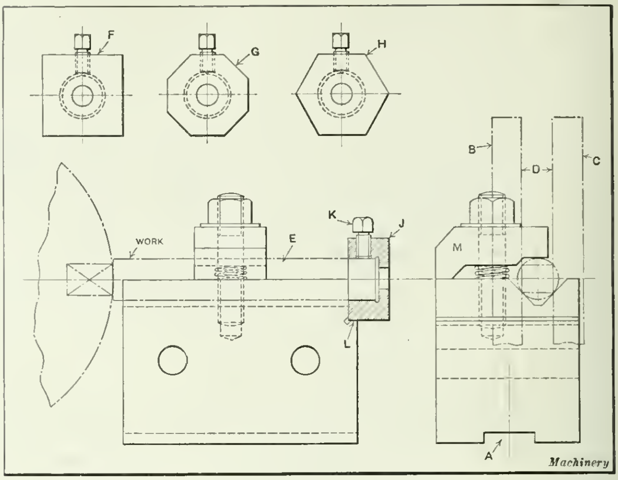
Fixture employing Sine Bar for Indexing Work lapped to a snug fit on the arbor; then the outside diameter and the splines are ground. The gage is placed on the arbor, which is clamped in the vee with a parallel clamp *D*, using a block on top of the arbor that has bearing points at each end to insure proper alignment of the arbor in the vee. The sine bar is placed on the opposite end of the arbor, and is lined up parallel with the base of the angle-plate by means of the buttons and an indicator, care being taken to see that the gage has two of its splines in alignment with the sine bar. The fixture is then placed on the surface grinder, and the upper sides of the two teeth in alignment with the sine bar are ground. The gage is next given half a turn, lined up again by means of the sine bar, and a cut taken on the opposite sides of the teeth without changing the vertical adjustment of the grinding wheel. The width of the teeth is then measured with a micrometer, and the amount of stock yet to be removed determined. The teeth should be first ground to within two or three thousandths inch all around before finish-grinding.

After the two teeth in alignment with the sine bar have been ground on both sides the sine bar can be released on the arbor by loosening set-screw *F*. It can then be locked in a position which will give the required setting for grinding two of the other teeth when clamp *D* is released and the sine bar again brought into a position parallel with the surface plate. The sine bar may be set at the proper angle by means of a height gage, or special size blocks may be used. As the sine bar is much longer than the diameter of the gage, slight errors made in setting the sine-bar are hardly noticeable on the work.

Beverly, Mass. John T. Clark

MILLING FIXTURE FOR SQUARING END OF ROUND SHAFT

The fixture shown in the accompanying illustration is designed for use in forming a section of either square, octagonal, or hexagonal shape on the end of a round bar by straddle-milling. The method of using the device is as follows: The fixture is clamped to the milling machine table, after first being lined up by means of the standard key-slot *A*. Cutters *B* and *C* are then placed on the arbor and set so that distance *D* between their cutting faces equals the distance across the flats required for the square, hexagonal, or octagonal shapes. To square the end of a shaft *E*, a block *F* is slipped on one end of the work and held in place, as shown in the cross-sectional view at *J* by set-screw *K*. The shaft is slipped along the vee until one edge of the square block rests on the ledge *L* of the fixture. The clamp *M* is then tightened and the work fed toward the cutters, thus milling two sides of the square. The work is then withdrawn from the cutters, the clamp loosened, and the work slid back in the fixture to permit it to be rotated 90 degrees until another side of the square block lines up with ledge *L*. The shaft is again pushed in so that the block rests on the ledge, the clamp tightened, and the work again fed forward. This completes the squaring operation, and the piece can be removed and a new piece placed in the fixture.



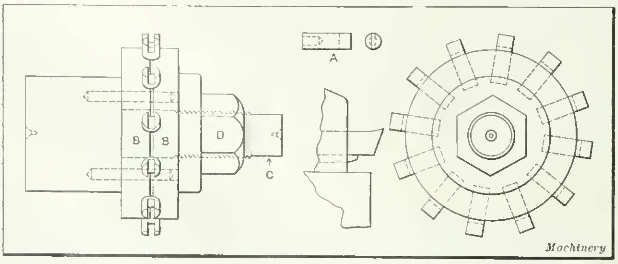
Fixture for milling Section of Square, Hexagonal, or Octagonal Shape on the End of a Round Shaft

The end of the work can be milled to an octagon shape by using block *G* in the same manner, except that the cutters are fed over the work four times instead of twice. By using block *H* in a similar manner, but passing the cutters over work three times, a section of hexagonal shape is obtained.

Pittsburg, Pa. William Owen

LATHE SLOTTING FIXTURE

The lathe slotting fixture shown in the accompanying illustration was made for use in cutting the slot in the machine-steel piece shown at *A*. This slot had previously been milled, but the highest production rate obtained by milling was easily exceeded by the use of the fixture shown, which made it possible to slot twelve pieces at one time. The clamping pieces *B*, which locate and hold the work, were turned up as one solid piece, and the twelve holes for holding the work drilled and reamed to proper size, after which the solid piece was cut in two, thus forming the two pieces. Arbor *C* was turned to fit the arbor holes through pieces *B* and threaded to receive flanged nut *D*. Care was taken to drill the radial holes exactly in line with each other, and also to make these holes a close fit for the work, as otherwise the slots in the pieces would not all be central and the fixture would not tighten up evenly on all the pieces.



Lathe Slotting Fixture designed for slotting Twelve Pins at One Time

Two dowels fitted tightly in holes drilled in arbor *C* and made a close sliding fit in corresponding holes in clamping pieces *B*, serve to keep these parts in alignment. In loading the fixture, one of the pieces is inserted and nut *D* screwed up until it holds the piece lightly, after which the lathe spindle is turned around to facilitate loading all twelve holes, by pulling on the drive belt. When completely loaded, the pieces are secured by tightening nut *D*. To unload the fixture, the nut is loosened a half turn, and the lathe spindle given a complete revolution by pulling on the belt so that all the pieces fall out into a chute which conveys them to a box. Although a bumping action is produced in this operation, the final result is a smooth clean slot. It may be well to mention that for this particular job there was no objection to the curved surface produced at the bottom of the slot.

Rosemount, Montreal, Canada **Harry Moore**

SAVING COMPUTATIONS FOR FUTURE REFERENCE

Computations which may prove of future value should be made on sheets of one size and filed in a book where they can be readily located when desired. A suitable loose-leaf book for the purpose is illustrated in Fig. 1. Index tabs are provided so that a sheet can be filed according to the information which it contains. One of these books might suffice for an entire department; however, each computer could be furnished with one if this should prove necessary. In making mathematical calculations, many persons show every step on the sheet which is to be saved, so that finally the sheet becomes covered with a mass of figures that is quite unintelligible to a fellow-worker. The division, multiplication, and squaring of numbers, etc., should be made on a paper which can be later destroyed, and only sufficient information should be given on the sheet kept for reference to indicate the method of obtaining the result. The latter should be marked conspicuously so that it can be seen immediately, and all information should be given in such a manner that it can be easily understood by others.

An example of a computation sheet is illustrated in Fig. 2. The upper portion of the sheet shows a sketch of a punching, the teeth of which are tested by means of a plug *P* placed between them. The horizontal center line of this plug must coincide with the pitch line (P.L.) of the teeth. The problem is to find what diameter plug *P* should be, and to determine dimension *Z*, and the magnitude of one-half the included angle of the sides of the teeth. The method followed in calculating these values is shown in the lower part of the sheet. Lead lines, such as *J*, *K*, and *L*, are employed to show how each figure entering into a calculation is obtained, and reduce the number of figures to a minimum; see (B), (C), and (H), Fig. 2. These lines should not cross each other, but when this cannot be avoided, a small loop should be made on one of the intersecting lines, as shown on line *K* where it crosses line *L*, so that there can be no misunderstanding as to the figure or angle that a line leads to. Each result sought should be the last line of a column of figures leading to it, as shown at *F*, Fig. 2. The results obtained are heavily underscored so that they can be quickly distinguished.

It will be noted that a symbol number is given at the top of the sheet, and so this sheet should be filed in the book under the division alloted to symbol numbers. The name of the computer and the date on which the calculation was made should always be written at the bottom of the sheet. When it is necessary to make another calculation for the same job after a sheet has been filed, the computation should be made on the original sheet if this is possible, in order to keep all calculations for one job in a compact form. In cases where a sketch is required with the calculations and it is desirable to trace it from another drawing, a sheet of tracing paper may be used to facilitate this. It is always preferable to explain everything possible by means of sketches rather than by words.

Reading, Pa. **B. Spector**

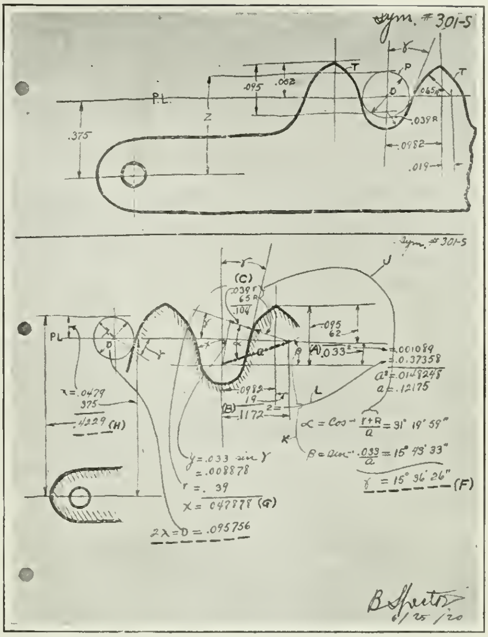


Fig. 2. Typical Calculation Sheet for Book prepared in a Manner to permit Information to be easily understood

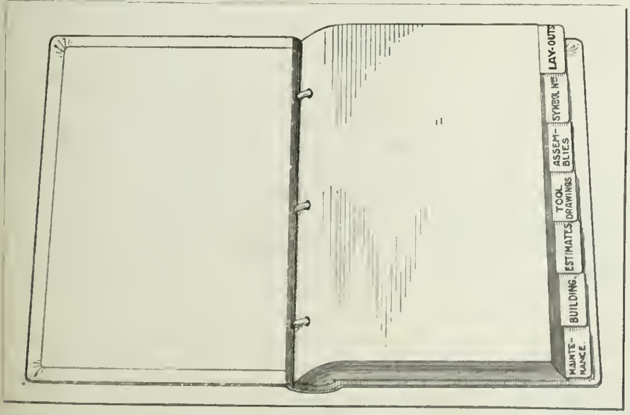


Fig. 1. Computation Book conveniently arranged for keeping Sheets in Orderly Condition

* * *

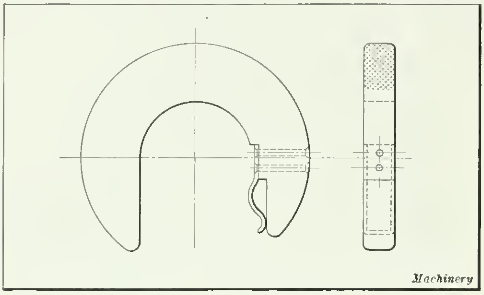
COURSE IN INDUSTRIAL ENGINEERING

A new professional course in industrial engineering has just been announced by Columbia University, the purpose of which is to give engineering students a broad conception of the problems met with in actual industrial production and in the management of engineering undertakings. The studies are grouped under the headings General Engineering, Business, Machinery, and Industrial Work. Under the heading Industrial Work, four months' work is required in a factory, half the time as a worker in the shop and the remainder in study and analysis of methods and processes. Mechanical operations are analyzed and the characteristics of machines examined. In the third year of this course each student selects and studies, under guidance, some particular industry. The study will include a survey of commercial, financial, and technical factors, with contemplation of ways and means for improvement. A final course aims to develop methods of analysis by which the machinery and equipment may be selected for manufacturing an assigned commodity according to an assumed schedule. A part of the job is the preparation of a financial budget for the undertaking.

SHOP AND DRAFTING-ROOM KINKS

SLIP COLLAR WITH RETAINING SPRING

The accompanying illustration shows a slip collar designed for use on a revolving arbor, a flat spring of special shape being provided to prevent the collar from being thrown off the arbor as the latter rotates, in the event that the nut locked against its face should become loose. This spring does not interfere with slipping the collar on or off the arbor in the usual manner.



Slip Collar of Special Design

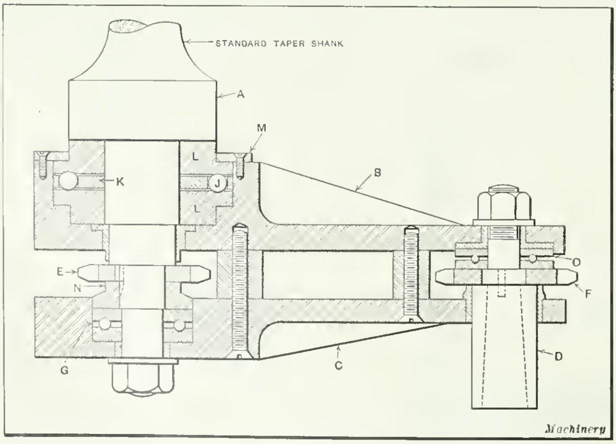
F. Server

ATTACHMENT FOR DRILLING IN INACCESSIBLE PLACES

Occasionally the drilling of holes in certain places on a casting is impossible because of an overhanging edge on the casting or some other feature in the design which prevents the drill held in the customary socket in the drilling machine spindle from being placed in position for the operation. The illustration shows an attachment developed for overcoming this difficulty. It consists essentially of a spindle *A* having a standard taper shank on the upper end to fit the socket in the spindle of the machine, two arms *B* and *C* which are attached to spindle *A*, and socket *D* which is supported at the opposite ends of the arms. When the machine is in operation, socket *D* is driven by spindle *A* through a chain traveling over sprockets *E* and *F*, which are keyed respectively to the spindle and socket. It is obvious that the arms permit the drill to be extended under edges or similar obstructions on a casting.

The thrust of spindle *A* is taken by a ball bearing *G* in the lower arm, and a set of balls *J* in the upper arm, which are held in place by retainer *K* and rotate against plates *L*. This unit is secured in the arm by plate *M*. Spacer *N* holds sprocket *E* in the proper location. A ball race *O* is also placed above the sprocket on socket *D* to overcome friction when a hole is being drilled.

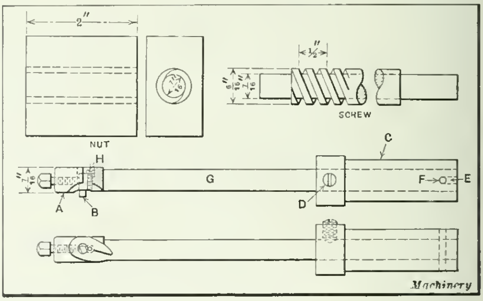
Chicago, Ill. H. A. Pearson



Drilling Machine Attachment having a Drill-holding Socket at End of an Extension Arm

A SPECIAL THREADING TOOL

The writer was recently required to make the nut and screw shown in the upper part of the accompanying illustration. The threads in the nut presented a problem of some difficulty, since the diameter of the hole was rather small for a double thread and consequently difficult to cut. In threading the nut, a special tool was made in the form of a boring-bar, as will be seen by referring to the illustration, the end of the bar *A* being of the same diameter as the root diameter of the thread so that it acted as a pilot. It will be seen that the cutter was provided with means of adjustment as required for taking the successive cuts. The shank *G* of the tool was held in holder *C* through the medium of screw *D* and a pin *F* passing through the slot *E*. The tool was held in the toolpost of the lathe by means of a boring-tool holder of the Armstrong type. In mounting the work preparatory to cutting the thread, an angle-plate was bolted to the faceplate of the lathe for convenience in clamping the work in place for the threading operation.



Nut and Screw, and Special Threading Tool made to cut the Threads in the Nut

After the hole was bored to the proper size, the special threading tool was placed in position and the first cut was taken. At the completion of the first cut, screw *D* was released and the bar pulled through the work and then relocated in the holder. With the cutter suitably adjusted by means of screw *H* the next cut was taken in a similar manner, this process being repeated until the work was finished.

Paterson, N. J. S. Courter

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, December 11

THE coal strike that lasted long enough for all industries to be seriously affected has now been settled. Many engineering firms are again getting into their stride after a compulsory period of short hands or short time, but it is questionable whether the losses can be caught up. In the machine tool trade generally the amount of business done continues to be small. Many makers are working to stock on standard lines, and short-time working has in many cases been adopted. A fair amount of inquiry is being received from Japan for machine tools, and several important shipments have recently been made to that country. It is of interest to note that a well-known Glasgow firm is executing an order for boring machines for use in a large American steel works.

Second-hand tools continue to be offered in fair quantities, though several instances are noted where prices have depreciated considerably. In the magneto industry, a trade which is now of great importance to the Birmingham, Coventry, and Rugby districts, manufacturers are experiencing considerable competition from the German organization which formerly had control over the world's trade in magnetos. With the market in its present condition, this organization has opportunities of underselling home makers, which it would not have under normal conditions.

In the Sheffield district steel is being offered by Germany in the form of billets at £9 per ton below the local prices. However, in the Midland district a fall in the price of pig iron has definitely begun, and a reduction of 10 shillings from the ton price is noted in some districts. An order has recently been placed by the government of New Zealand with Cammel Laird & Co., Ltd., for 2500 railway cars, the total value of which is stated to exceed £800,000.

Export and Import Trade

As often happens the export and import trade of the country shows no decline during the strike period, but rather an upward tendency. The trade returns for October showed an increase in both value and tonnage of exports and imports in machine tools over those for September. Under the Overseas Trade (Credits and Insurance) Act, Parliament has provided that credits may be accorded up to an aggregate amount not exceeding £26,000,000 in respect to exports of British manufactured goods to the following countries: Finland, Latvia, Esthonia, Lithuania, Poland, Czecho-Slovakia, Serb-Slovene state, Roumania, Georgia, and Armenia. Bulgaria has recently been added to the list, and other countries may possibly be included as occasion arises. Under the scheme as originally framed, advances were made by the department up to only 80 per cent of the cost of the goods, including freight and insurance, and commission paid to the Exports Credit Department, such advances being without recourse against the exporter. The department is now authorized to advance in approved cases up to 100 per cent, retaining recourse against the exporter to the amount of 20 per cent. Credits may be granted up to a maximum period of three years.

Labor Conditions

During the last month employment in the engineering trades showed a decline. The period of the coal strike saw some firms avoiding discharges of men by working for only three or four days a week, but many were compelled to close down. Coupled with the coal strike were the delivery delays asked for by consignees, and both these conditions have had a depressing influence on employment. Trades unions representing about a million and a half workers reported that the end of October saw 5.3 per cent of their number without work. But for the short time referred to above, these figures would have been considerably higher. The paralyzing effect of trade union restrictions on output is a factor which must be reckoned with. Instances are not wanting where men who have been in the habit of getting a certain wage in a five-and-one-half-day week have earned the same amount by piece-work in a short-time week of three days. On several works extensive development has been held back by the bricklayers' union stipulation of 300 bricks per day and no more, despite the fact that a short time ago the same men on the same job were laying 1000 bricks per day.

New Tools and Developments

A new universal relieving lathe has been placed on the market by Ward, Haggas & Smith, of Keighley, which has a distance between centers of 11½ inches. The outstanding feature of the design is the worm drive to the spindle. This avoids backlash and insures relief of perfectly regular contour. An automatic copying mechanism can be used on the machine when only a small number of similar pieces require to be machined, and in such cases saves the manufacture of a form tool. The lathe will swing 18½ inches over the saddle or 13½ inches over the relieving slide.

The Lumsden Machine Co., Ltd., Gateshead-on-Tyne, is making a new vertical-spindle surface grinder for flat surfaces up to 24 inches by 12 feet. Two other new grinding machines are being made by this company; one, intended for constructional work, is specially applicable to grinding flat surfaces or girder ends after the members are jointed together. A 24-inch segmental grinding wheel is used. The other machine is a horizontal surface grinding machine for surfaces up to 20 by 72 inches. The wheel mounting is novel, since it is carried in an eccentric bushing which is rotated for applying feed. The firm is also developing a 6-foot vertical grinding machine, designed along the lines of a vertical boring mill. The work is mounted on a rotating table, and the wheel is carried in a ram operating in an intermediate cross-slide. The machine is suitable for grinding either flat surfaces or internal and external cylindrical surfaces. Taylor, Taylor & Hobson, Ltd., Leicester, are making a microscope especially designed for measuring Brinell indentations.

The Stalker Drill Works, Ltd., Sheffield, have built a new factory in which gear-cutters and hobs will be manufactured. Sanderson Bros., & Newbould, Ltd., Sheffield, are making large works extensions in order to increase their output of tungsten steel hacksaw blades.

Shipbuilding and Engineering Exhibition

The Glasgow shipbuilding, engineering, and electrical exhibition, promoted by the Glasgow Corporation, was opened at Kelvin Hall on November 8 and continued until December 4. Kelvin Hall has a floor area of fully 200,000 square feet, or 20,000 square feet more than the space available at Olympia. The whole of this space was occupied by 317 stands, representing some 300 exhibitors. About 200 additional firms who desired representation had to be turned away. While most of the firms exhibiting were from the Clyde area, all parts of Britain were represented, particularly the London, Birmingham, Sheffield, and Tyne districts, and a number of foreign firms were represented as well.

Trend of Automobile Manufacturing Practice in England

By RALPH E. FLANDERS, Manager, Jones & Lamson Machine Co., Springfield, Vt.

The automobile industry in both Europe and America has been passing through a crisis in the last few months. While the final solution of the problems involved is not yet in sight, the author of this article has drawn certain conclusions relating to the industry during a recent visit to England and France, where he had an opportunity to see conditions in the automobile-building field and to obtain first-hand information. Mr. Flanders' impressions regarding the trend of automobile manufacturing practice in England and France are presented in this article.

MASS production is an expression constantly on the lips of English shop managers. This is understood to be an American phrase or, at least, an American principle, though I do not remember having heard the term used here. The idea is plain enough to understand. It is that of making the product in a sufficiently large mass to take advantage of the latest and most refined production methods for the sake of reducing the cost to the lowest possible figure. Some English automobile shops have been reorganized on this basis, and the most successful of them would produce an output that would be fairly appalling if they were running full time and full force on the plans for which they were laid out. The output would not, of course, be appalling in America, but it would be in Great Britain. For one thing, the country is very much smaller than the United States; and in the second place a much smaller proportion of the population is able to maintain an automobile, which is due to a somewhat lower standard of living, even where wages are good, and also to the greatly increased cost of maintaining a machine resulting from the higher cost of gasoline, oil, government taxes, etc. It is said that the number of automobiles licensed in New York City alone exceeds the total of all the British Isles; and the field occupied by the medium or low-priced car here, is taken care of there by the motorcycle with side car, which is the ordinary man's means of conveyance.

Competition with America

Automobile builders in England have been looking to an export trade as an outlet for the increased products of this "mass production." This offers no immediate prospect of success, however, owing to their inability to compete with American manufacturers, who are at a considerable advantage due to the greatly increased cost of material in England and to the fact that wages are, in many cases, now on a parity with those of America instead of being considerably below as in years past. This, added to the lower production capacity of the English workman, would seem to make competition hopeless for the near future, at least, in the markets of the world.

Market for High-grade Cars

There does, however, appear to be a fine field in both England and France for the manufacture of the luxury car, whether of the moderate grade or of the variety that can be purchased only by the very rich. It is evident that this industry is on a sound foundation, inasmuch as most of the factories building the finer class of car in a more or less old-fashioned way are still running, whether in England or France; some of them are operating at full capacity, while those who have tried to modernize their methods and build in large quantities are in some cases almost down and out. There is, furthermore, a possible field of export for these cars, not merely to other foreign markets, but to America as well. The ability and willingness to do the highest grade of body finishing and upholstering still survives in England to the extent that the stock cars of the best makers bear comparison with the finest product of the customs body builders in the United States.

Their market in the United States should still further improve in view of the continuous tendency in this country for the makers of the finest cars to expand their facilities more and more and put them on a manufacturing basis. While this tendency, if wisely carried out, will produce a car of the same excellence in large quantity, it does tend to eliminate the distinction of the better makes by making them more common, and a rich man is willing to pay for distinction; consequently there will probably always be a demand in this country for the high-priced foreign car made in smaller quantities and therefore necessarily by less efficient methods.

Points to be Studied in Producing High-grade Cars

In the future, it would seem that the great prizes in automobile production in England and France will go to the maker of the first-class car, who is willing to give careful study to the following points:

1. Making such changes in the design as will facilitate the manufacture of the car without affecting its quality in any degree whatever. A great improvement in this respect can be made in practically all high-grade cars.
2. Developing the ability to rough-machine the parts as rapidly as is done by the makers of the cheaper grades of car while maintaining the fine finish and fitting in the final operation. This is difficult but possible.
3. Making a study of the possibilities of machine-finishing of parts where hand work is now the rule. This applies to many surfaces where hand work is of no advantage but costs more and is only employed out of deference to the tradition as to the excellence of hand work in itself.
4. Making sure that the body work and upholstering in general is done as finely as at present, and that the finished car will suffer in no degree whatever from the improvements in design and manufacture mentioned.
5. Specializing on one design of chassis. The manufacturer who is willing to do this, can carry out all the previously mentioned points to a much more successful extent than the builder who carries two or three designs. It should be possible to specialize without injuring the quality of the product in any way.

In a word, all the conditions of manufacture for such things as automobiles are so different in Europe from those existing in America, that the rules for one region do not apply in the other. In America, the manufacturer who can build a car of fair quality in enormous quantity, has an opportunity to make engineering skill reap the highest reward. In Europe, the man who succeeds in solving the problem of design and manufacture for the very high grade car, made in moderate quantities, will be the one reaping the largest financial reward. Modern machinery and careful engineering study of the highest grades is required for both problems, but the solution will be quite different in the two cases.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

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Brown and Sharpe High-speed Milling Attachment

This attachment is intended for use on Brown & Sharpe milling machines, and it makes provision for increasing the speed of the milling cutter by means of a large gear mounted on the nose of the milling machine spindle, which meshes with a pinion on the special spindle. This attachment is made in two sizes, the larger one of which is furnished with adjustable gib stops that furnish means of mounting the attachment on machines with columns of different face widths.

A HIGH-SPEED milling attachment recently developed by the Brown & Sharpe Mfg. Co., Providence, R. I., for use on milling machines of its own manufacture is illustrated in Figs. 1 and 2. Reference to Fig. 2 will show that the increase in the speed of the milling cutter is obtained by means of a large ring gear which is placed on the nose of the regular spindle when the attachment is mounted on a machine; and this gear meshes with a pinion on the special spindle provided in the attachment. Two sizes of this attachment are manufactured, the No. 1 being intended for the smaller machines and the No. 2 for the larger. The latter size is adapted to columns of different face widths by means of adjustable gib stops, which eliminates the necessity of providing a separate attachment for each different size of column on the various machines in a shop.

A positive vertical position of the attachment is assured by the provision of a segment that rests upon the spindle box of the machine. This spindle box projects beyond the face of the column, and serves as a centering guide. The correct horizontal position is obtained by first tightening the gib on the right-hand side of the attachment, which effects the location. A gib on the left-hand side furnishes a means of securely clamping the attachment to the face of the column. This arrangement affords a large bearing surface and insures rigidity. The large ring gear previously mentioned has a tapered hole, ground to fit the nose on the machine spindle on which it is mounted. This gear is made of machine steel and is left soft to permit a smooth driving action and to avoid the chatter and noise often produced by the rotation of hardened gears at a high speed. On the No. 2 attachment, the pinion is heat-treated and keyed to the spindle, while on the No. 1 attachment, the teeth of the pinion are cut directly in the spindle.

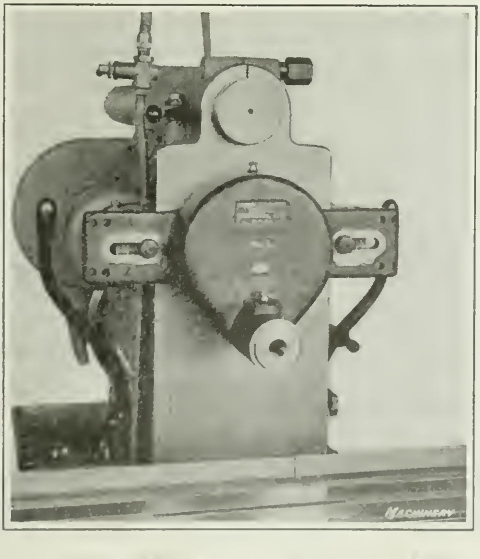


Fig. 1. High-speed Milling Attachment designed for Use on Machines built by the Brown & Sharpe Mfg. Co.

The spindle is hardened and ground, and it runs in a phosphor-bronze bearing, which is tapered to permit adjustment for wear. The adjustments are obtained by tightening a nut which causes the spindle to be drawn into the bearing. After an adjustment has been made on the spindle, the nut can be securely clamped by means of a small set-screw. End thrust of the spindle is taken up by hardened steel and babbitt washers mounted directly behind the shoulder on the front end. A No. 7 tapered hole is provided in the spindle on the smaller attachment for receiving the shanks of milling cutters, and a No. 9 tapered hole is furnished on the larger attachment. Oiling of the spindle bearing is secured by means of an oil

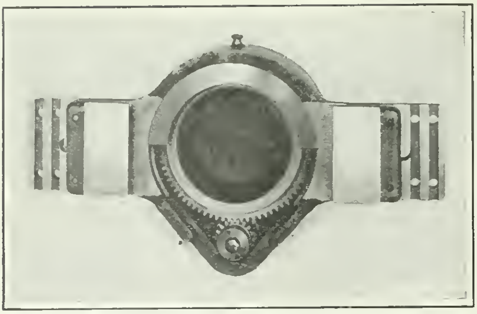


Fig. 2. Rear View of Milling Attachment, showing Adjustable Gibs and Method of driving Spindle

pocket on the front of the housing. Milling cutters are readily removed from the spindle by means of a releasing bolt, which positively causes their ejection.

HERCULES GEAR-HOBBING MACHINE

A gear-hobbing machine designed for the quantity production of spur, spiral, and worm gears at a low cost, and which is said to be particularly adapted to the manufacture of gears for automobile and tractor transmissions, change-gears, and gears entering into the drives of machine tools and other classes of machinery has been developed by the Hercules Machine & Tool Co., Inc., Broome and Lafayette Sts., New York City. The main feature of this machine is a differential mechanism that greatly simplifies the calculations necessary to determine the change-gears required in hobbing spiral gears. On account of this differential, no calculations are involved when changing the rate at which the hob is fed, or from a right- to a left-hand gear, provided the angle and pitch of the teeth remain the same. Another feature which the makers claim is not furnished on any other gear-hobbing machine, is a rapid traverse of the cutter-slide up or down on the column.

Feed and Rapid Traverse of the Cutter-slide

Reference to Fig. 1 will show that the machine is equipped with a single-pulley drive that is connected to the machine through a gear-box permitting nine different speeds, any of which may be secured by operating one of two handles at the rear of the box. The cutter-slide is moved vertically by means of a feed-screw that engages with a nut held in a casting attached to the top of the column. When this nut is revolved, the cutter-slide is either raised or lowered, the movement depending upon the direction in which the nut is rotated. The rate at which this nut revolves, and therefore the feed of the cutter-slide, is governed by the gear-box *A*, Fig. 2, to which the nut is connected by means of shaft *B* and suitable gearing. The gear-box furnishes eight feeds for the cutter-slide, four of which are obtained by moving handle *C* to various positions when lever *D* is placed in one of its two positions, the other four feeds being also secured by moving handle *C* when lever *D* has been placed in its other position. Three locking positions are also provided for lever *E;* when it is in the central position, the feeding mechanism is in neutral, and when it is in the upper position the mechanism is connected for feeding the hob to the work. By placing the lever at the low stop and pulling lever *F* away from the machine, the rapid traverse of the cutter-slide in a downward direction is obtained. By pushing lever *F* toward the machine, the cutter-slide is traversed upward at a fast rate of speed. The cutter-slide may also be raised or lowered by hand, by revolving the handwheel at the top of the column, which can clearly be seen in Fig. 1.

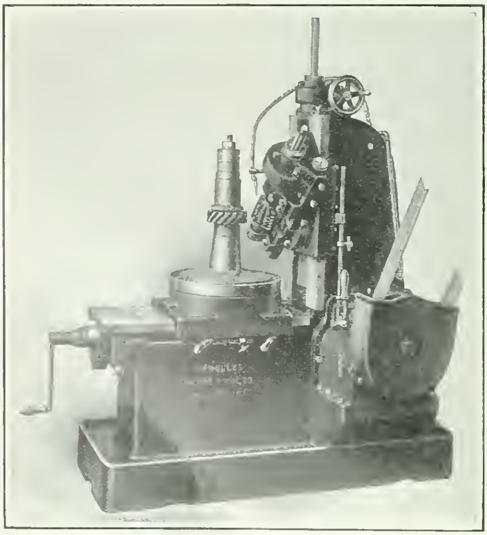


Fig. 1. Hercules Gear-hobber provided with Differential that simplifies Spiral Gear Hobbing

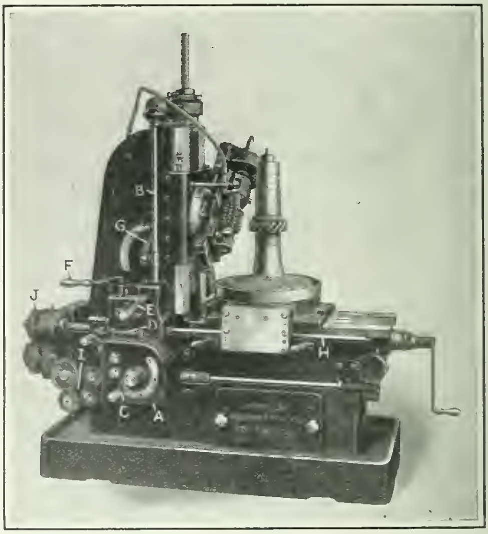


Fig. 2. Left Side of Gear-hobber, showing Gear-box controlling Feed of Cutter-slide

Setting the Hob and Obtaining its Rotation

The cutter-spindle is mounted on a swivel head bolted to the cutter-slide. This head permits the teeth of the hob to be set at the proper angle in relation to the blank to be cut, a circular surface on the cutter-slide being graduated in degrees to facilitate the setting. Adjustment of the hob axially is also provided, and a centering device is furnished for determining when the center of a tooth on the hob has been placed in alignment with the center line of the work-arbor. The rotation of the hob is obtained by means of a vertical driving shaft connected to the cutter-spindle through a set of bevel gears and two sets of spiral gears. By employing spiral gearing, the cutter-spindle is brought close to the column, thus permitting greater rigidity of the unit, producing a smooth running action, and eliminating chatter.

The direction of rotation of the hob to suit the cutting of right- and left-hand spiral gears is obtained by locating lever *G* in one of its two working positions. A tripping mechanism is provided at the right-hand side of the cutter-slide to disengage the driving clutch in the speed gear-box when the cutter-slide has been lowered to a predetermined position. In this way, not only is the feed of the machine stopped, but all other moving parts as well, except of course, the driving pulley.

Work-holding Fixture and Table

The rotation of the work-holding fixture on the table is obtained by means of gearing that connects it to the shaft *H* running along the left side of the bed, the proper ratio between the feeding movement of the hob and the rotation of the work being secured by means of the indexing change-gears *J* at the rear of the machine. These change-gears are driven through the differential mechanism previously mentioned, and a sufficient number is furnished to permit the hobbing of spur, spiral, and worm gears up to 360 teeth. Gears *I* are change-gears for the differential mechanism, and are chosen to suit the angle of spiral gear teeth.

The table is moved toward the column until the hob is cutting to the desired depth by means of a feed-screw provided with a dial graduated in thousandths of an inch. Arrangements are made to feed the table automatically when worm-wheels are being hobbed. The work-holding arbor is prevented from springing during an operation on large gears by an upright support which is not shown on the machine, but which is mounted on the bed and connected to the arbor at its upper end, so that it slides along the bed with the arbor. The height of the supporting member on this attachment can be adjusted vertically to suit the work.

A self-contained lubricating system supplies cutting oil to the hob, and the gears in both gear-boxes run in oil. The machine has a capacity for cutting steel gears up to 4 diametral pitch, 29 inches outside diameter, and 12 inches face width. The minimum distance from the center of the work-arbor to the center of the cutter-spindle is 1½ inches; the diameter and face width of the clutch pulleys on the countershaft, 12 and 4 inches, respectively; the speed of the driving pulley, 360 revolutions per minute; and the weight of the machine, approximately 4000 pounds.

LEHMANN GEARED-HEAD ENGINE LATHE

A type of geared-head engine lathe giving sixteen spindle speeds, and which is built in a number of sizes, is shown in Figs. 1 and 2. This lathe is the product of the Lehmann Machine Co., Chouteau Ave. at Grand Ave., St. Louis, Mo. The spindle speeds on the 16-inch machine cover a range of from 10.5 to 422 revolutions per minute in geometrical progression, while those on the 22-inch machine range from 8.5 to 330 revolutions per minute. Various speeds are obtained by shifting levers on the front of the gear-box.

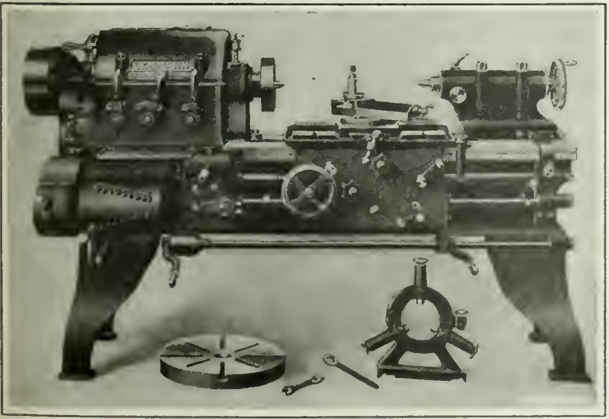


Fig. 1. Geared-head Engine Lathe built by the Lehmann Machine Co., which has Sixteen Spindle Speeds

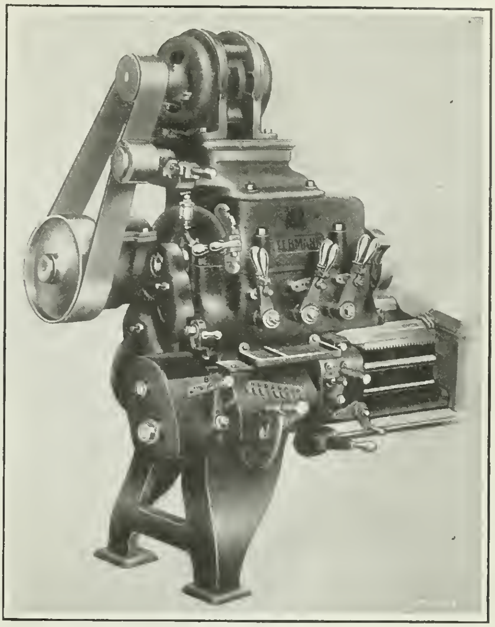


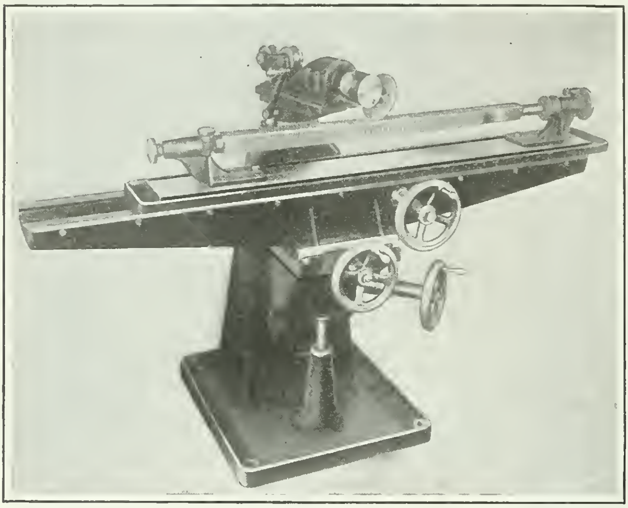
Fig. 2. Headstock End of Lathe showing One Arrangement of Direct Motor Drive

Owing to the gear ratio, which is 57.1 to 1 on the 16-inch lathe and 70.6 to 1 on the 22-inch machine, the driving shaft can be operated at a high rate of speed and the position of the shaft permits the use of a driving pulley of large diameter. The usual arrangement for a direct drive is to mount the motor on the headstock, as shown in Fig. 2, driving through a short belt running over an idler pulley. Ball bearings are provided for the idler pulley, and it has ample adjustment. It is stated that with the fast belt travel employed on these lathes, this arrangement is a satisfactory application and no trouble is experienced on account of the short belt, the pull on the belt being much less than usual on account of the large diameter and high speed of the driving pulley. The construction of the geared head is such that no interlocking device is needed to prevent the engagement of two different gear ratios at one time. All gears in the headstock are made of heat-treated steel.

The motor runs at the rate of 1800 revolutions per minute. Suitable guards are provided for the belt and pulley. A direct drive can also be furnished with the motor mounted on a base hinged to the rear leg at the headstock end of the lathe. No idler pulley is required in such an application. The spindle is made of an alloy steel, and its bearing surfaces are hardened and ground. Four keys are milled integral with the spindle to suit the sliding back-gear clutch. Two surfaces of different diameters are provided on the spindle nose to furnish bearings for faceplates, one bearing surface being in front of the threads on the nose, and the other being in back of them. This design permits the faceplates to be rigid on the spindle and facilitates their mounting and removal.

J. N. LAPOINTE BROACH GRINDER

A single-purpose grinding machine designed for the sharpening of broach teeth has been recently placed on the market by the J. N. Lapointe Co., New London, Conn. This machine is a refinement of one used similarly for a number of years in the shops of this company, and it has been placed on sale to meet the demand for a tool-room machine capable of accurately and rapidly grinding the rake and face of all types of broach teeth. The machine is of the adjustable knee type, is ruggedly constructed, and will support broaches up to 64 inches in length, by 8 inches in diameter. Round broaches may be swung between centers furnished with the machine, and square broaches or keyway cutter-bars may be clamped to the table.



Grinding Machine built by the J. N. Lapointe Co. for grinding the Rake and Face of Broach Teeth

The live center is driven by a belt from an auxiliary countershaft and may be operated at three different speeds. A simple indexing mechanism contained in the headstock unit adapts the machine for the accurate grinding of spline and internal gear broaches. The grinding wheel is mounted on a spindle supported by a swivel head, motion being transmitted to the spindle by a belt from the main countershaft. A pair of idler pulleys guides the belt to suit the various angles at which the spindle and its abrasive wheel may be swung. The swivel head pivots on the column of the machine, and may be swung to any angle in the horizontal plane so as to permit the grinding of broach teeth which are not machined at the customary right angle to the work axis. The entire swivel-head unit is moved forward to bring the grinding wheel in contact with the work by means of a hand-lever located in a convenient position for the operator. The over-all dimensions of the machine when the table is extended, are as follows: Length, 11 feet 2 inches; width, 3 feet 3 inches; and height, 3 feet 11 inches.

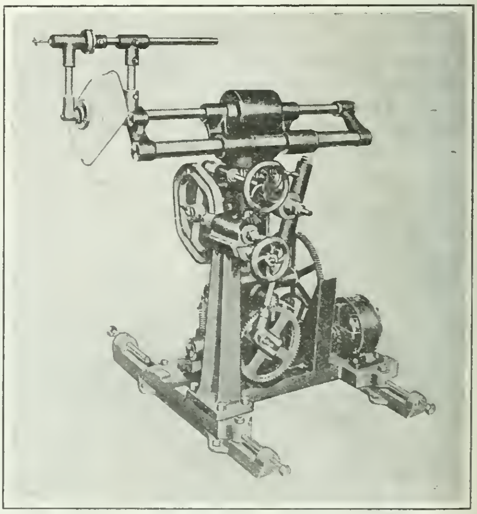
CONTOUR BUFFING MACHINE

A machine designed for automatically feeding work of oval, rectangular, or triangular contour, as well as that of circular form, against the wheels employed on polishing or buffing lathes, has been developed by the Contour Buffing Machine Co., Inc., 410 Bird Ave., Buffalo, N. Y. By reference to the illustration, it will be seen that the machine is self-contained, being driven by an electric motor attached to the bedplate. This bedplate rests on slide-rails, permitting an adjustable travel of 8 inches to or from the polishing wheel, to suit work of different diameters and various sizes of polishing wheels. The work-spindle is rotated slowly, and it is supported in a sliding frame having a reciprocating motion that is adjustable from zero to sixteen inches.

The work-spindle and the sliding frame are driven by gears on a vertical shaft in the column, the latter being supported on trunnions located on the bedplate, and thus it is free to oscillate through about 10 degrees. When the article being polished is of a special contour, this oscillating movement is controlled by a cam which corresponds to the contour of the work. The position of the guiding roller used in connection with this cam may be adjusted through a slide actuated by a handwheel, and the roller is controlled by an adjustable spring in the slide. When the article being polished is of circular form, a cam is not required and a link is substituted for the purpose of holding the column stationary in a vertical position.

The upper part of the column and the sliding frame are arranged to be swiveled by means of worm-gearing operated by a handwheel. By this arrangement, the operator may swing the work to or from the buffing wheel without stopping the machine. The article being polished is held on the chuck by the work-holder as illustrated, the outer arm, which is provided with a free-running wooden washer which it holds against the work, being pulled hard toward the right by means of an adjustable tension spring inside the pipe at the top of the work-holder. The outer arm is held by stops in the position shown, but it can be swung through a half circle until it again engages the stops and be held in that position to facilitate the removal of the work and the substitution of an unpolished piece.

A variable angle attachment can be readily fastened to the sliding frame to accomplish the polishing of conical articles and the bottoms of pans, etc. This device permits the work to be set at any point in a horizontal plane within an



Machine developed by the Contour Buffing Machine Co., Inc., for polishing Parts of Circular, Oval, Rectangular, or Triangular Contour, etc.

arc of 90 degrees. The direction of the motor-shaft rotation is reversible; and these machines are made in right- and left-hand models so that two of them can be run in conjunction with one polishing lathe, and by one operator. It is claimed that in this way an important saving of labor is effected. Various modifications of this machine can be furnished to suit requirements; if the articles to be polished are all of circular form, the cam mechanism can be dispensed with, and, for many classes of work, the mechanically operated reciprocating motion is unnecessary, as the sliding frame can be moved to any desired position by hand and locked in place.

MEREY ROTARY EMBOSSING MACHINE

The rotary embossing machine shown in Figs. 1 and 2 is a recently patented invention of Julius Merey, 2842 N. Maplewood Ave., Chicago, Ill. This machine was designed to emboss inscriptions on tubular objects, such as ice-cream cans, milk cans, and similar containers, as well as flat objects. One of the advantages of the rotary type of embossing machine is that it permits the manufacturer to make up a quantity of milk cans or other standard tubular products and then emboss the inscriptions required by the purchaser when his order is received. This feature makes it possible to fill orders quickly and also enables the manufacturer to maintain a more uniform production rate.

Referring to Fig. 1, it will be seen that the main frame is of heavy cast-iron construction. Four boxes provided with phosphor-bronze bushings are located in the cast-iron housing at the left-hand end of the machine. The two lower boxes are stationary, while the upper ones are adjustable vertically. The two adjustable boxes carry the shafts on which the embossing dies are mounted. These two shafts are each two feet long; they have bearing diameters of 3¾ inches, and are hardened and ground all over. The machines are equipped for belt drive, a 16- by 4½-inch pulley provided with a positive clutch being located at the back of the machine as shown in Fig. 2. At the opposite end of this shaft there is a bevel pinion which meshes with a bevel gear attached to a vertical shaft. The vertical shaft transmits power to the shafts on which the embossing dies are carried by means of worm-gearing.

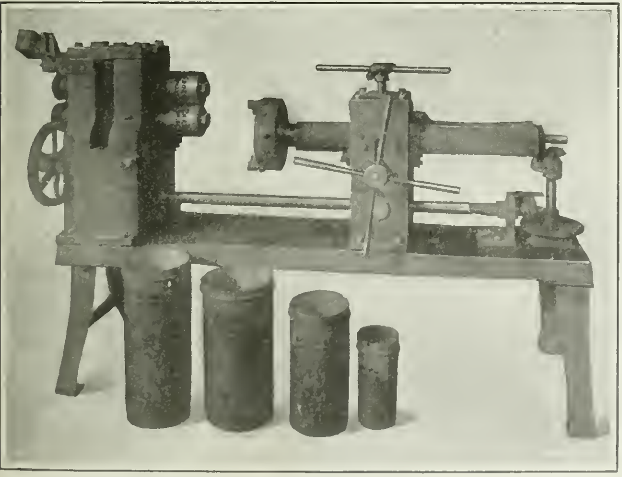


Fig. 1. Rotary Type of Embossing Machine developed by Julius Merey

The vertical shaft is made in two pieces; the lower section having a right-hand worm is rotated in a stationary position and drives the lower worm-gear, while the upper section having a left-hand worm rotates in a stationary position until forced to move upward with the upper worm-wheel to permit the work to be placed between the embossing dies. The upper section of the vertical shaft slides in the lower one and is provided with two accurately fitted keys in order to maintain proper alignment of the embossing dies and to insure adequate driving power. The upward movement of the shaft, which permits the work to be entered between the embossing dies, is obtained by means of a cam. This upward movement is approximately ⅜ inch and takes place after the embossing operation has been completed. A locking device is provided which permits the upper shaft to be held down in the proper position while the embossing operation is taking place. An automatic stop is also provided for stopping the machine when the operation is completed.

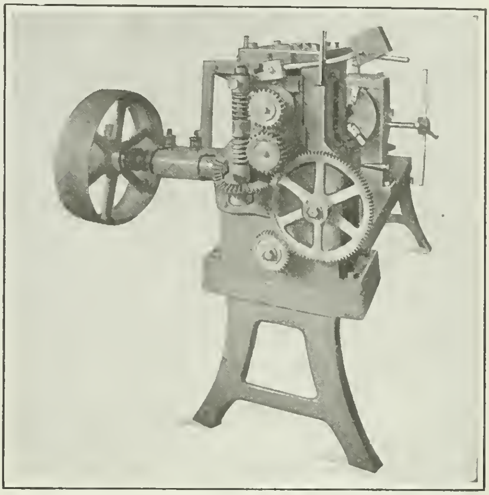


Fig. 2. End View of Merey Embossing Machine shown in Fig. 1

The male and female embossing dies are made in segments which are interchangeable, thus providing means for setting up the machine to emboss any name or inscription that is desired. The upright frame at the right-hand end of the machine, Fig. 1, supports a shaft on which the work-holding chuck is mounted. Longitudinal and vertical movement of this shaft is provided to accommodate work of various sizes. The shaft on which the chuck is carried is driven by means of spur gears. At the end of the driving shaft is an adjustable friction plate which permits objects having steps of different diameters to follow the arcs of the embossing-die segments. This machine weighs approximately 2000 pounds and has a capacity for embossing three-row inscriptions at the same time on 16-gage steel. Only 3 horsepower is required to drive the machine.

BRIDGEPORT FACE GRINDER

A motor-driven horizontal face or edge grinding machine having a capacity for handling work up to 24 feet in length, which has recently been developed by the Bridgeport Safety Emery Wheel Co., 83 Knowlton St., Bridgeport, Conn., is illustrated in Figs. 1 and 2. This machine was designed for bolting to a solid foundation; it is provided with a stationary work-holding table; the grinding wheel being mounted on a column bolted to a short carriage that is traversed along flat top rails of the bed in back of the table. The traversing movements in either longitudinal direction are obtained by means of a 5-inch diameter lead-screw running the entire length of the bed between the surfaces on which the carriage is supported. This lead-screw is driven by a 7½-horsepower motor operating at 1150 revolutions per minute, the motor being connected to the screw by means of a silent chain and reduction gearing. A toothed clutch operated by a shifting lever serves to place the proper gears in mesh for revolving the lead-screw in the desired direction. Radial ball bearings are provided at both ends of the lead-screw and end thrust ball bearings on each side of the journal at the right end of the screw, adjustments being furnished to compensate for any slight wear. Several supports are provided for the lead-screw between the end bearings.

One side of the column has two finished flat surfaces upon which the wheel saddle is mounted. The vertical movements of the saddle, and therefore of the grinding wheel, are obtained by means of a 2-inch elevating screw that is driven by a 3½-horsepower motor running at 850 revolutions per minute which is mounted on top of the column. The motor is connected to the screw through spur and worm reduction gears, which permit a practical speed for the screw. The necessary gears to move the wheel up or down as desired are thrown in mesh by means of a shifting lever. The grinding wheel is made up of sectional blocks forming a wheel 32 inches in diameter with a face 8 inches wide and a cutting rim 4 inches thick, there being fourteen sections with an open space between each one to cause the chips to be removed from the face of the wheel.

The wheel-spindle is driven by a 40-horsepower motor running at the rate of 1150 revolutions per minute, to which it is connected by a fiber pinion and a large gear, the ratio between the two being about 2 to 1. Both the grinding-wheel spindle and the motor are mounted on a head that is attached to the saddle previously mentioned. Transverse movements of the wheel can be obtained by operating the head on the saddle by means of a 1½-inch diameter screw that is turned through the use of a 14-inch diameter handwheel at the rear of the machine. The wheel-head can be swiveled to permit the work to be ground at an angle as well as perpendicularly. The wheel-spindle runs in ball bearings and is provided with end-thrust bearings to take up the thrust in either direction, adjustments being furnished for wear.

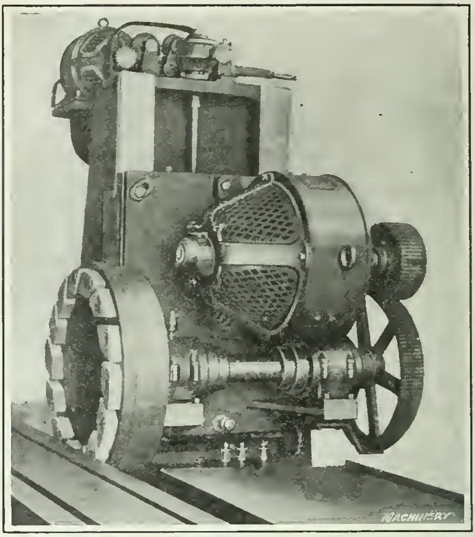


Fig. 2. Close-up View of Grinding Wheel and Motor, showing Method of mounting on Column

Automatic reversal of the traverse of the column is obtained by means of a stop on the front of the column near the bottom, which comes in contact with dogs mounted on a shipping bar extending the full length of the bed. This shipping bar is supported at five points and two dogs are furnished between each support, the dogs being pivoted so that they can be readily moved out of the way and only two of them used as required to cover the range of travel desired. The table previously referred to has a working face 18 inches wide and has two T-slots running its entire length. The work must be firmly mounted on this bed in such a manner that the face to be ground will come in contact with the grinding wheel. If the work is of such width that it extends back from the table to any great extent, it should be supported by suitable horses. A full-length supplementary table 10 inches wide is provided to be attached to the work-table when small pieces or sheet stock are to be ground. The weight of the machine, ready for domestic shipment, is approximately 32,000 pounds.

RYERSON HIGH-SPEED FRICTION SAWS

A line of high-speed friction saws, designed for the rapid cutting of structural steel, has been developed by Joseph T. Ryerson & Son, Sixteenth and Rockwell Sts., Chicago, Ill., one of which is shown in the illustration accompanying this description. The base of the machine is made of cast iron and is of a heavy box section. It supports a carriage on which there is mounted the motor furnishing power for rotating the saw disk. This carriage runs on large rollers, equipped with ball bearings, the rollers being mounted on eccentric shafts furnishing adjustment for wear. The saw disk or blade is directly mounted on the armature shaft of the motor, the blade being made of a special grade of soft steel, balanced, hollow-ground and nicked on the edge to increase the friction between the saw and the work. The saw is held in place by two heavy cast-steel collars, and the cutting edges are cooled by jets of water directed against it. A hood bolted to the carriage serves as a guard for the saw; this hood can be opened to facilitate examination or removal of the saw.

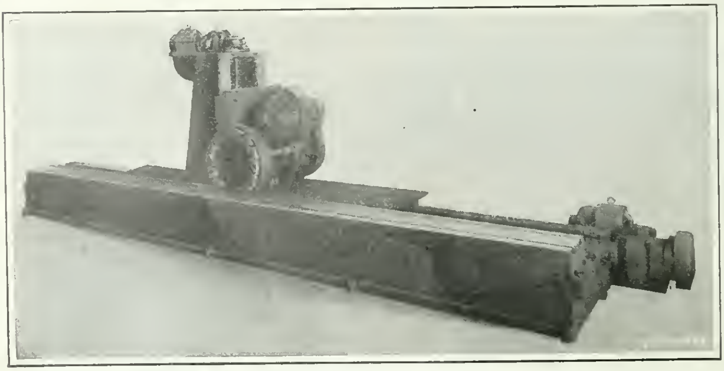
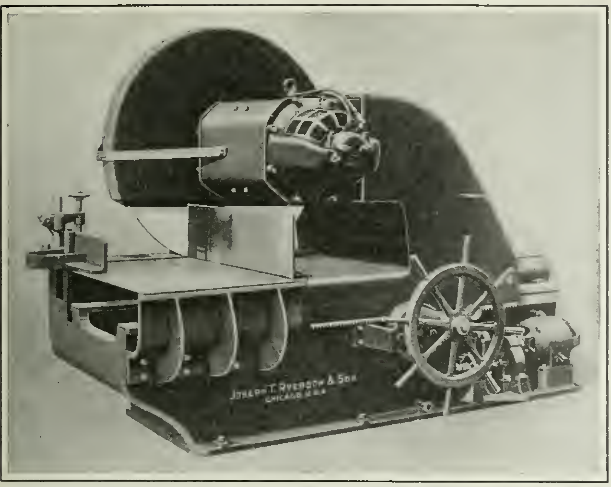


Fig. 1. No. 152 Face Grinder built by the Bridgeport Safety Emery Wheel Co. for Work up to 24 Feet in Length

Movement of the carriage is accomplished either by hand or power, the power feed being obtained through the em-



Hand- and Power-feed Friction Saw developed by Joseph T. Ryerson & Son

ployment of a special electro-hydraulic arrangement which consists of a cylinder connected to the base of the machine, a piston attached to the under side of the carriage, a one-horsepower motor which drives a geared pump, a suitable tank, and pressure relief and four-way controlling valves. The four-way valve may be placed in any convenient position and affords the operator complete control of the movements of the carriage.

The cutting speed is regulated by adjusting the pressure of the saw against the material, but the speed should not be so great as to overload the saw motor. To guard against this, the relief valve is placed in the feed line leading to the cylinder, and set to operate at a pressure corresponding to the maximum ampere load of the saw motor. This arrangement also insures the working of the saw to its full capacity when cutting through materials with varying cross-sections, such as rails, beams, angles, etc.

Various sizes and shapes of material can be cut in immediate succession without any adjustment of the machine, it being unnecessary to clamp the material. Miter cutting, as well as straight cutting, is easily handled by means of a graduated swivel clamp supplied as part of the machine. The machine is made in four sizes, Nos. 1, 2, 3, and 4, which can be furnished for any current or voltage. The No. 1 machine has a capacity for cutting standard I-beams up to 12 inches, 40-pounds; channels up to 12 inches, 40 pounds; angles up to 8 by 8 by ½ inch; standard rails up to 50 pounds; and bars up to 1½ inches square and 2 inches in diameter. The diameter of the saw blade is 46 inches, and the weight of the machine provided with power feed is about 5740 pounds. The capacity of the No. 4 machine is for standard I-beams up to 24 inches, 100 pounds; maximum sizes of channels, angles, etc., and bars up to 3 inches square and 3½ inches in diameter. The saw blade on this machine is 56 inches in diameter, and the weight of the machine is approximately 12,650 pounds.

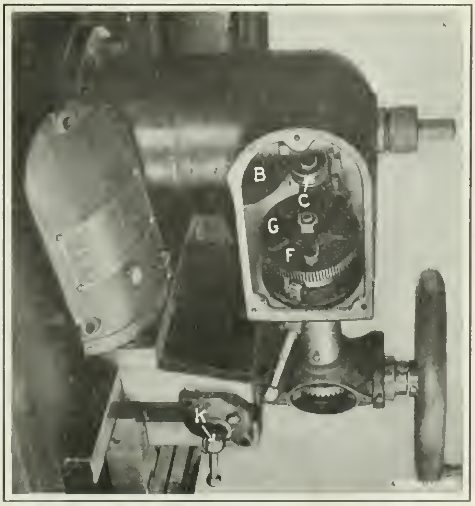
FEEDING DEVICE FOR QUEEN CITY SHAPERS

The feeding device shown in the accompanying illustration was recently brought out by the Queen City Machine Tool Co., 1405 Sycamore St., Cincinnati, Ohio, for use on this company's line of shapers. This device consists of two units, one of which is attached at the bull-wheel bearing and the other at the end of the rail feed-screw. The unit attached to the bull-wheel bearing controls the amount of feed for each stroke of the ram, while the unit attached to the rail feed-screw controls the direction of feed. At the end of the bull-wheel hub is attached a face-cam *B*, which actuates roller *C* mounted on a swinging arm, at one end of which is a ratchet pawl which engages ratchet wheel *F*.

The ratchet wheel is unusually large and drives the splined feed-shaft sleeve through the medium of a safety friction device. This arrangement prevents the machine from being damaged in case the table is fed to the limit of its traverse, or in case the feed is obstructed by interference with the work or by a wrench accidentally dropped where it will prevent the proper functioning of the mechanism. A powerful spider spring *G* provides a driving pressure which is ample for all needs and automatically compensates for wear. However, if it is desired to change the pressure at any time, it can easily be accomplished by adjusting the nut on the top of the spring.

The swinging arm on which the cam-roll *C* is mounted has a large bearing which fits over the outside of a sleeve that is pressed into the housing. The double splined feed-shaft sleeve is, in turn, fitted inside the sleeve that is held in the housing. The swinging arm is held in contact with the cam by means of a long torsion spring. The amount of feed is controlled by a stop on the adjusting-handle extension, which limits the swing of the roller arm. When the feed-controlling lever is placed at the zero position, the actuating members remain motionless. Sixteen changes of feed are provided for the movement of the parts. The feed can be started, stopped, or reversed by operating lever *K*.

The gear-box contains the familiar bevel gear and clutch construction, the clutch teeth being integral with the gears. Provision is made for adjusting the mesh of the gears to compensate for wear. A partition is placed back of the cam, and felt oil-retaining rings and wipers are employed so that the gears can be run in oil. The sliding connection to the rail is rigidly supported by a long sleeve. The driving keys and the shaft are made unusually long, and the position of the shaft is such that it prevents the parts from being forced out of alignment. All parts of the device are interchangeable, and it is stated that it can be easily disassembled and completely reassembled in less than fifteen minutes.

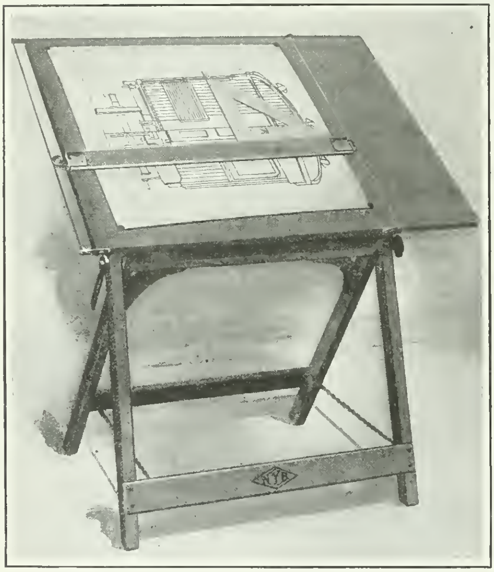


Feed Mechanism for Use on Shapers built by Queen City Machine Tool Co.

PARALLEL RULING ATTACHMENT

The parallel ruling attachment shown mounted on a drawing board in the illustration has been placed on the market by the New York Blue Print Paper Co., 102 Reade St., New York City. This attachment consists of the following metal parts which are made of aluminum to eliminate corrosion: one plate with a double pulley, one plate with two small pulleys, and four metal brackets with a hole at each end and a small metal grip to hold the cord firmly. Sufficient silk cord is also supplied for arranging the attachment on a drawing-board. A shoulder on the double-pulley bracket slides along one edge of the drawing-board and thus serves the same purpose as the head of a T-square. The parallel cords running across the drawing-board are hidden in the straightedge. The latter can be held at an angle for the purpose of drawing slanting lines.

The attachment is so made that it is easy to mount on a drawing-board, and it may be supplied with crystalloid transparent-line straightedges, mahogany ebony-line straightedges or hardwood-line straightedges. Various lengths ranging from 24 to 60 inches may be furnished. Anyone possessing a good straightedge not less than ⅛ inch thick, can have the necessary metal parts of the attachment mounted on it by sending it to the concern mentioned.

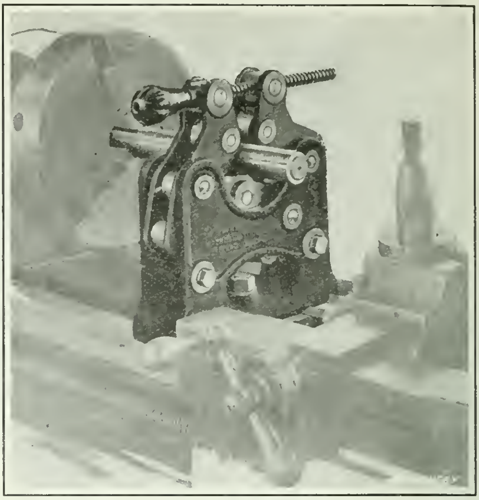


Drawing-board equipped with Parallel Ruling Attachment made by the New York Blue Print Paper Co.

MC CROSKY SELF-CENTERING STEADYREST

A quick-acting and self-centering steadyrest designed for use on lathes and grinding machines, and especially adapted to the holding of work, on the ends of which facing, boring, turning, and similar operations are to be performed, has been developed by the McCrosky Tool Corporation, Meadville, Pa. Reference to the illustration will show that the work is supported by three rollers, two of which are mounted on pivoted brackets, the third being arranged to support the work at the bottom. These three rollers are adjusted simultaneously to suit the diameter of the work.

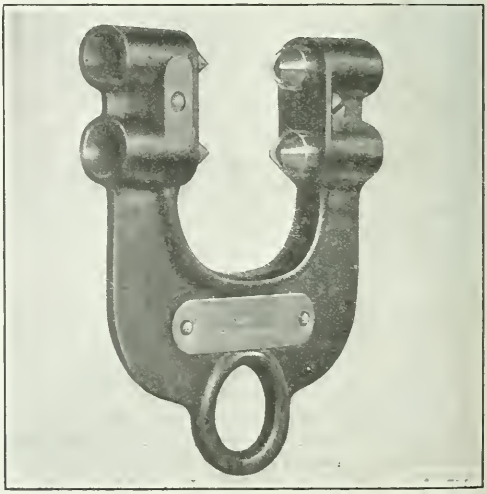
The rollers on the regular steadyrest are hardened and rotate on roller bearings; however, if soft and highly finished work is to be handled, hardened rollers are not recommended, stationary cast-iron jaws being supplied instead. It is claimed that the steadyrest is equally suitable for a variety of general work and for quantity production. When it has been once adjusted to the centers of the machine, the steadyrest can be taken off frequently and replaced in a few moments without readjustment.



Lathe and Grinding Machine Steadyrest made by the McCrosky Tool Corporation

G T D THREAD LIMIT SNAP GAGE

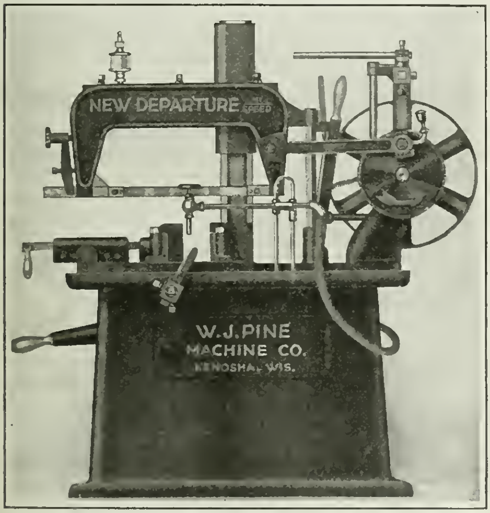
An improvement has been made on the thread limit snap gages manufactured by the Greenfield Tap & Die Corporation, Greenfield, Mass., so that the two "Go" or "Not Go" anvils of a gage are placed directly opposite each other, instead of having them offset an amount equal to one-half the pitch of the screw thread, the latter construction being necessary on the old type of gage on account of the complete use of solid conical measuring points. With the new type, however, one of the anvil points is solid as before, but the opposite one is of a much larger diameter and is provided with



Improved Type of Thread Limit Snap Gage made by the Greenfield Tap & Die Corporation a V-shaped groove running across the center. This groove is of sufficent depth to clear the thread diametrically across the screw from the first anvil, the measurement of the thread being accomplished by having the conical surface of the second anvil in contact with the thread flanks, instead of the V-groove surfaces. When testing the pitch diameter of a screw, the work is simply passed between the "Go" anvils of the gage, but it must not be possible to pass it through the "Not Go" anvils.

W. J. PINE METAL SAW

The metal saw illustrated is known as the "New Departure," and was designed by the W. J. Pine Machine Co., 411 Jenne St., Kenosha, Wis., to more economically and rapidly perform such operations as cutting out machine parts of various irregular shapes, which are frequently machined on shapers and milling machines. In work of this kind, a certain amount of stock is usually lost when the operation is performed on other machines, but by the use of this saw it can be saved for future use. The depth of a cut can be regulated by means of a graduated indicator, and the work may be clamped accurately in the vise at any desired angle, the correct setting being obtained by means of a graduated adjusting device. Auxiliary vise jaws which can quickly be put in place or removed from the machine are provided for holding irregular work. On the return stroke of the saw blade, it is lifted from contact with the work by a positive movement which is not dependent upon a spring. Because of this arrangement, the saw cannot be dragged, and danger of injury to it from such a cause is eliminated.



Hacksaw Machine manufactured by the W. J. Pine Machine Co.

KANE & ROACH STRAIGHTENING MACHINES

The No. A straightening machine shown in Fig. 1 is a recent product of Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y. This machine is designed especially for straightening sheet steel blanks for hacksaw blades, files, knives, and similar work which requires straightening while cold, both before and after tempering. One of the notable features of this machine is the employment of stepped rolls for the purpose of overcoming the difficulties experienced in straightening blanks which vary in thickness, amount of curvature, and hardness.

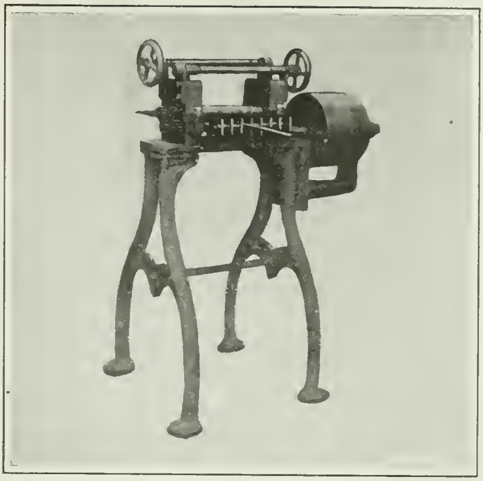


Fig. 1. Kane & Roach No. A Straightening Machine

The straightening is accomplished by passing the work between two pairs of rolls which are gear driven, as will be observed by referring to Fig. 1. The two upper rolls are adjustable vertically, while the two lower rolls are mounted in stationary bearings. The function of the first or front upper roll is that of taking out kinks and bends while the last or back upper roll completes the final straightening operation. There are seven steps on each roll, the diameter of the first step at the right-hand end of each roll being the smallest. The diameter of each succeeding step to the left of the small step is greater than that of the step which precedes it. Therefore, this construction gives seven steps each of a different size.

When the machine is set up for any particular size or thickness, it is usually adjusted so that the middle step will properly straighten the average blank. This leaves three smaller steps at the right of the middle step and three larger steps at the left. There is a guide or pocket leading into each of these different steps which will not allow the material to start at an angle with the rolls or allow it to run off the step.

When an experienced operator picks up a piece, he can tell almost instantly into which step it should be placed.

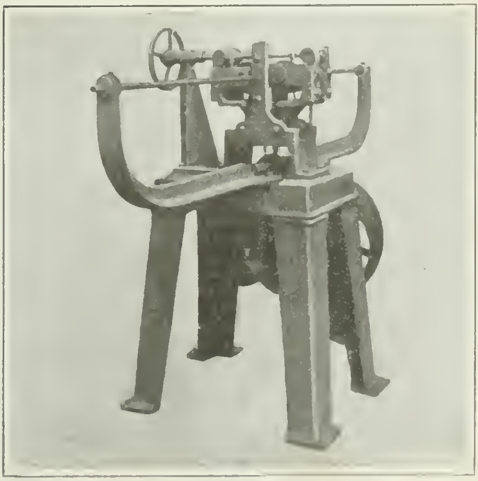


Fig. 2. Kane & Roach No. 00 Straightening Machine

If the piece is of average thickness, curvature, and hardness, it will be placed in the middle step, while if it varies considerably from the average it will be placed on either a larger or smaller step according to its condition. This machine can be used for straightening blanks as short as 3 or 3½ inches and from that size up to almost any length. The machine occupies a floor space 24 by 36 inches and can be driven by a ½-horsepower motor.

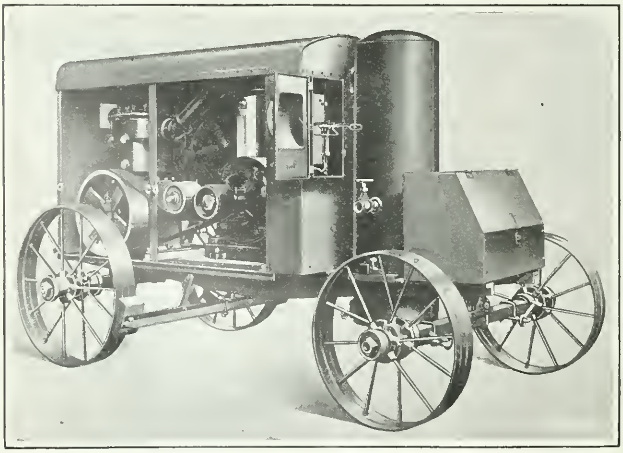
No. 00 Rotary Straightening Machine

The No. 00 rotary straightening machine shown in Fig. 2 is intended for handling round stock (either tubes or solid bars) in sizes from 3/32 to 5/16 inch in diameter. The stock to be straightened enters the machine through a tube and passes between the rolls at the center of the machine. There are two rolls, one convex and the other concave. The relative position and shape of these rolls is such that the material is fed through the machine automatically. When in operation, the rolls grip the round stock, revolve it, carry it through automatically, and straighten it. It is seldom necessary to pass the stock through the machine the second time as it is generally found to be sufficiently straight for ordinary purposes after one passage through the machine. The machine will handle pieces from 8 inches to 30 feet in length if required, but it is generally employed for straightening pieces of from 3 to 10 feet long. The rolls are made of steel and are hardened. By turning the handwheel shown on the side of the machine, it can be adjusted for any diameter within the range of the machine. This machine occupies a floor space 24 by 60 inches, including the projecting arms which carry the tubing through the machine.

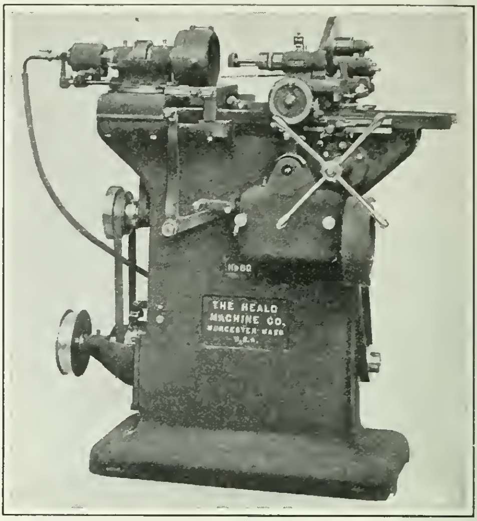
INGERSOLL-RAND PORTABLE AIR COMPRESSOR

The Ingersoll-Rand Co., 11 Broadway, New York City, has recently added an electrically driven portable air compressor to its line of "Imperial" gasoline-driven compressors. This new unit, which is shown in the accompanying illustration, is known as the Imperial Type 14 electrically driven portable compressor. It has a capacity of 118 cubic feet per minute, and the complete unit weighs approximately 4450 pounds, the weight depending upon the size of motor used.

This unit is especially adapted for the use of contractors, street railway, and public service companies which have electric current available for power purposes. It is of all-steel construction, light steel doors being provided which completely house the compressor and motor. This equipment can be furnished with alternating- or direct-current motor.



Portable Electrically driven Air Compressor built by the Ingersoll-Rand Co.



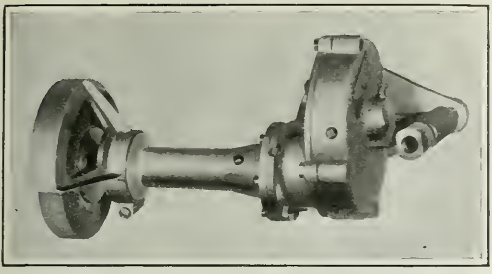
Grinding Machine built by the Heald Machine Co. for grinding Long Holes of Small Diameter

HEALD INTERNAL GRINDING MACHINE

The Heald Machine Co., 16 New Bond St., Worcester, Mass., has recently added to its line of products a No. 80 internal grinding machine, which is of practically the same design as the No. 85 machine described in the August, 1919, number of Machinery, except that the new grinder is intended for machining long holes of small diameter, whereas the previous one was intended for short holes of small diameter. The new No. 80 machine is provided with power feed for the grinding-wheel table in addition to the hand feed with which the No. 85 grinder is equipped. The makers state that the reason for this addition is because it is usually a difficult proposition to grind a long small hole by means of a hand feed when extreme precision is required, such as is generally necessary in tool-room work. With this arrangement, work longer than 1½ inches can be ground to a limit of 0.0001 inch or less.

Ordinarily, the power feed is used while the grinding wheel is in actual contact with the work, but as the wheel leaves the work, by pulling a vertical lever at the head end, which can be plainly seen in the illustration, the operator disengages the clutch operating the power feed and engages one connecting the hand feed. In this way, rapid hand movement of the table away from the work is obtained. At the same time a guard automatically swings over the wheel, the flow of water ceases, and rotation of the work stops, making gaging or removal of the work instantly possible.

A two-step cone drive provides two speeds of travel for the table with the power feed, and this travel can be reversed accurately at any point. The wheel-head provided on the machine is known as the Type 11, and has a solid adjustable taper bearing at the wheel end and ball bearings at the pulley end. The machine is suitable for grinding holes ranging from ¼ to 2 inches in diameter and up to a maximum length of 3¾ inches. The actual swing is 6 inches inside the water guard and 10 inches with the guard removed. The floor space required is 28 by 56 inches, and the weight, 1300 pounds.

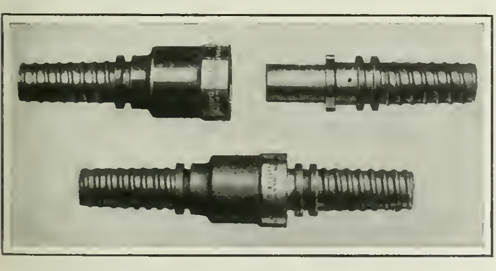


Air-operated Machine for driving Grinding Wheels, etc., built by the Turbine Air Tool Co.

TURBINE PNEUMATIC GRINDER

A pneumatically operated machine designed for driving grinding wheels, wire brushes, buffing wheels, etc., for grinding and cleaning castings and for buffing or polishing metals of all kinds, is made by the Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio. Some of the advantages claimed for this machine are lightness of weight, compactness of construction, small number of parts, and absence of vibration. The housing is made of aluminum, the turbine of a special aluminum alloy having the tensile strength of steel, the gears of nickel steel, and the pinions of chrome-vanadium steel. The grinder is fitted at one end with an air throttle, while a shank on the other end furnishes a grip for the operator to guide the machine over the work. When equipped with a wheel 6 inches in diameter, the peripheral speed is about a mile a minute. The weight, with a wheel 6 inches in diameter and 1 inch thick, is 16 pounds.

INGERSOLL-RAND AIR-HOSE COUPLINGS



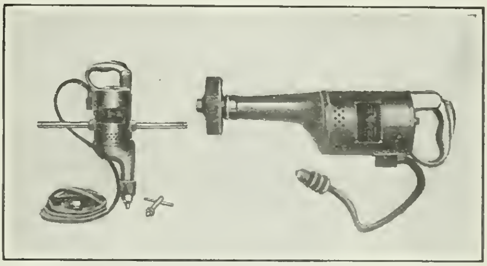
Disassembled and Assembled Air-hose Coupling manufactured by the Ingersoll-Rand Co.

Hose couplings which leak after a short period of use are the cause of serious air losses, both in small shops and in large plants using hundreds of connections. Another trouble commonly experienced is that the couplings jam or stick through some slight injury, and these tendencies make them difficult to connect or disconnect. With the idea of eliminating such troubles, the Ingersoll-Rand Co., 11 Broadway, New York City has added the type of coupling here illustrated to the line of "Little David" pneumatic equipments of its manufacture. The main feature claimed for this coupling is a sturdiness and simplicity of construction which will stand lots of abuse without impairing its surface. As shown in the upper portion of the illustration, the coupling consists of two parts, male and female. These parts are made of a metal which is not subject to ordinary corrosion. The female end is fitted with a V-shaped rubber gasket to provide an airtight joint. This gasket is prevented from being blown out in the event that the coupling becomes accidentally disconnected under pressure, by a protective shoulder inside the coupling. The locking shoulders have large bearing surfaces and the locking spring can be replaced when necessary.

The male end has a liberal bearing in its mating part to assure proper alignment and long wear. The air ports are straight and of uniform diameter, thus offering a minimum amount of resistance to the air. The coupling may be connected and disconnected by a quarter turn. Grooves are provided on the hose end of each part to allow the use of a clamp in attaching hose to the coupling. These couplings are manufactured in ½- and ¾-inch sizes which are interchangeable, that is, a ½-inch male section may be used with a ¾-inch female end, or vice versa.

WODACK PORTABLE ELECTRIC TOOLS

The Wodack Electric Tool Corporation, 23-27 S. Jefferson St., Chicago, Ill., is manufacturing a portable motor-driven drill, suitable for operation on either alternating or direct current. A feature of this drill, which is shown at the left in the accompanying illustration, is that the current is automatically disconnected when the operator releases his grip on the handle. This is effected by having a switch of the "quick make and break" type located in the handle and actuated by the palm of the operator's hand. In this way, the current is shut off instantaneously with the release of pressure. The drill is made in the following six sizes: 3/16, 5/16, ⅜, ½, ⅝, and ¾ inch the nominal size representing the diameter of the hole which the drill is capable of machining in steel.

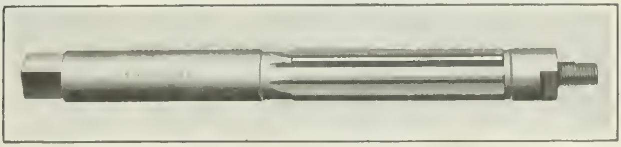


Portable Motor-driven Drill and Grinder made by the Wodack Electric Tool Corporation

In addition to this drill, the concern is manufacturing the portable grinder shown in the illustration at the right, which is equipped with the same style of control as the drill. This grinder is suitable for smoothing castings and buffing or polishing parts, being made in three sizes. Both the drill and grinder are fitted with motors manufactured by the maker of these tools. They have been designed to withstand severe usage and overloading. The casings are made of aluminum, and S K F ball bearings are used throughout the construction.

SCHELLENBACH-HUNT EXPANSION HAND REAMER

The illustration shows an expansion type of hand reamer which is a recent product of the Schellenbach-Hunt Tool Co., Cincinnati, Ohio. This reamer is split the length of the



Expansion Hand Reamer made by the Schellenbach-Hunt Tool Co.

teeth, and is expanded by means of a taper-threaded screw which engages with tapped threads at the starting end of the reamer. The ends of the teeth are ground at an angle on the outside, and they are locked in the adjusted position by means of a beveled locking nut as shown. The construction of the reamer permits quite a large range of expansion, 0.025 inch or more being easily obtainable on a ½-inch diameter reamer. Corresponding increases in diameter are possible on the larger sizes of reamers. The adjusting screw and locking nut are hardened.

"SACREY" OIL-GROOVING MACHINE

A machine for cutting practically every type of oil-groove, including straight, cross, and right- or left-hand helical, on internal and external surfaces of parts, has been developed by the Philadelphia Engineering & Machine Co., 1130 Race St., Philadelphia, Pa. This machine is known under the trade name of "Sacrey," and is shown in the accompanying illustrations. It may be driven from a lineshaft or by a constant-speed ¾-horsepower motor. The work is held stationary in a chuck at the top of the machine and the cutter rotates, reciprocates, or performs both movements, according to the type of groove that is to be produced.

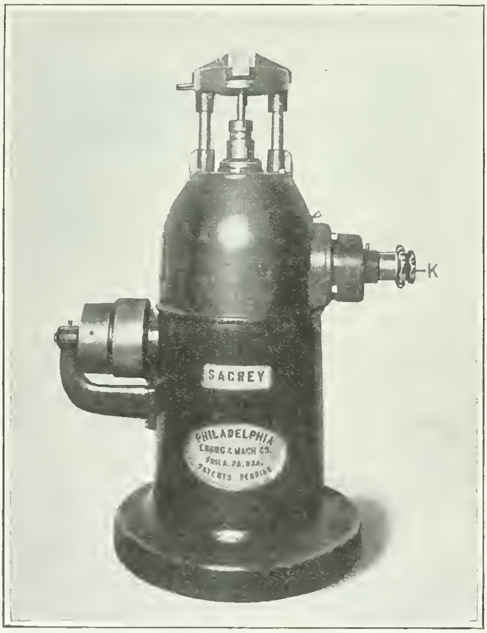


Fig. 1. "Sacrey" Oil-groover made by the Philadelphia Engineering & Machine Co. for cutting Grooves on Internal and External Surfaces

The main driving shaft is held in a horizontal position and is connected to the vertical shaft *A*, Fig. 2, through a set of bevel gears. At the upper end, shaft *A* is connected by means of change-gears with the spindle driving shaft *H*, which is in two sections, the lower section being driven from the upper by means of a hardened steel clutch, so constructed that the machine is adapted to the cutting of multiple oil-grooves. This clutch is engaged and disengaged by operating the knurled spring plunger *B*, which is mounted on the feed-box panel and adjacent to all other operating levers. By disengaging this clutch, the rotation of the cutter-spindle is stopped, but it may still be operated vertically, this arangement permitting the cutting of straight grooves.

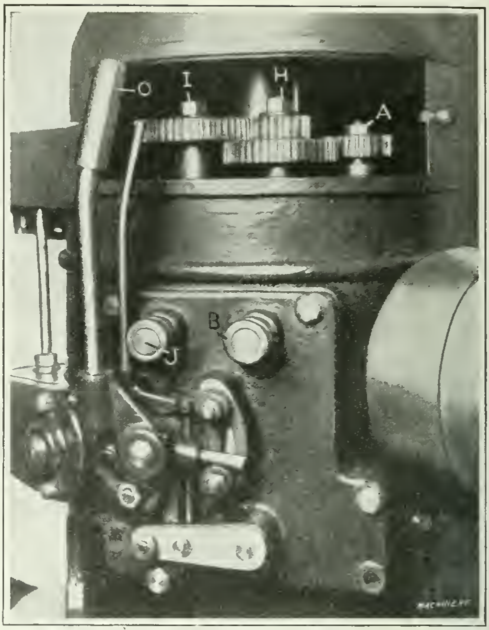


Fig. 2. Close-up View of Control Levers and Mechanism at the Operating Side of the Machine

The necessary movement for bringing the grooving tool in contact with the work after the latter has been inserted in the chuck is obtained in the following manner: Mounted on shaft *H* below the clutch there is a steel spiral gear *C*, Fig. 4, which engages with a bronze spiral gear *D* mounted on the lower end of the feed sleeve that surrounds the spindle located at the center of the machine. Spiral gear *D* has a much wider face than gear *C* so that when the latter is moved vertically by the clutch lever *E*, operated by handle *O*, Fig. 2, the feed sleeve is rotated 30 degrees, due to the cam action of the teeth on one gear when slid along those of the other. This rotation brings cam *F*, Fig. 4, on the sleeve into contact with a hardened roller carried on the lower end of the pivoted cutter-bar holder, giving the holder a rocking motion and feeding the tool into the work. The cutter-bar holder is held against the cam by a long flat spring *G*. A tapered hole is provided at the top of the holder, into which the cutter-bars fit and are held by a locking nut. By this means it is possible to readily change from a small to a large bar, according to the size of work that is being done.

The rotary movement of the cutter is obtained by means of a set of spur gears connecting the spindle and shaft *H*

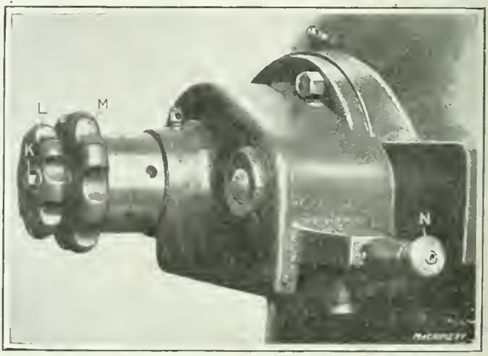


Fig. 3. Knobs at End of Crankshaft which control the Crank Stroke

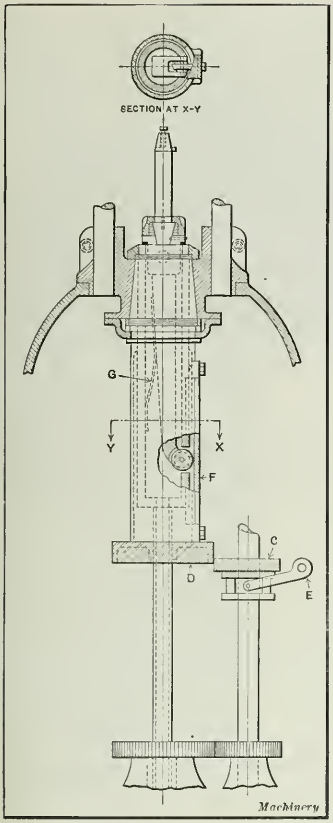


Fig. 4. Construction of Cutter-holder, Spindle and Sleeve

near their lower ends, and a reciprocating motion is accomplished as follows: At the top of shaft *H* there is a second change-gear which meshes with another gear carried at the top of shaft *I*. This shaft is also in two sections which are connected or disconnected by a clutch operated through the spring plunger knob *J*. At the lower end of the shaft there is a spur gear engaging an idler meshing with another gear mounted on the lower end of a vertical shaft which, in turn, drives the horizontal crankshaft *K*, Figs. 1 and 3, through the medium of bevel gearing. The crank on shaft *K* is connected in a suitable manner to the spindle, and imparts to it the reciprocating movements. The stroke of the crank is adjustable by increments of ⅛ inch from 0 to 7 inches, this adjustment being easily accomplished by loosening the locking knob *L* and then turning knob *M* to the graduation on the sleeve indicating the desired stroke. This adjustment is absolutely positive, because teeth in the collar mounted on the crankshaft fit similar teeth on knob *M*.

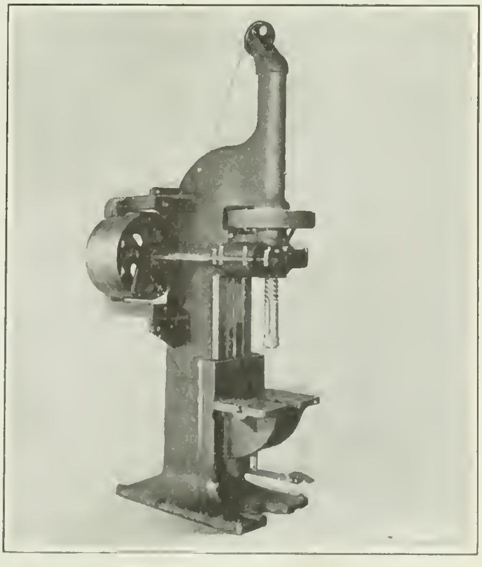
The machine is adapted to the cutting of intermittent grooves by simply turning knob *N*. This causes a roller carried on a bellcrank to be thrown in contact with one of two cams on the crankshaft. The resulting motion is imparted through the bellcrank to the spiral gear *C*, Fig. 4, and moves the gear up and down its shaft from one to four times per revolution of the cutting tool. Of course, the number of movements depends upon the change-gears connecting shafts *H* and *I*, Fig. 2. The work-holding chuck is attached to two upright steel posts at the top of the machine and is adjustable up and down to accommodate various lengths of bushings or other work in which oil-grooves are to be cut. The chuck is of the three-jawed scroll type and is quickly opened and closed by means of a handle. Work up to 4½ inches in diameter may be held in the chuck body.

An adjustable arm mounted on one of the upright posts serves as a stop to locate the work when it is placed in the chuck. The vertical construction of the machine permits the handling of a large variety of sizes or shapes of work, as special fixtures can be designed for many cases. In quantity production, all grooves are cut with the automatic feed, while hand feed may be used for small lots. Provision of an automatic feed permits the machine to be operated by girls or unskilled help. Double-row ball bearings are furnished to take up the thrusts on the spindle and the crankpin. All other bearings are made of phosphor-bronze. The large exterior bearings are equipped with oilers, and the interior bearings are lubricated by tubes from a central reservoir.

"FLEXIBLE" POWER PRESS

The General Mfg. Co., Detroit, Mich., has recently brought out a machine known as a "flexible" power press which is shown in the accompanying illustration. As the name implies, the amount of pressure exerted by the press is flexible or variable. By simply pressing down on a foot-pedal, the operator can obtain any desired pressure from a few pounds up to 20 tons, the pressure exerted on the work by the ram being in direct proportion to the amount of pressure applied to the pedal. This feature makes the machine especially adapted for performing straightening operations on a large variety of work. The press is also particularly well adapted for performing such operations as push-broaching, pressing in bushings, and assembling gears on shafts. The ram, having a stroke of 18 inches and a maximum distance of 28 inches above the adjustable table, gives the machine a capacity for work of considerable size.

The machine is belt-driven and power is transmitted to the ram through a 10 to 1 ratio worm-gear, which runs in oil and which has two ⅝-inch splines that are a sliding fit in keyways cut in the ram. The ram rotates at a constant speed and is caused to advance by pressing down on the foot-pedal. Pressure on this pedal causes a brake-band to tighten about a drum in which the ram is threaded. When the foot-pedal is in its normal position, with the brake-band released, the drum rotates with the ram and no forward motion is imparted to the ram. When the foot-pedal is depressed, the brake-band is engaged, stopping the drum rotating. This causes the ram to travel down at 100 to 140 inches per minute, as determined by the speed of the driving pulley, until the brake-band slips or the foot-pedal is released, at which time a counterweight inside the column gives a quick return to the ram. During the return movement, the drum spirals or turns on the threaded ram, the end thrust being taken by a ball bearing between the drum and the main casting. The knee adjustment is made by means of a rack and pinion, and the knee is held at any desired height by clamp gibs secured by six nuts, and a spring plunger engaging a ratchet cast integral with the column.

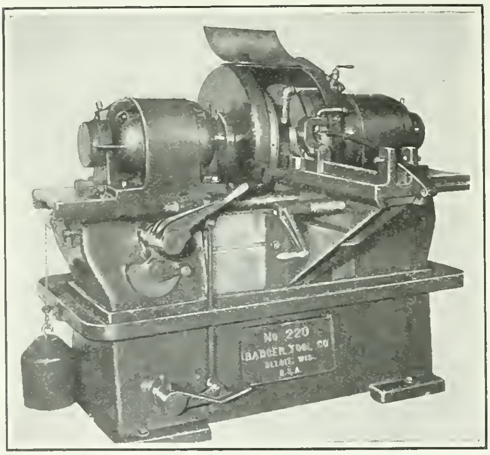


"Flexible" Power Press built by the General Mfg. Co.

BADGER GRINDER ATTACHMENT FOR OPERATION ON LEAF SPRINGS

In the manufacture of leaf springs, it is necessary to grind each eye to a specified length to fit the spring shackle, and, to facilitate this operation, the Badger Tool Co., Beloit, Wis., has produced an attachment which is shown in the accompanying illustration mounted on a No. 220 motor-driven disk grinder. This attachment consists of a support carrying a sliding ram which is caused to move in and out between the grinding wheels by means of a rack and a pinion rotated by the crank at the front of the machine. The eye of the spring to be ground rests in a hardened V-block attached to the rear end of the ram, adjustable upright lugs being provided to locate the spring so that the ends of the eye will be ground parallel to the general axis of the entire spring. A quick-acting clamping screw locks the spring in position for the operation.

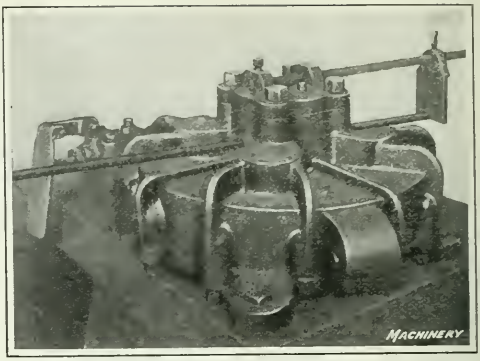
A sheet-metal pan which was removed from the machine at the time that the photograph was taken, encloses the attachment, and this pan, together with the wheel-hoods and drip-pans that completely surround the machine base, confines the grinding compound and causes it to be returned to the tank attached to the machine at the rear. In operation, the two grinding wheels are brought up to a stop, and after the spring has been clamped in position, the spring is passed back and forth between the grinding wheels in the manner previously described. The total weight of the machine equipped with the attachment is about 3800 pounds.



No. 220 Badger Disk Grinder equipped with Attachment for grinding Eyes of Leaf Springs

SCULLY-JONES PNEUMATIC OR STEAM ROD-CUTTERS

Two sizes of rod-cutters, one of which is capable of shearing rods up to ⅜ inch in diameter and the other up to ⅝ inch in diameter, and both of which are suitable for operation either by air or steam, have been developed by Scully-Jones & Co., 647 Railway Exchange Bldg., Chicago, Ill. These machines will cut all sizes within their range, without necessitating any changes or readjustments, and at a minimum pressure of 60 pounds. The only moving part with which the operator can come in contact is the knee lever at the left, which is operated to move the cutters, after the work has been inserted through the device, until the end comes in contact with the bar stop set to suit the desired length. The cutters are of the round ring type, and are provided with ten cutting edges which can be used successively as the preceding one becomes worn. The travel of the piston in the ⅜-inch machine is ½ inch, and that in the ⅝-inch machine is ⅞ inch. The machines are suitable for installation on permanent benches or on portable ones. They are particularly adapted for use in foundry core-rooms, machine and blacksmith shops, etc.

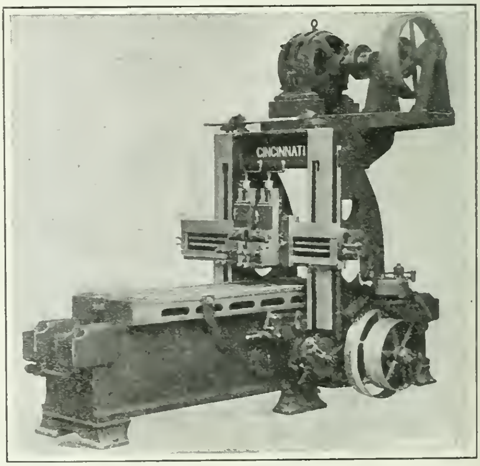


Rod-cutter made by Scully-Jones & Co., which is operated by Air or Steam

CINCINNATI SHOE AND WEDGE PLANER

The 30-inch shoe and wedge planer shown in the accompanying illustration was especially designed by the Cincinnati Planer Co., Cincinnati, Ohio, to withstand severe conditions of service. The extra-heavy box bed is cast closed on the top for its entire length, except where the bull gear meshes with the rack. The machine is equipped with forced lubrication, herringbone gears, and all-steel gearing. The box table is made of unusual depth and strength, to overcome all possibilities of springing. The stop holes are drilled all the way through the upper half of the table to eliminate the necessity of cleaning out the holes before inserting a stop, while the lower half of the table is cast solid to prevent dust and chips from working into the vees of the bed.

The housings are fastened to the sides of the bed, and their faces are liberally proportioned to furnish sufficient bearing surfaces for the cross-rail. The heavy box arch employed to tie the housings together at the top gives increased strength and rigidity. Both tool-heads are mounted on one saddle, so that they move transversely in unison, but provision is

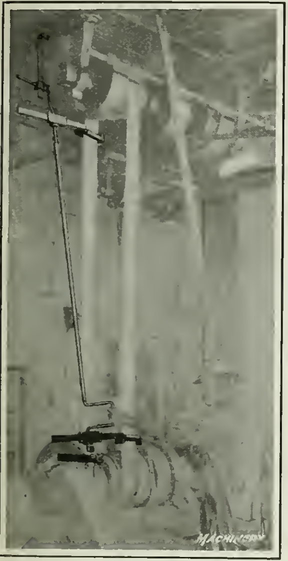


Shoe and Wedge Planer recently developed by the Cincinnati Planer Co.

made for operating them in a vertical direction independently by hand or by power. The machine is regularly equipped with a patented two-speed countershaft, but it can be arranged for a plain or variable-speed motor drive as shown.

HASKINS BELT SHIFTER

The R. G. Haskins Co., 27 S. Desplaines St., Chicago, Ill., has recently placed on the market a device known as the "Spurgin" belt shifter. It is claimed that this device not only permits the belt to be shifted quickly and without apparent effort on the part of the operator, but that its use also results in doubling or trebling the life of a belt, due to the frictionless guides. The manner in which the shifter is operated will be apparent from the accompanying illustration. Steel is used in the construction of the shifter wherever possible, and its durability is said to have already been thoroughly demonstrated through results obtained from its use in several large manufacturing plants. The use of this belt shifter allows belts to be shifted without danger of accidents; the production rate is increased by always operating the machine at a suitable speed.

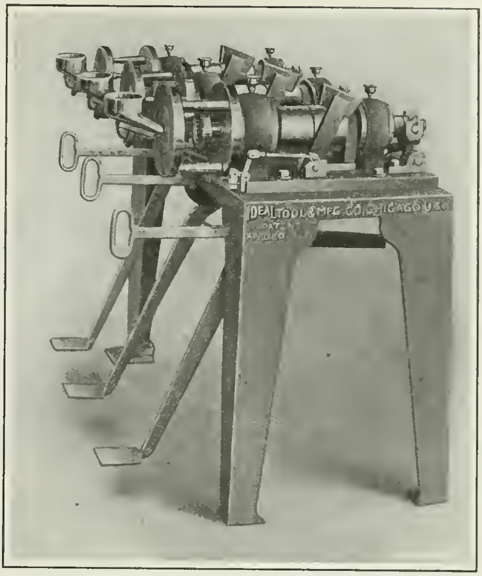


"Spurgin" Belt Shifter developed by the R. G. Haskins Co.

CENTRIFUGAL BABBITT LINING MACHINE

Die-casting machines have been generally employed in the manufacture of babbitt-lined bronze bearings such as are extensively used for automobile engine crankshaft bearings, and also in electric motor bearings. The machine here described may also be termed a die-casting machine, but it operates on an entirely different principle from the usual type. As a result of carefully conducted experiments, the Ideal Tool & Mfg. Co., 5825-5829 S. Western Ave., Chicago, Ill., has succeeded in producing the machine shown in the accompanying illustration, by means of which it is claimed that the babbitt and bronze can be united as a single piece. When in operation this machine holds the molten babbitt against the bronze bushing by centrifugal force, until it is properly cooled. The machine shown is a three-spindle equipment, and each of the spindles runs at 1800 revolutions per minute. The employment of three spindles keeps the operator constantly at work loading and unloading the machine, and at the same time allows the metal to cool sufficiently before removal. The output of a machine of this type is approximately 700 bearings a day. The thin wall of babbitt left in a bushing after it is properly bored to size ready for the motor housing, and the close-grained condition of the babbitt, which is evenly distributed by centrifugal force, give to a bearing made by this process the appearance of being a single piece of metal, except for the difference in the colors of the two metals.

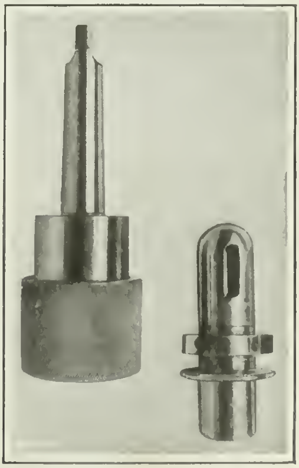
The advantage of making a bearing by this process is that while the babbitt is shrinking and actually pulling together, the centrifugal force is pulling in the opposite direction, and tends to hold the metal in place close to the bronze back until both metals have cooled. The machine is equipped with extra heavy type S K F ball bearings throughout. A belt-shifting mechanism is provided for each spindle which works in conjunction with the brake for starting and stopping the spindles. The loading and unloading is accomplished by the operation of a pedal which is within easy reach of the operator's foot. Separate chucks are, of course, provided for bushings of different sizes. The principal specifications are as follows: Weight, 1200 pounds; length over all, 48 inches; width, 24 inches; height, 48 inches; speed, 1800 R. P. M.; and speed of countershaft, 600 R. P. M.



Machine built by Ideal Tool & Mfg. Co., for lining Bronze Bushings with Babbitt

DOMPIER QUICK-ACTION SLIP-COLLET CHUCK

A new type of slip-collet chuck adapted to the performance of drilling, reaming and boring operations, etc., and which permits instant removal of the tool when necessary, is being manufactured by the Dompier Chuck Co., 446 Book Bldg., Detroit, Mich. The collet, as well as the various parts which enter into the construction of the chuck proper, is made of 0.20 per cent carbon steel, carburized, hardened, and ground. The chuck can be used at any speed and can be placed in any desired position. It is locked in place by tapered keys, and in order to remove a collet it is simply necessary to push back the spring-actuated knurled sleeve



Quick-action Slip-collet Chuck manufactured by the Dompier Chuck Co.

with one hand and slip out the collet with the other. If another collet is substituted, it will become locked in place when the knurled sleeve is released. The shank on the chuck is a standard Morse taper and this is also true of the hole in the collet. The chuck is made in four sizes having Nos. 2, 3, 4 and 5 Morse taper shanks, respectively. Each size of chuck accommodates two or more sizes of collets, the sockets of the latter ranging from Nos. 1 to 5 Morse taper, inclusive.

NEW MACHINERY AND TOOLS NOTES

Hand-operated Grinder: Luther Grinder Mfg. Co., 285 S. Water St., Milwaukee, Wis. A hand-operated bench grinder for use in sharpening drills, chisels, and similar small tools where power-driven grinders are not available.

Kerosene Torch: Mahr Mfg. Co., Minneapolis, Minn. A self-contained kerosene torch known as style T, for use in foundries, tin shops, machine shops, or wherever a small heating appliance is required. This torch is made in ½-,1-, and 1½-gallon sizes.

Blueprinting Lamp: J. H. Wagenhorst & Co., Youngstown, Ohio. A twin arc lamp especially suitable for vertical types of electric blueprinting machines. The arc is designed to operate at high speed, and it will produce a uniform distribution of light of a color duplicating daylight.

Fuel Oil Heater: Griscom-Russell Co., 90 West St., New York City. A heater designed for preheating oil fuel before it goes to the burners of oil-burning foundry cupolas. The oil is heated by passing through two coils enclosed by a high-pressure steam container, thus insuring proper vaporization.

Metal-cutting Machine: Metal Saw & Machine Co., Inc., Springfield, Mass. A horizontal metal-cutting machine with a capacity for cutting metals up to 4 by 4 inches, which is known as the "Horizontal Junior," to distinguish it from the 10- by 10-inch horizontal Napier metal-cutting machine of this company's manufacture.

Solders: Rohde Laboratory Supply Co., 17 Madison Ave., New York City. A line of solders, each one intended for a certain class of work or material. This line includes solders especially adapted for soldering sheet aluminum and aluminum castings, also a general utility solder intended for joining iron, brass, lead, nickel, tin, and zinc.

Cutting-off Tool: Rigid Tool-holder Co., Washington, D. C. A device consisting of a narrow cutting-off tool of high-speed steel, held by a hardened steel clamp on the base of the holder, which is a steel casting. The tool can be held by the toolposts of a lathe, and swung to cut on either the right or the left, the cut being made from the rear.

Self-locking Hub Plate: J. P. Finerty & Co., Dunmore, Pa. A self-locking hub plate for locomotive driving-boxes, which is made in two pieces, so that it may be slipped into an under-cut recess in the driving-box. As the under-cut recess is made slightly eccentric with the bore the crown brass acts as a key, thus holding the hub plate firmly in place.

Electric Controllers: Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis. A new line of controllers for alternating or direct current, made in sizes ranging from 1 to 150 horsepower. These controllers are known as the "Clapper" type, and are intended to supplant the Q, R, and S mill, crane, and hoist controllers of this company's manufacture.

Grinding Attachment for Portable Drill: Arnold Electric Tool Co., Inc., New London, Conn., and 114 Liberty St., New York City. A grinding attachment made for use on the Type B portable electric drills of this company's manufacture. A frame carrying the wheel-spindle is clamped to the body of the drill, and a plate running on the sleeve chuck transmits power to the wheel-spindle.

Self-gripping Mandrel: Eastern Tube & Tool Co., Inc., 41-59 Gardner Ave., Brooklyn, N. Y. A self-gripping mandrel for holding bushings, gears, and similar parts for turning or grinding operations. When the cut is applied to the work, three rollers in the body of the mandrel are caused to wedge and grip the work rigidly. Parts can be slipped on or off the mandrel by simply turning them slightly to the left.

Oilstone Holder: J. A. Raught, 1006 Grand Ave., Racine, Wis. A self-cleaning oilstone holder made of cast aluminum, the surfaces being ground and polished. The stone lies in a bath of oil, thus keeping one side of it soaked. In this way the stone can be prevented from clogging and glazing, as it is kept clean and sharp. The holder is made in sizes to hold stones 1 inch thick, 2 inches wide, and either 6, 7 or 8 inches long.

Bench Centers: Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich. A line of bench centers built in seven sizes ranging from 6 by 18 inches up to 12 by 60 inches. The bed is a ribbed casting of box form construction, and the ways are scraped. Both of the stocks which carry the centers can be moved to accommodate work of various lengths. Conveniently located levers are provided for clamping the stocks in position.

Electric Furnace: Industrial Electric Furnace Co., 53 W. Jackson Blvd., Chicago, Ill. An electric furnace for melting steel and non-ferrous metals, known as the Von Schlegell arc furnace. This furnace can be operated from 220-volt motor circuits, and the self-regulating flaming arc torch with which it is provided can be suspended in various kinds of chambers for obtaining high temperatures with deoxidizing conditions maintained.

Metal-cutting Band Saw: Seattle Machine Works, 37-51 W. Lander St., Seattle, Wash. A metal-cutting band saw intended for cutting out solid forged crankshafts, for cutting slots, and for cutting pieces to length. When cutting pieces to length, the saw cuts on both sides of its loop, the cut, of course, being downward on one side and upward on the other. Two idlers having horizontal adjustment are provided for setting the machine to cut to any desired length.

Metal-testing Machine: Holz & Co., Inc., 17 Madison Ave., New York City. A static notched-bar testing machine for the quantitative measurement of the brittleness and ductility of steel and other metals. This machine was designed and patented by J. C. W. Humfrey. It yields an autographic record of the bending-angle, bending moment diagram, and is equipped with an automatic integrator which gives the total energy absorbed in breaking the test piece.

Multiple-spindle Tapping Attachment: Fox Machine Co., Jackson, Mich. A tapping attachment for use on multiple-spindle drilling machines of this company's manufacture. It is necessary that some changes be made in the machines when they are equipped for tapping. With this attachment a simple movement of a control lever causes the spindles to rotate in the right-hand direction. A stop is set to trip the mechanism and cause the spindles to reverse their direction of rotation when the taps have reached the desired depth.

Semi-automatic Drilling Machine: Detroit Machine Tool Co., 1487 St. Antoine St., Detroit, Mich. Improvements on the semi-automatic multiple-spindle drilling machine of this company's manufacture, including the incorporation of a clutch on the worm-shaft which operates the camshaft worm-gear, thus permitting each spindle to be advanced to the extreme position without stopping the machine while the fixture is clamped in position for drilling to the required depth. Another improvement is the addition of a work-holding pan.

Core Machine for Foundry: E. J. Woodison Co., 1681 St. Aubin Ave., Detroit, Mich. A core machine operated by compressed air, which has an output of 180 cores an hour. To make a core by the use of this machine, it is simply necessary to put the core-box in place on the machine and give the control handle a quarter turn. The cores produced by this machine have a natural venting, because the air is forced through the core, thus carrying the fine sand to the outside, giving a smooth surface and allowing all gas to pass off freely.

Double-carriage Lathe: Hamilton Machine Tool Co., Hamilton, Ohio. A lathe equipped with two independent carriages to enable turning and facing operations to be performed at the same time. The front carriage holding the turning tools runs on one V-way and one flat way, while the rear carriage carries the facing tools and runs on another set of ways. This machine is intended for production work on steering knuckles for automobiles and tractors, small shafts, axle parts, and gears of different types.

Multi-punch Press: Toledo Machine & Tool Co., Toledo, Ohio. A double crank type press with twin-gear drive, fitted with sixty independently adjustable punches and dies for punching holes with varying center distances. The punch-holders are fitted with gags in order that holes may be punched or omitted as desired. The press is capable of punching fifteen 1-inch holes through 15/16-inch steel. The weight is about 165,000 pounds, the width between uprights 103 inches, the opening in the bed 4 by 98 inches, and the maximum distance from bed to slide, 33 inches.

Self-loading Electric Truck: Cowan Truck Co., 50 Water St., Holyoke, Mass. An elevating platform electric industrial truck known as the I. T C., which is of all-steel construction and has a capacity of 5000 pounds with a lift of 4½ inches. The turning radius on the extreme outside point is 7 feet 10 inches, and it is claimed that the truck will operate in intersecting aisles 60 inches wide. A 24-volt, 50-ampere driving motor is employed, which runs at 1500 revolutions per minute, and a 24-volt, 35 ampere elevating motor is provided which has a speed of 1800 revolutions per minute.

Universal Gage Measuring Machine: Alfred Herbert, Ltd., 54 Dey St., New York City. A universal gage measuring machine known as the Wickman, which is intended for measuring length gages up to 12 inches long, outside, pitch, and root diameters of screw and plug gages up to 6 inches in diameter; pitch of screw plug gages up to 4 inches in diameter; and outside, pitch, and root diameters of screw ring gages up to 3 inches in diameter. This machine is claimed to be accurate within 0.000005 inch when used as a comparator, or within 0.00001 inch when used in the regular way.

Thread Snap Gage: Alfred Herbert, Ltd., 54 Dey St., New York City. A gage known as the Wickman adjustable snap gage for measuring threads. The gage consists of a U-shaped frame such as used for plain snap gages, which is provided with grooved anvils to suit the pitch which is to be measured. Two sets of anvils are used on each gage, the front and rear anvils being of different form. The teeth of the front set are made to conform exactly to the profile of the screw thread. The second or inner set of anvils is used to detect thin threads which are not within the tolerance allowed on the work.

Electric Truck for Handling Annealing Pots: Elwell-Parker Electric Co., 4223 St. Clair Ave., Cleveland, Ohio. A truck driven by an electric motor, which receives its power from a storage battery. The three wheels of the truck may be equipped with rubber tires when the oven is charged at low temperatures, or with a smooth steel wheel at the steering end, and a pair of herringbone steel driving wheels at the front end when the oven temperatures are high at the time of charging. The truck has an especially short turning radius and is so equipped that it will automatically stop should the operator step off the truck while it is in motion.

Instrument for Checking Testing Machines: Holz & Co., Inc., 17 Madison Ave., New York City. An instrument known as the Amsler standardizing box for checking tensile and compressive loads of testing machines of either lever or hydraulic types. This instrument can be used for checking horizontal and vertical testing machines, and is acted upon by the testing machine in exactly the same way as the test bars are. The load acting on the instrument is read off on a direct-reading scale which forms a part of the instrument itself. The boxes are made universal, that is, for measuring both compressive and tensile loads of 20,000, 60,000, and 100,000 pounds maximum.

Gear-measuring Machine: Alfred Herbert, Ltd., 54 Dey St., New York City. A machine known as the Wickman gear-pitch and concentricity measuring machine, for testing gears before and after hardening. This test is usually made on one gear in each lot. The gear to be tested is mounted on a vertical arbor which is revolved by means of a handwheel. As the gear is revolved, the space between the teeth at the pitch circle and the concentricity of the pitch circle are measured. After the measurements have been taken in this manner, two curves are plotted from the data thus obtained, one showing the pitch error between the teeth and the other the concentricity error. This machine has a capacity for testing gears from 2 to 12 inches in diameter, and is provided with a vertical adjustment of 6 inches.

Planer: William Sellers & Co., Inc., Philadelphia, Pa. A 16-foot planer having the principal members made in two or more pieces to facilitate transportation by rail. The table is driven by the Sellers type of planer drive through a spiral pinion engaging a rack on the under side of the table. The spiral pinion is set at an angle of 33 degrees from the center line of the bed, and is about 24 inches long. With this drive at least four of the driving teeth are in contact at all times, which results in smooth action with no tendency for the rack or pinions to wear more at one point than at another. The motor is of the reversing planer type, of 75-horsepower capacity, having a speed range of 250 to 1000 revolutions per minute, which gives variable cutting speeds from 20 to 40 feet per minute. The motor rests on a separate baseplate, and is connected with the machine by a flexible coupling. The return speeds of the machine are selective between 40 and 80 feet per minute. A pneumatic device is provided for clamping the cross-rails to the uprights. This machine will plane work 16 feet in width, 13 feet in height, and 36 feet in length. The total weight is 412,300 pounds.

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TYPOGRAPHICAL ERROR IN CROUSE-HINDS CO.'S ADVERTISEMENT

In December MACHINERY, in an advertisement of the Crouse-Hinds Co., Syracuse, N. Y., a line reading "Send for Conduit Catalog" should have read "Send for Condulet Catalog." The Crouse-Hinds Co. does not make or sell "conduit," and inasmuch as their specialties "Condulets" are used mostly in connection with conduit wiring, this correction seems essential.

TAPER THREADING OPERATION

An interesting manufacturing job was recently done in the plant of the S. A. Potter Tool & Machine Works, New York City, by making a slight modification in the regular thread-chasing attachment furnished with the precision bench lathe of this company's manufacture. This job consisted of cutting the threads on the tapered end of a special tool-steel sharpener used in sharpening the spiral cutters of an ordinary desk lead pencil pointing machine. The angle of taper of the tool is 15 degrees, as shown in Fig. 1, and it is required to cut 64 threads per inch on this tapered surface to a depth of 0.015 inch. The blanks were first rough-turned on automatic screw machines, special care being taken to maintain an accurate angle at the point. A special thread-chaser having about twenty teeth of the correct pitch was then made, and this tool was held in the regular toolpost of the lathe, as shown in Fig. 2. The work was held in a ⅜-inch collet chuck provided with an inside stop so as to enable the same relationship of the tool and each piece of work to be maintained throughout the job. The only other special part was a hardened steel master guide plate which was attached to the machine as shown at *A*, Fig. 2. The regular handle provided with the Potter thread-cutting attachment was furnished with a stylus *B* that rides on the upper angular surface of this plate, thereby swinging the tool radially outward simultaneously with its traverse, so that the tool follows the angularity of the tapered end of the sharpening tool. Fig. 2 also shows a number of the blank sharpeners lying on the bed of the lathe, as well as the gage by means of which the taper is inspected. The chasing attachment was geared up for a 64-pitch thread. As the chasing tool was fixed in the holder, it was only necessary for the operator to swing the arm over so that the stylus rested on the guide plate *B*, and take one cut to complete the job.

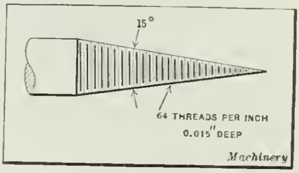

Fig. 1. Tapered End of Special Tool

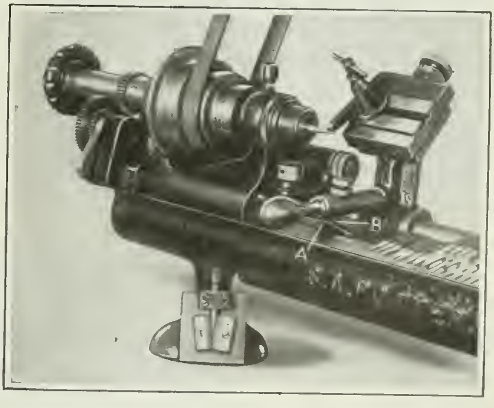

Fig. 2. Bench Lathe set up for threading Sharpening Tool shown in Fig. 1

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DESIGN OF CIRCULAR FORMING TOOLS

In conjunction with the article "Design of Circular Forming Tools" published in the December number of MACHINERY, beginning on page 366, there appeared a table headed "Dimensions and Constants for Calculating Circular Forming Tools." Unfortunately the dimensions in column C were given without specifying that these dimensions apply only to tools having a rake angle of 8 degrees.

TRAVERSING MECHANISM FOR OXY-ACETYLENE CUTTING TORCH

The difficulties encountered in cutting 4000 tons of armor plate into charging-box sizes at the government proving grounds at Sandy Hook, N. J., resulted in the development of a mechanism for semi-automatically traversing a torch across the plates. The conditions were such that no straight-line cutting equipment on the market was adapted to the work. The armor plates were badly warped by the impact of shells which had pierced them in target practice, and the punctures, of which there were six in each plate, were mushroomed and ragged. Each of the plates was about 13 feet long, 9 feet wide, and 3 inches thick, and weighed between 7 and 8 tons. Besides the irregular surfaces, another difficulty arose due to the metal containing large percentages of nickel and chromium. Such a steel yields a heavy and viscous slag that does not flow freely from the kerf in blowpipe cutting. This condition not only retards the cutting speed, but necessitates higher oxygen pressures than are required in cutting ordinary steel of the same thickness.

However, the engineering difficulties were overcome by means of a machine developed at the Buffalo shops of the Linde Air Products Co., 30 E. 42nd St., New York City. This machine traverses across the plate a carriage holding in a vertical position an Oxweld C-7 torch, which is manufactured by the Oxweld Acetylene Co., Newark, N. J. The carriage and traversing mechanism are shown in the accompanying illustrations. Power for operating the machine is obtained from a phonograph spring motor. The turntable spindle of the machine has a worm that meshes with a worm-wheel on a horizontal shaft. On the outer end of the latter there is mounted a knurled-groove pulley, and above it there is another, but larger, similarly grooved pulley which is held down by spring tension. Through these rollers passes a jointed and knurled pull-rod, the outer end of which is attached to the torch carriage. From this description it will be understood that the torch is traversed across the plate as the pull-rod is drawn through the rollers when the motor is started.

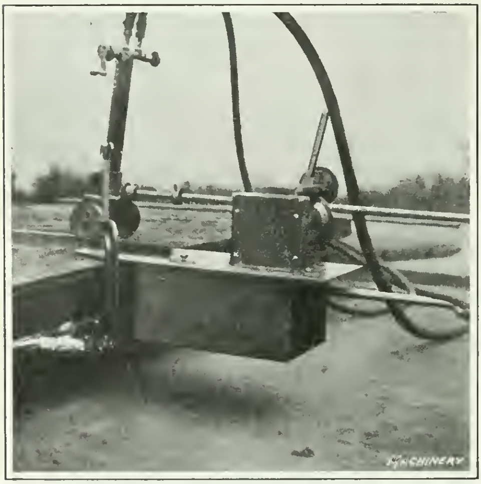


Fig. 1. Mechanism designed to traverse an Oxy-acetylene Cutting Torch across Armor Plates

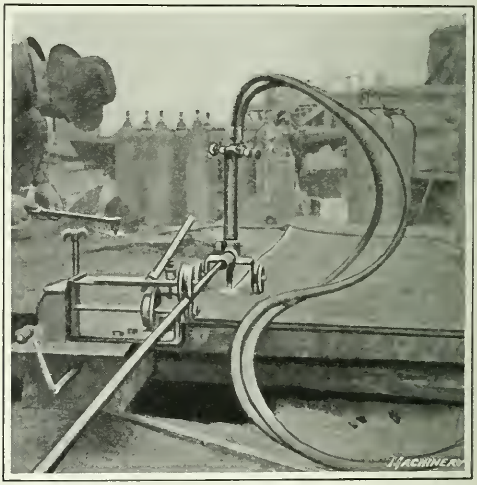


Fig. 2. Illustration clearly showing Rollers and Knurled Pull-rod drawing Torch Carriage

By raising to a vertical position a lever pivoted on an idler shaft, a brake is applied to the driving shaft and, at the same time, the two rollers are separated, giving freedom to the pull-rod. The usual phonograph speed control is used, but a change was made in the governor weights of the motor to cause it to run faster. The wheels of the carriage are 3 inches in diameter and are made of cast iron, the wheels and their bearings being protected from sparks by metal shields. Runners are provided inside the wheels to prevent the carriage from falling off a plate at the beginning and end of a cut. Provision was made to keep the torch tip at a correct distance from the plate at all times in spite of the irregular surfaces of the warped armor, and the cut is also kept at the correct angle to the plate. The motor is fastened to a plate by means of a C-clamp, and may be readily moved to perform a new cut. In setting up the equipment, all that is necessary is to place the motor in such a position that the pull-rod extends across the line of cut. The entire equipment weighs less than 30 pounds.

* * *

WINTER MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS

The annual meeting of the Society of Automotive Engineers will be held January 11 to 13 in the Engineering Societies' Building, New York City. The meeting coincides with the New York Automobile Show. Tuesday, January 11, the Standards Committee will meet both morning and afternoon. Wednesday morning, January 12, there will be a business session, and in the afternoon there will be simultaneous sessions by the Body Engineering Section and the Aeronautic Section. Thursday morning, January 13, there will be a fuel research session, and in the afternoon a continuance of the fuel research session and two other sessions on highways and on chassis design.

During the fuel research session new and interesting chemical and physical phenomena of combustion will be disclosed. The body engineering session will be devoted to the presentation of means to reduce body weight, a consideration of passenger-car body styles and a discussion of problems of construction. The aeronautic session will include a paper on the present status of commercial aviation in America and Europe, a study of recent developments in airplane design, and a discussion of the possibility of successful operation of commercial lighter-than-air craft. Because of the direct relation of the motor vehicle to the good-roads movement, it has been decided to devote one technical session to highways. It is planned to familiarize the members of the society with the progress highway engineers are making with the problems of highway deterioration. The chassis session is intended to cover the relation of chassis design to fuel economy. This naturally includes the question of light weight, higher transmission and axle efficiencies, and the reduction of rolling resistance.

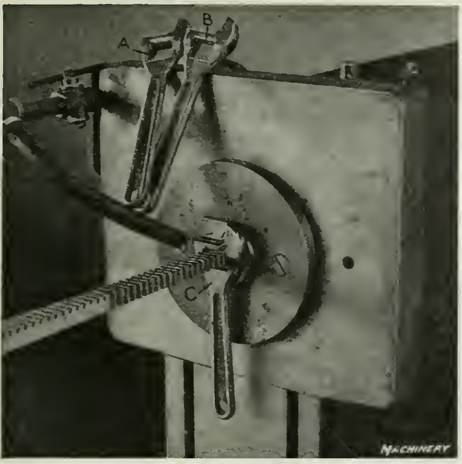


Fig. 1. Broaching a Rectangular Opening in a Wrench Part

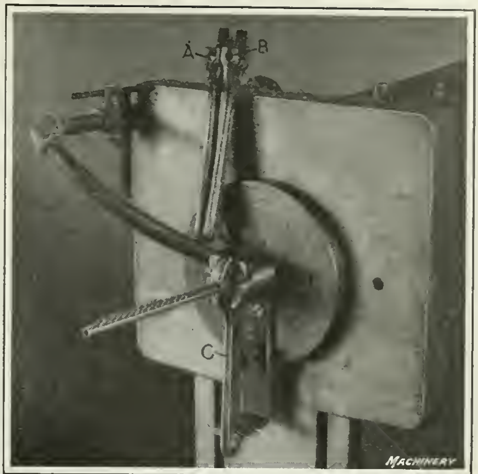


Fig. 2. Operation in which Two Broaches are employed

BROACHING OPERATIONS ON AN ADJUSTABLE JAW WRENCH

Three machining operations on the main section of an adjustable jaw wrench are rapidly and successfully performed on a No. 1½ broaching machine, made by the American Broach & Machine Co., Ann Arbor, Mich. Each of the accompanying illustrations shows one of these operations being performed on the part, as well as specimens of the work before and after the operation. A description of each operation and the floor-to-floor time required are given in the following: The first operation on the part is shown in Fig. 1. This operation consists of broaching the rectangular hole shown unfinished at *A* and finished at *B*, the work being shown at *C* with the broach being pulled through it. The time required for this operation is thirty seconds.

The next operation on the wrench part is illustrated in Fig. 2 and consists of broaching slot *B* along the upper side of hole *A*. This slot is provided to accommodate the lower portion of the movable jaw of the wrench when the latter is assembled. The work is again shown in place on the machine at *C*, suitable means being provided for locating the part and holding it in an upright position during the operation. Two broaches are necessary for the production of this slot, and both of them are used in thirty-two seconds. The final broaching operation on the part consists of broaching an angular slot *B*, Fig. 3, through surface *A* of the part. The purpose of this slot is to afford clearance for a reinforced rib on the movable jaw of the wrench. Eighteen seconds is the time required for this operation.

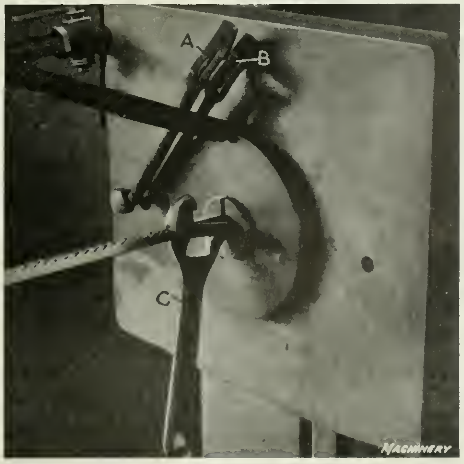


Fig. 3. Final Operation which consists of broaching an Angular Slot

* * *

It is stated that 86 per cent of the automobiles in the world are manufactured in America. Over 80,000 automobiles were exported during the last fiscal year. It is estimated that there are about 7,000,000 or 8,000,000 automobiles in use in the United States at the present time.

NEW AUTOMOBILE WITH AIR-COOLED ENGINE

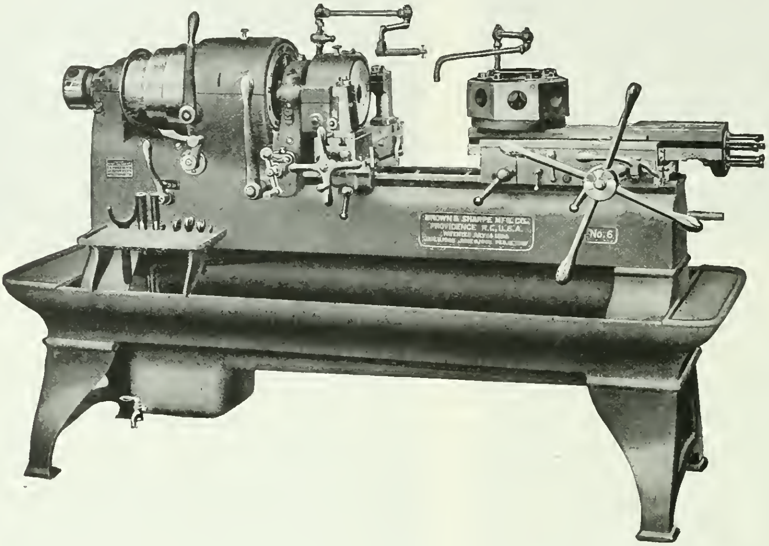
It is reported that a new automobile with an air-cooled type of engine, known as the Spencer, has been developed by the Research Engineering Co., of Dayton, Ohio. According to O. H. Spencer, the inventor of the motor, the new car will be light and high-powered, weighing approximately 1500 pounds and selling for $1200. It is stated that tests have been made of the air-cooled engine in competition with a good water-cooled engine of the same stroke and bore, and that the Spencer motor was run for an hour up to 3500 revolutions per minute without being overheated. A factory is now being planned and the promoters hope soon to be able to produce the car on a commercial scale.

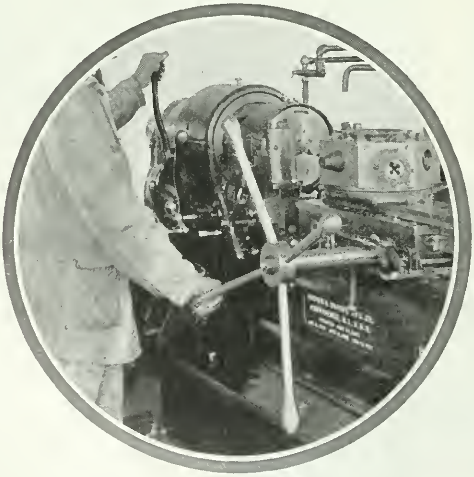
* * *

INDUSTRIAL VALUE OF MOVING PICTURES

The Goodyear Tire & Rubber Co. recently installed a moving picture in one of its plants, mainly with a view to furthering the safety movement. Various methods of accident prevention in other plants were shown. The company asked each employe to submit in writing a brief statement as to his opinion of the value of the pictures to himself and his fellow-workmen. It was found that one of the valuable results derived from the pictures was that it enabled older employes to answer the questions of new men coming into the plant. In addition to Safety First pictures, films were also shown of the work in which the men were engaged and of the processes through which the raw materials had been passed before coming to the plant. This aroused a great deal of interest, and the general conclusion was that the more knowledge a workman can acquire relative to the materials used in his department, the more intelligent work he will be likely to do. That the motion picture will prove of great educational value in the industries is beyond doubt.

BROWN & SHARPE SCREW



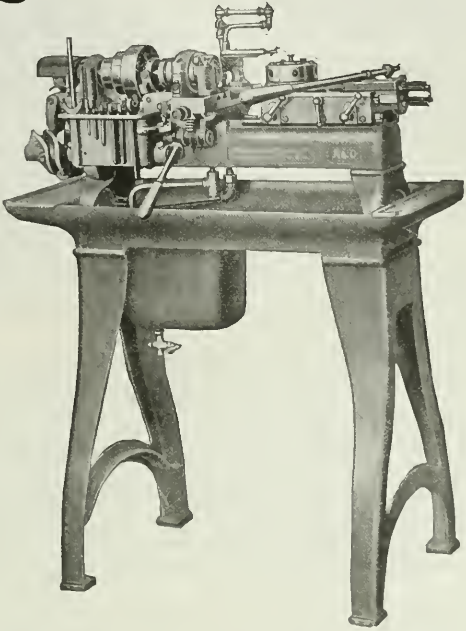


THREE LEVER CONTROL

The larger machines, the Nos. 4 and 6, are controlled by three levers. The operator controls the turret tools by means of a pilot wheel with his right hand, while with his left he feeds the cross slide tools to the work. At the end of the operation, when the piece is cut off, by throwing the feed lever shown in the illustration, the next length of stock is instantly brought into position. Upon releasing the feed lever, the chuck closes firmly, securely holding the stock for the various operations.

BROWN & SHARPE MANUFACTURING

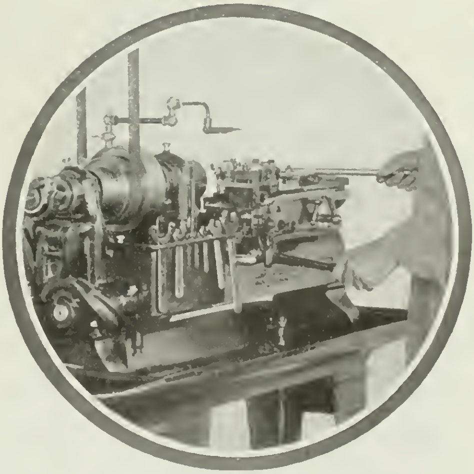
WIRE FEED MACHINES



The ease and rapidity with which the smaller machines are controlled is particularly noteworthy. The operator has complete control of all operations by means of two levers. One advances the turret tools, the other controls the cross slide tools. When the piece is cut off, a slight forward movement of the cross slide automatically trips the feed clutch, bringing the next length of stock into position.

This largely eliminates lost motion, every lever being so located that a minimum amount of labor is involved in operating the machines.

Send for Catalog 22-G



TWO LEVER CONTROL

COMPANY, Providence, Rhode Island, U.S.A.

PERSONALS

P. V. Burwell has been appointed assistant advertising manager of the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md.

Frank Thornton Jr., chief engineer of the Westinghouse Electric Products Co., has been appointed manager of the electric heating engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

John T. Chidsey, president of the C. J. Root Co., Bristol, Conn., manufacturer of automatic counters, has been elected president of the Chamber of Commerce of Bristol, and a member of the board of directors of the Connecticut Chamber of Commerce.

John C. Pangborn, vice-president of the Pangborn Corporation, Hagerstown, Md., manufacturer of sand-blasting and allied equipment, sailed November 27 on the *Olympic* from New York for Southhampton, with the intention of spending several months in Europe on business.

George E. Temple has been appointed manager of the welding and cutting equipment department of the Oxweld Acetylene Co., New York City. Mr. Temple was previously connected with the Prest-O-Lite Co. which formerly manufactured and marketed the welding and cutting apparatus known as "Eveready."

Ernest C. Morse, director of sales of the War Department, who retired from service on December 31, has been awarded the Distinguished Service Medal for his work in organizing and training a competent force for supervising, coordinating, and directing the disposal of the vast War Department surplus of supplies. During Mr. Morse's term of office as director of sales, more than $1,750,000,000 worth of supplies were disposed of, at a percentage of recovery of 63 per cent.

Henry S. Moos has recently returned to Spain from this country after having made arrangements for the American Machinery Corporation, of Madrid and Sindicato de Maquinaria Americana, of Bilbao, with whom he is associated, to represent a number of American machine tool manufacturers in Spain. Mr. Moos and the engineers associated with him will attend to the inquiries and the engineering needs of the Spanish industry. American machines will be demonstrated in practical operation in the show rooms of the two companies, and important stocks of machines and tools will be carried. These concerns maintain a New York office at 719 Broadway.

George T. Chapman, who has been connected for the last two years with the Flaxen Fiber Down Co., of North Tonawanda, N. Y., as machine and tool designer, engaged on the development of some new textile machinery, intends to devote his entire time to the development of an automatic gear-shifting device for automobiles. The fundamental principle on which the mechanism is based is that a motor in order to operate at high efficiency should never run, under a load, below a certain number of revolutions per minute; consequently, in ascending a grade the device will shift from high to second, as soon as the engine fails to make the proper number of revolutions, and in the same manner from second to low. The mechanism operates in a similar manner when descending. When a car is brought to a standstill, the gears are automatically shifted to low for starting.

Ethan Viall, for the last ten years on the staff of the *American Machinist*, has resigned as editor-in-chief to become a member of the firm of T. W. Minton & Co., Barbourville, Ky., the largest producers of hickory dimension stock in the country. Previous to joining the staff of the *American Machinist*, Mr. Viall was a frequent contributor to numerous technical journals, and was for fourteen years foreman and superintendent in several plants in the Middle West. He made a specialty of automatic machine work and tool and die design, as well as giving considerable study to broaching and welding. He is a member of the American Society of Mechanical Engineers, the Society of Automotive Engineers and the American Institute of Electrical Engineers. He is author of a number of books. Mr. Viall is especially well known among the machine tool men of Cincinnati and the Middle West. He is succeeded by K. H. Condit, formerly managing editor.

OBITUARIES

M. L. Andrew, president of M. L. Andrew & Co., Cincinnati, Ohio, special machinery manufacturers, died December 9 at the age of eighty-four years. Mr. Andrew was born in Port Credit, Ontario, Canada, and came to the United States when he was fourteen years old. He entered an apprenticeship in a tool shop at Rochester, finishing his trade just before the outbreak of the Civil War. After serving in the Navy as assistant engineer of the United States fleet during the war, he became affiliated with J. A. Fay & Co., in Cincinnati with whom he was associated for twenty years, and then engaged in business for himself as a manufacturer of wood-boring machines. About six years ago he retired from active work because of failing health.

COMING EVENTS

January 11-13—Annual meeting of the Society of Automotive Engineers in New York City. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

January 24-29—Third National Marine Exposition held at Grand Central Palace, New York City, under the auspices of the National Marine League of the United States of America, 268 Pearl St., New York City.

February 1-3—Annual and general professional meeting of the Engineering Institute of Canada in Toronto; headquarters, King Edward Hotel.

April 27-29—Convention of the Society of Industrial Engineers in Milwaukee, Wis. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel.

May 19-20—Spring convention of the National Machine Tool Builders' Association in Atlantic City, N. J.; headquarters, Hotel Traymore. General manager, Charles E. Hildreth, Worcester, Mass.

SOCIETIES, SCHOOLS AND COLLEGES

Northeastern College, Bridgeport. Conn. Catalogue for 1920-1921, containing general information and outlining the courses for the evening school of engineering.

Valparaiso University, Valparaiso, Ind. General catalogue, 1920-1921, containing calendar and general information concerning the university, courses of instruction, etc.

California Institute of Technology (formerly Throop College of Technology), Pasadena, Cal. Annual catalogue for 1919-1920, including a statement of requirements for admission, a description of the courses of instruction, and announcements.

Detroit Institute of Technology, Detroit, Mich. Bulletin of the school of engineering, giving an outline of the mechanical and electrical engineering and trades courses offered. Circular entitled "Learn to Be a Machinist," containing a description of the machine shop courses offered by the institute. Bulletin entitled "Learn Autos where Autos are Made," containing information relating to the automotive school.

NEW BOOKS AND PAMPHLETS

Proceedings of the Annual Convention of the Industrial Relations Association of America. 592 pages, 6 by 9 inches. Published by the Industrial Relations Association of America, Orange, N. J. Price, $5.

Slushing Oils. By Percy H. Walker and Lawrence L. Steele. 23 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 176 of the Bureau of Standards. Price, 5 cents.

Relation of the High-temperature Treatment of High-speed Steel to Secondary Hardening and Red Hardness. By Howard Scott. 16 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 395 of the Bureau of Standards. Price, 10 cents.

A Study of the Relation between the Brinell Hardness and the Grain Size of Annealed Carbon Steels. By Henry S. Rawdon and Emilio Jimeno-Gil. 45 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 397 of the Bureau of Standards. Price, 10 cents.

Advanced Shop Drawing. By Vincent C. George. 147 pages, 6 by 9 inches; 137 illustrations. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $1.60.

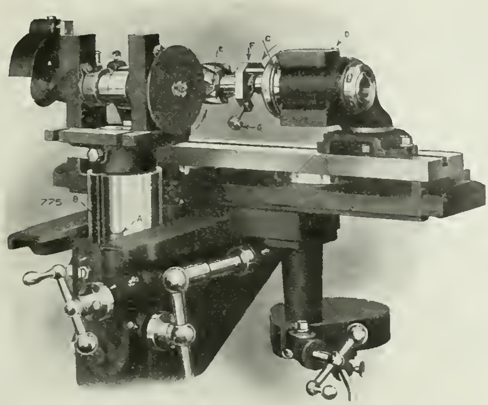
The contents of this book have been laid out with the view of enabling anyone who has had preliminary training in mechanical drawing and in the use of drawing instruments, to gain a practical knowledge of drafting as applied to various lines of engineering. The text material and problems have been so arranged as to enable the student who has had sufficient practice in drawing to become familiar with the principles of orthographic projection and the use of drawing instruments. Emphasis has been laid on drafting as applied to such special subjects as pictorial representation, patent office drawings, electrical drawing, piping lay-outs, structural drawing, and sheet-metal work. An idea of the treatment of the subject will be obtained from a list of the following chapter headings: Working Drawings; Gearing; Gearing (Bevel, Worm, and Special Gears); Isometric, Cabinet, and Shaded Drawings; Patent Office Drawings; Structural Drawing; Electrical Drawing; Plans for Pipe Systems; and Sheet-metal Work.

Safety in the Machine Shop. 188 pages, 6 by 9 inches. Published by the Travelers Insurance Co., Hartford, Conn.

This book has been produced as the result of an effort on the part of the company to reduce the number and severity of industrial accidents. It is divided into fourteen sections, the first of which outlines the development of the modern machine shop from its earliest beginning up to the present-day shop employing thousands of persons. The remaining sections of the book discuss the safety problems that arise in the machine shop, special attention being paid to the hazards responsible for the major part of the serious accidents. The subject matter covers the Use of Cranes; the Spacing of Machines; Shafting and Belting; Individual Motor Drive; the Safe Operation of Lathes; Forging and Hammering; the Press-working of Metals; Automatic Machines; Infection from Cutting Oils; Grinding, Polishing, and Buffing; Hand Tools; Illumination; and the Employment of Women. Those interested in the prevention of accidents in industrial plants will undoubtedly find many valuable suggestions in this book. Copies will be sent without charge upon request to the supply department of the company.

Motorcycles and Side Cars. By Victor W. Page. 693 pages, 5 by 7½ inches; 371 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

This is a new enlarged and revised edition of a book describing the leading types of motorcycles, their design, construction, maintenance, operation, and repair. The new edition incorporates the 1921 improvements in motorcycle construction, and gives complete instructions for starting, driving, and repairing all types of motorcycles. Modern starting methods are dealt with in detail, and an explanation is included of the



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There is a graduated dial on the work head spindle, from which the clearance angle may be read direct. This eliminates the use of tables and formulas. You can always duplicate exactly the correct clearance at repeated grindings.

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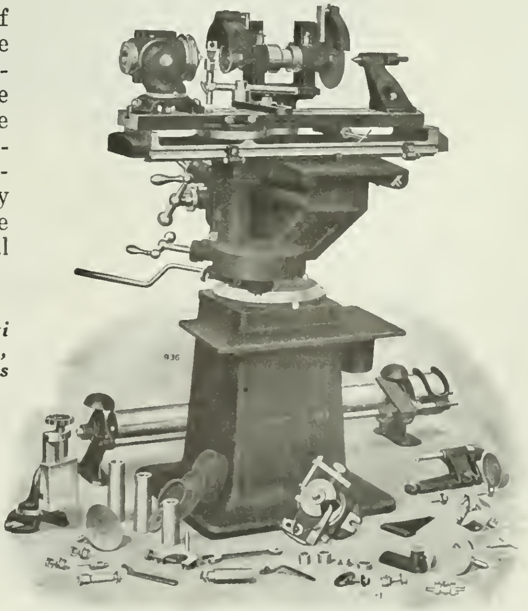

The No. $1\frac{1}{2}$ Cincinnati Universal Cutter and Tool Grinder
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operating principles and repair of the new automatic electric lighting systems. The types of change-speed gears and clutches are described, and instructions for their use are given. A new chapter has been added on the thorough overhauling and repairing of motorcycle engines, and the reader is told how to detect depreciation and make adjustments. The book contains eleven chapters headed as follows: Motorcycle Development and Design; the Motorcycle Power Plant Group; Construction and Design of Engine Parts; Lubrication, Carburetion, and Ignition; Power Transmission System Parts; Design and Construction of Frame Parts; Construction, Equipment, and Operation of Modern Motorcycles; Motorcycle Maintenance; Harley - Davidson - Remy Electric Lighting and Ignition System; Motorcycle Troubles and Side Car Attachment; and Complete Instructions for Overhauling Engine.

Industrial Oil Engineering. By John R. Battle. 1065 pages, 5 by 7½ inches. Published by J. B. Lippincott Co., Philadelphia, Pa. Price, $10.

This is the first part of a reference work which is to be published in two volumes, containing data relating to lubrication and industrial oils, general oil information, and engineering and industrial oil requirements, intended for the use of oil engineers, lubricating engineers, oil salesmen, oil equipment manufacturers, mechanical engineers, machinery designers, mill and power plant superintendents, purchasing agents, and others interested in the selection and utilization of oil products and equipment. The first volume of this work covers the field of lubricating engineering, industrial oils and processes, fatty oils, lubricating and industrial oil equipment, marketing data for oil, specifications, etc. The book is divided into eleven sections as follows: Mathematics; Marketing; Mechanical Engineering; Petroleum and its Products; Fats and Oils other than Petroleum Products; Testing and Properties of Oils; Lubrication and Friction; Filters, Filtration, and Reclamation of Lubricating Oils; Oil Storage and Handling; Industrial Practice and Utilization of Lubricating Oils and Industrial Oils; and Industrial Oil Specifications. The tenth section is subdivided into a number of subsections, each dealing with the utilization of oil products for a specific industrial or manufacturing purpose. Special pages are inserted between each section on industrial practice to provide space for the user to insert prices, tests, and competitive brands for his own oils and other products.

Essentials of Descriptive Geometry. By F. G. Higbee. 218 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $2.25.

This is the third edition of a book on geometry which has been in use in the classroom for some time, and the changes incorporated in the new edition have been suggested by its use. Changes have been made in the data of some of the problems in order to more clearly emphasize certain important points, a number of the illustrations have been improved, and portions of the text have been reworded in such a way as to help students over difficult ground. The aim of the author in writing the text has been to include only those portions of descriptive geometry that possess industrial utility and develop qualities of mind essential in a draftsman. The purpose of the book is first to teach projection; second, to develop the ability in the student to solve problems concerning the relations of points, lines, and planes, which are elementary parts of all engineering structures as shown on drawings; third, to promote the ability to analyze a problem, to reason from a given set of conditions to a required set of conclusions, and to build up from the drawing a mental picture of the object which is presented. Thus it will be seen that the subject has been discussed from the point of view of the draftsman. There are twenty chapters included in the book, which are headed as follows: Orthographic Projection; Profile Plane; Assumption of Points and Lines; Planes; Location of Points, Lines, and Planes; Revolution of Points; Problems on the Line; Problems on the Plane; Problems on Angles; Problems on Points, Lines, and Planes; Surfaces; Plane Surfaces; Cylindrical Surfaces; Conical Surfaces; Intersection of Surfaces; Surfaces of Revolution; Warped Surfaces; Tangent Planes and Lines; Model Making; Appendix.

Labor's Crisis. By Sigmund Mendelsohn. 171 pages, 5 by 7½ inches. Published by the Macmillan Co., 64 Fifth Ave., New York City. Price, $1.50

This book constitutes a discussion of labor problems written from the employer's viewpoint. The author states in the preface that he makes no pretensions to a scientific study of the institution of labor nor of the causes and effect of the present labor unrest. His observations are based on the practical experience of an employer who has to deal not with theory but with the facts that determine the relationship of capital and labor. The book analyzes the labor problem as it exists today and discusses the causes of the present labor unrest, which it is pointed out, is a logical sequel of the conditions under which labor existed until recently. The psychology of labor strongly influences the relation between capital and labor, as well as the performance of labor, and the author believes that mistrust and prejudice can be transformed into good will and confidence when the laborer is made to realize that his own welfare is served and promoted in his employment. The subjects discussed are treated under the following headings: Poverty, its Nature and Effect; Poverty as Related to Labor; Characteristics of Capital and Labor; Labor not a Commodity; Comparative Value of Physical and Mental Exertion; Depletion and Deterioration of Labor; Labor-saving Inventions and Labor Supply; the Malthusian Theory as Applied to Labor; Maximum Effort the Foundation of Society; Economic Effect of Curtailed Labor; Can Reduced Hours Advance the Welfare of Labor and Society? Cost of Living Subject to Psychological Influences; Inflated Cost of Living Due to Contraction of Labor; Labor Welfare as Related to Material and Social Welfare; Causes of the Present Labor Ferment; Profit-sharing as a Basis of Insurance and Pensions; Labor Unrest as a Check upon Industrial Concentration; Moral Economics as Applied to Labor; Handling of Labor in Small Plants; Labor as It Affects the Wife and the Home; Objections to a Legislated Minimum Wage; Housing of the Laborer; Inflation and High Taxes—their Effect.

MacRae's Blue Book. 1851 pages, 8½ by 11½ inches. Published by MacRae's Blue Book Co., Railway Exchange, Chicago, Ill.; New York office, Hudson Terminal Bldg. Price, $10.

This is the 1920 edition of an annual publication intended to serve as a buying guide for the machinery and allied industries. It is divided into the following sections: Catalogue section, address section, classified material section, trade name index, miscellaneous data section, standard list prices of building materials and iron and steel products, and net discount computer. The catalogue section illustrates and gives descriptive matter of the products of the various manufacturers included in the directory, the information being collated in condensed form for ready reference; this section covers 300 pages. The address section, which covers 100 pages, lists in alphabetical order the addresses of all the principal manufacturers of iron and steel products, building materials, etc., in the United States, and gives the location of their branch offices and representatives. The classified material section contains 20,000 classifications, arranged alphabetically, of iron and steel products, building construction materials, railway supplies, etc., the names and addresses of the manufacturers of each class of equipment being given. This material, which comprises the main section of the book, covers 1100 pages. In the trade name index, comprising 100 pages, are given the names of manufacturers of many thousands of trade-named articles. In the miscellaneous data section is collected and indexed information of special interest to the man who specifies or purchases material. It contains 100 pages of tabular matter, including such material as weights and dimensions of steel angles, weights of band iron, approximate weight of leather belting, tables of board measure, weights of seamless brass tubing, tables of weights and thicknesses of cast-iron pipe, weights of pipe fittings, weights and strength of chain, weights of steel disks, engine classifications, dry and liquid measures, standard dimensions of steel rails, wire tables, and a large amount of railway and other data. A distinctive feature of the book is the section giving standard list prices of the products, included in the directory. This section is supplemented by the net discount computer, the two latter sections covering 155 pages.

NEW CATALOGUES AND CIRCULARS

Charles A. Schieren Co., 73 Ferry St., New York City. Calendar for 1921, advertising "Duxbak" leather belting.

Whitman & Barnes Mfg. Co., Akron, Ohio. Calendar for 1921, containing three months on each sheet, and a view of a Whitman & Barnes twist drill and reamer.

Edison Lamp Works of General Electric Co., Harrison, N. J. Buletins LD-117 and 119, treating of the calculation of lighting installation, and the manufacture of the Edison mazda lamp, respectively.

Smalley-General Co., Inc., Bay City, Mich. Circular descriptive of the No. 1B Smalley-General thread milling machine, the No. 1C thread milling machine with power traverse, and the No. 4 thread milling machine.

Warner Elevator Mfg. Co., Cincinnati, Ohio. Circular containing a reprint of a paper on "Passenger Elevator Service," by Howard B. Cook, presented at the Elevator Manufacturers' Association's convention in Atlantic City.

General Electric Co., Schenectady, N. Y. Calendar for 1921, containing on each sheet the current month and the preceding and following months, as well as a view of different electric equipment produced by the company.

Oliver Instrument Co., Adrian, Mich. Circular illustrating the Oliver sawing, filing, and lapping machine, which is adapted for sawing and filing articles from carbon, fiber, bakelite, cardboard, soft or hard rubber, and leather, as well as for metal working.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Leaflet 862, treating of Cutler-Hammer convector type electric air heaters for use in industrial plants and factories for heating crane cabs; valve, pump, and meter houses; exposed remote corners or rooms; and similar uses.

James Clark, Jr., Electric Co., Louisville, Ky. Catalogue 28, containing illustrations, descriptions, and specifications for the "Willey" line of electrically driven tools, including portable drills, screwdrivers, grinders, hacksaws, bench drills and sensitive drilling machines.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular containing information relating to the proper care of punches and dies, discussed under the following heads: Lining up punch and die; lubrication; stripping; loose nuts and stems; hard material; ripping; and multiple work.

Dodge Sales & Engineering Co., Mishawaka, Ind. Catalogue describing Dodge heavy oil stationary engines, heavy oil marine engines, and heavy oil engine electric generating units. Catalogue containing 160 pages, 6 by 9 inches, treating of Dodge standardized elevators and conveyors.

Metalwood Mfg. Co., Detroit, Mich. Bulletins B-18, B-38, and B-68, illustrating, respectively, the Metalwood No. 10 stamping and embossing press; drop-forged steel flange unions for light hydraulic, superheated steam, and ammonia pressures; and heavy hydraulic and steam flanged fittings.

Cooper Hewitt Electric Co., 95 River St., Hoboken, N. J. Technical bulletin 102 on Cooper Hewitt quartz lamp and ultra-violet light. Bulletin 86, descriptive of the Cooper Hewitt quartz lamp laboratory outfit, which is used as a source of ultra-violet light for chemical and industrial purposes.

Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder, announces that additional loose-leaf catalogue pages showing operations of internal thread grinding and the grinding of spindle threads on new and used lathes are now ready for distribution.

Cedar Rapids Engineering Co., Cedar Rapids, Iowa. Circular descriptive of the construction and design of the "Kwik-way" valve facing machine for use in refacing motor valves preparatory to grinding. The machine has a capacity for any size valve up to and including 3-inch head, and ½-inch stem.

Fort Wayne Engineering & Mfg. Co., Fort Wayne, Ind. Bulletin 5011, listing the characteristic features of the "Paul" Type A cold water check valve, for use in suction lines with pressures up to 100 pounds per square inch. A diagrammatic view shows the valve in five different working positions.

Victor R. Browning, Cleveland, Ohio. Bulletin illustrating and describing the various types of electric overhead cranes and hoists manufactured by the company. Tables of specifications for I-beam traveling cranes, geared trolleys and push trolleys, as well as a clearance table for box girder type cranes are included.

Defiance Packless Valve Co., 431 S. Dearborn St., Chicago, Ill. Pamphlet descriptive of the Defiance packless valve, which is designed with a metal-to-metal seat and a non-rising stem to prevent leakage. These valves are applicable for low- and high-pressure steam, hot and cold water, and oil and air up to 2000 pounds.

Pittsburg Steel Stamp Co., Pittsburg, Pa. Catalogue 54, illustrating the line of marking devices made by this company, which includes heavy-duty single letter stamps, steel type holders, hammer and fuller stamps, hand stamps, inspector's hammer, special stamps for marking shells, billets, etc., coining dies, and graduating dies.

Chicago Belting Co., 127 N. Green St., Chicago, Ill. Catalogue of leather packings, cups, valves, and leather specialties. All the standard sizes of packings made by the company are illustrated in the catalogue, but attention is called to the fact that special packings are also provided in any shape or size, and in any number of plies.

Reed Mfg. Co., Erie, Pa. Folder entitled "The Primary Function of a Vise," pointing out the influence that the construction of a vise has on the work performed by its use, and explaining the characteristics necessary in a satisfactory vise. Features of the Reed vises are described, and special attention is called to the rigidity of their construction.

Jaynes Period Counter Co., Inc., 202 Main St., Buffalo, N. Y. Circular descriptive of the operation of the Jaynes period counter—an instrument for obtaining and recording factory costs, which is made in two types, designated as weekly and monthly machines. The circular reproduces cards containing records made on this machine to illustrate its operation.

Yost Mfg. Co., Meadville, Pa. Catalogue 9, containing illustrations and tables of dimensions and prices of the Yost line of vises, including machinists' vises, chipping vises, filers' vises, double-swivel toolmakers' vises, drill press vises, pipe vises, woodworkers' vises, etc. A section of the catalogue is also devoted to the Yost soldering furnaces and anvils.

National Premier Machine Tool Co., 1512 Lakeside Ave., N. E., Cleveland, Ohio. Circular describing the Premier screw-cutting bench and production lathe. The circular shows a general illustration of the lathe, and contains complete specifications, and a description referring in detail to the various parts of the lathe, such as the bed, carriage, tailstock, spindle, etc.

Consolidated Belting Co., Germantown and Sedgley Aves., Philadelphia, Pa. Catalogue 12, treating of "Hycalibre" leather products, and

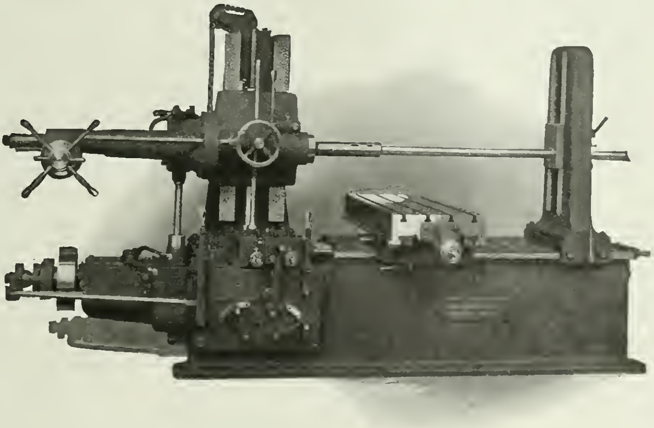
Anyhow, we are not tied down to large JIGS, the cost of which MIGHT hold us back from making the

"PRECISION"

BORING, DRILLING AND

MILLING MACHINE

better, when we saw a way to do so.



The "PRECISION" is a Jig in Itself

and is the kind of big jig we can use in our own factory (and so do many others).

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

containing views of some of the steps in the production of leather belting, as well as suggestions relating to belting problems. Formulas are given for calculating the length, width, horsepower and speed of belts, and for calculating the size and speed of pulleys.

Union Switch & Signal Co., Swissvale, Pa. Catalogue showing the products of the drop-forge department of the company, including axles, crankshafts, radius-rods, connecting-rods, brake-shoes, steering knuckles, gear-cases, levers, etc. The pamphlet also gives a chart of S. A. E. steel specifications for carbon steels, screw stock, steel castings, nickel steels, nickel-chromium steels, chromium steels, chromium-vanadium steels, and silico-manganese steels.

Halcomb Steel Co., Syracuse, N. Y. Card giving the uses and heat-treatment of high-speed and tool steels. On the card are reproduced the labels of various brands of high-speed and tool steels made by this company, and opposite each label are given the principal uses of the steel and the proper temperatures for forging, hardening, and drawing. Only those steels are described that are carried in stock in Syracuse and in the company's branch warehouses.

General Electric Co., Schenectady, N. Y. Bulletin 42010A, illustrating and describing small Curtis steam turbine generating sets which have been used under a great variety of service conditions in stationary plants, for train lighting, and on board ship. These sets have a capacity up to 300 kilowatts. Bulletin 49706, descriptive of the construction and function of the oil conservator for power transformers. The bulletin shows photographs of conservator tanks and of installations of this type that have been made.

Air Reduction Sales Co., 120 Broadway, New York City. Booklet entitled "Cutting Cast Iron with the Oxy-acetylene Torch," containing a reprint of a paper on this subject prepared by A. S. Kinsey, professor of shop practice, Stevens Institute of Technology, for a convention of the American Foundrymen's Association. The article describes how the cut is made, gives the necessary pressures of oxygen and acetylene for varying thicknesses of metal, and describes the advantages to be obtained from the use of the torch for cast iron.

Birmingham Tool & Gage Co., Grove St., Winson Green, Birmingham, England. Catalogue containing illustrations and descriptions of high-speed steel milling cutters and reamers, the dimensions of which conform to the standards laid down by the British Engineering Standards Association. The leaflet gives dimensions of cylindrical cutters, side and face milling cutters, slotting cutters, angle cutters, end-mills, T-slot cutters, form cutters, grooving and fluting cutters, as well as of hand reamers, jig reamers, chucking reamers, taper pin reamers, and bridge reamers.

L. S. Starrett Co., Athol, Mass. General catalogue covering the line of small tools produced by this company. This catalogue contains information about twenty-one new tools, one of the improved tools being a universal bevel protractor. A new micrometer caliper gage is also shown, which is especially adapted to the tire industry for measuring tire molds. A new toolmaker's button intended principally for heavy jig work is also shown. Improved micrometer caliper heads and micrometer caliper sets are included, as well as a new metric fillet or radius gage and an accurate set of V-blocks for use in connection with the surface plate, angle-iron, etc.

Timken Roller Bearing Co., Canton, Ohio. Circular entitled "The Companies Timken Keeps," containing a list of the names of passenger car, commercial car, farm tractor, axle, and transmission manufacturers in America and Europe who use Timken tapered roller bearings, wholly or in part in their present models. The list covers thirty-sevent 4- by 7-inch pages. Under the name of each company is given the product in which Timken bearings are used. Booklet containing a record of four interviews which took place between the Tikmen Roller Bearing Co. and a large tractor corporation, in which the latter was convinced of the advantages of applying Timken tapered roller bearing in its product.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 222, describing the car type and the car-and-ball type furnaces, placing before furnace-using manufacturers the principles involved in the design and use of these furnaces. The bulletin points out the applicability of the car type and the car-and-ball type to the heat-treatment of materials that cannot be advantageously handled in other types of furnaces; the factors governing the selection of the type of furnace best suited to individual manufacturing requirements; the differences in the design of the two types mentioned; and the influence of unequal cooling on the quality of the finished product. It also gives examples of typical heat-treatment installations using the car type and the car-and-ball type furnaces.

National Twist Drill & Tool Co., Detroit, Mich. Catalogue 11, containing illustrations and tables giving dimensions and prices of the line of high-speed and carbon steel twist drills, reamers, milling cutters, and special tools made by this company. The book is divided into four sections as follows: Drill section, reamer section, cutter section, and millimeter section, the latter giving millimeter sizes for the different tools. The practice is followed all the way through the book of giving two prices for each tool—one for the tool made from carbon steel, and one for the high-speed steel tool, the latter being printed in red in each case. The high-speed tools are given distinguishing numbers which are also printed in red so that they can be easily picked out. The catalogue concludes with general tabular matter including tables of speeds, decimal equivalents, weights of carbon and high-speed steel bars, tap drill sizes, etc.

Federation of British Industries, 4 Red Lion Court, Fleet St., London, E. C. 4, England. Export Register of the Federation of British Industries, containing an outline of the organization of the federation and a list of its members, which are classified both alphabetically and according to their products. As the federation comprises no less than 1300 members and is in direct touch with 20,000 British manufacturers covering every industry in the country, the book is virtually a directory. The list of products of the various manufacturers is arranged alphabetically, as is also the list of firm names and agents. There is, in addition, a list of associations arranged alphabetically under the Industrial Grouping System adopted by the federation. With each association are given the names of its exporting members. The book is intended to be of service not only to British merchants and buyers, but to all those who use and buy British goods throughout the world. It is also published in several foreign languages, including French, Spanish, Portuguese, and Dutch.

Cleveland Twist Drill Co., Cleveland, Ohio. Booklet entitled "Handbook for Drillers," which is written for the purpose of making the twist drill clear to even the non-technical reader. The first chapter describes in detail the parts of a twist drill. In the second chapter, which deals with points on grinding, the importance of grinding a drill to produce the correct lip clearance, the proper length and angle of lips, and the correct location of the point in relation to the center of the drill is emphasized. The third chapter treats of drill speeds and feeds. The fourth chapter discusses the drilling of hard material, small-hole drilling, the drilling of brass, cutting compounds for various metals, drilling with automatic machines under flood of lubricant, and thinning the point of the drill. The final chapter deals with common errors and their results, giving reasons for drill breakage and dulling of the cutting edges. The last page of the pamphlet, which is entitled "The Little Doctor" gives a list of symptoms, probable causes, and remedies for drilling machine trouble.

National Tube Co., Pittsburg, Pa. Bulletin 6D, containing an article treating of correct pipe threading principles. The design of threading dies is taken up, information being given on lip angle, chip space, clearance, lead, use of oil, and number of chasers. The care and repair of dies also is discussed at length. The booklet is illustrated with a large number of diagrams as well as halftone illustrations to clarify the points discussed. It contains considerable technical information on the subject, including formulas and tabular matter. Bulletin 7, treating of the manufacture and advantages of National welding-scale free pipe. A detailed description of the process of manufacture is included with illustrations of the various steps, and the physical properties and other qualities of National pipe are discussed. A diagram shows comparative friction velocity curves of standard wrought-iron pipe, and welding-scale free pipe. Bulletin 9, discussing the use of National pipe for shipbuilding purposes. The ductility, uniformity, and other physical properties of National pipe are considered, and tables of properties of pipe, discharging capacities, dimensions of pipe columns, etc., are included.

TRADE NOTES

Wicaco Screw & Machine Works, Inc., has removed its manufacturing plant and general offices to larger quarters at Stenton Ave. and Louden St., Philadelphia, Pa.

Jacquet Motor Corporation of America, Belding, Mich., at a recent meeting of the stockholders voted to increase the capital stock of the corporation from $100,000 to $250,000.

Peninsular Machinery Co., 419 E. Jefferson St., Detroit, Mich., is now occupying its entire building, where a fine display room is maintained. The company reports business very good in both new and second-hand tools.

F. C. Sanford Mfg. Co., 2060 Fairfield Ave., Bridgeport, Conn., announces that in the future the sale of the Sanford precision centerless cylindrical grinder will be handled directly by the company from the home office.

Oxweld Acetylene Co., Carbide and Carbon Bldg., New York City, has appointed the **Standard Supply & Equipment Co.** of New York and Philadelphia, as eastern sales agent for welding and cutting apparatus known as "Eveready."

G. C. Goode Co., production engineers, have opened an office at 317 Frankfort Ave., Cleveland, Ohio, to distribute the following lines: Edgar Allen high-speed and carbon tool steels; Davidson-ized milling cutters; Lincoln twist drills, reamers and slitting saws; insert blades and quick-change drill chucks.

Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder, has moved its offices from 1932 Arch St. to 1 S. 21st St. A machinery display department will be maintained at the new location, in which will be shown, in addition to the grinders, the Craley master toolmaker, Miller radius and angle wheel dressers, Herrmann snap thread gages, and other tools and accessories.

Air Reduction Sales Co., 120 Broadway, New York City, has recently completed the construction of a four-story addition to its apparatus plant in Jersey City, which will provide for increased production of the "Airco" welding and cutting torches. The extension is of brick with reinforced concrete floors Careful attention has been paid to securing maximum lighting, and in every other way the comfort and safety of the employes has been considered.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., manufacturer of portable electric tools, electric air compressors, and special machinery, has established a new branch office at 303 Penn Ave., Pittsburg, Pa. This office will be the headquarters for the Black & Decker sales force in western New York, western Pennsylvania, and the northwestern part of West Virginia. W. D. Royer, formerly sales engineer of the Robbins Electric Co. of Pittsburg, will be in charge of the new office. A service station has also been established at the same address, where there will be a factory trained mechanic to offer service to users of Black & Decker products in that territory.

Sleeper & Hartley, Inc., 335 Chandler St., Worcester, Mass., designers and builders of high-speed automatic wire coiling machinery and other special machinery, announce that they have decided on a price reduction of 10 per cent upon all their various lines of special and standard machinery, applying to all new business and to take effect immediately. It is stated by Sleeper & Hartley, Inc., that this action has been taken in spite of the fact that there is no reason to believe that there will be any immediate reduction in the cost of labor or in the prices of raw materials; it is their belief that prices in general are too high and must be reduced and the sooner this is done the better it will be for industry.

C W. Couch & Co. is a new selling organization organized by C. W. Couch, until recently sales manager of the Ford-Clark Co. Previous to his connection with the Ford-Clark Co., Mr. Couch was associated for eleven years with the Western Automatic Machine Screw Co., of Elyria, Ohio. The headquarters of the new company are at 614 National City Bldg., Cleveland, Ohio. Among the firms for whom the organization will act as direct selling agent are the Perry-Fay Co. of Elyria, manufacturer of screw machine products; the City Brass Foundry Co., of Cleveland, manufacturer of aluminum, brass, and bronze castings; the Superior Metal Products Co., of Elyria, manufacturer of pressed and drawn steel parts; and the Marquette Metal Products Co., of Cleveland, manufacturer of hardened and ground steel bushings.

Toledo Crane Co., Bucyrus, Ohio, has been chartered under the laws of the state of Ohio, with a capitalization of $500,000, to succeed the **Toledo Bridge & Crane Co.** of Toledo, Ohio, as manufacturer of Toledo cranes. The new company has purchased all the drawings, patterns, records and other items pertaining to the crane business, and the change will be made without interrupting production. W. F. Billingsley, who for the last eleven years has been active in the management of the crane department for the Toledo Bridge & Crane Co., will hold an executive position with the new company, and the entire crane department organization of the former company will be retained. The plant of the Toledo Crane Co. will consist of a machine shop, 60 by 300 feet, a structural or girder shop, 90 by 300 feet, an assembly shop, 120 by 320 feet, a pattern shop and storage, 75 by 200 feet, and a forge shop, 40 by 100 feet.

Bertschy Engineering Co., Cedar Rapids, Iowa, which was organized in May, 1920, has just completed the installation of a large amount of machine tool equipment. The company started business in July, 1920, when it purchased the buildings, property, and equipment of the Peerless V-Belt Co., of Cedar Rapids. Following its organization in July, it purchased from the Mattison Machine Works, of Rockford, Ill., the metal-working shaper business which had been conducted by the Rockford company for several years. In addition to the purchase of this business, the company also purchased the "Bermo" welding apparatus business from the Bertschy Mfg. & Engineering Co., of Omaha, Neb. Attention is called to the fact that the latter company has no connection with the Bertschy Engineering Co., except for the fact that some of the officers and directors of the Iowa company are interested in the Omaha company. The new Iowa company began its production activities in October, 1920, and now has on hand castings, parts, and material in process of manufacture for 16-, 20-, and 24-inch heavy-duty back-geared shapers. Preparations are being made to extend the machine tool department to take care of the increasing business. In the company's welding apparatus department it has in process of manufacture upward of 5000 complete welding equipments, and a large number of additional "Bermo" welding torches. The company reports that the demand in its belt department exceeds its ability to supply.

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FOREIGN MACHINERY MERCHANTS PAGES, 408-409 ADVERTISERS INDEX, 439-440 PRODUCT INDEX, 410-436

The Editor's Monthly Talk

IN July, 1919, MACHINERY began the publication of the most complete treatise on interchangeable manufacturing that has hitherto been published. These articles, covering completely the principles of this work, appeared in eighteen consecutive numbers, the last article being published December, 1920. Owing to the wide scope of the subject, the applications of the principles were dealt with but briefly, and no attempt was made to describe actual manufacturing practice in detail. This has been done now in two articles that will be published in the February and March numbers of MACHINERY entitled "Application of Interchangeability to Drill Chuck Manufacture." These articles describe the tooling and gaging equipment used by the Marvin & Casler Co. in the manufacture of the Casler twin-screw drill chuck, and show the practical application of many of the principles that have been formulated in the series of articles previously published. They also show that interchangeability is not practicable except by the exercise of the greatest care in the planning of every manufacturing operation. All important tolerances are given, and the jigs, fixtures, and gaging methods employed are illustrated and described so that the reader can follow the complete manufacturing procedure in detail.

While this article deals with the manufacture of drill chucks, it shows also the practical application of the principles of interchangeable manufacturing to a variety of products of similar character, with similar requirements for accuracy and interchangeability. It is one of those articles that will be *studied* rather than *read* by mechanical men to whom production of interchangeable work is a vital subject.

Increasing the Efficiency of Labor

Many manufacturers have complained during recent years about the decreasing efficiency of labor. That there has been a decrease in general efficiency is beyond doubt; but some leading shop executives are of the opinion that the shop men are not alone responsible for this condition. These executives believe that by the right kind of methods in shop management former efficiency could have been maintained, and have proved it by the results they have obtained in their own shops. In an article in February MACHINERY that will be read with interest by all employers, John C. Spence of the Norton Co. explains how production may be increased by a rational piece-work system, and in another article, also published in this number, A. H. Dittmer, president of the Dittmer Gear & Mfg. Corporation, explains in detail a method worked out by his company for encouraging industrial cooperation and for obtaining the highest efficiency of which each man is capable.

The tool designer will find several articles in February MACHINERY that will be of particular interest to him. Among these may be mentioned especially "Dimensions of Straight Forming Tools," "Dies for Flanged Shells" and "Dies for Ford Automobile Hub Plates."

March MACHINERY will contain an unusual number of articles of special value to jig, fixture and die designers. One of these articles deals with the making of jigs and fixtures on a manufacturing basis, showing how these tools can be so designed that many of the parts used in their construction can be made interchangeable, thereby decreasing the cost and simplifying the design in a marked degree. Manufacturers will also find this article of value and interest because it points the way to a decrease in manufacturing costs and shows how one firm, by specializing in the manufacture of jigs and fixtures, can supply other manufacturers with these tools cheaper than they could make them themselves, on the same principle that manufacturers specializing in machine tools can supply better machines and at less cost than they can be made singly.

The Training of Salesmen

In the past, the salesman of machinery and engineering products was often severely criticised because of his lack of first-hand knowledge of the products he was handling. During recent years a decided effort has been made by many large manufacturers to train salesmen to become thoroughly familiar with the product they are selling. Some of the large electrical firms, as well as machine builders in other fields, have selected technical graduates from the engineering schools and put them through a kind of apprenticeship at their plants, meanwhile noting their qualifications, and if they seemed to be the right type for salesmen, their training was continued along commercial lines. One of the largest concerns in the machine tool field has made a practice of training its salesmen by putting them through a systematic course covering nearly a year. The details of this plan will be given in an article in March MACHINERY on "Machine Shop Training for Salesmen."

The articles referred to are but a few of the large number dealing with design, shop practice, foreign and domestic industrial conditions, and problems in management that will appear in March MACHINERY. All the articles, whether prepared by MACHINERY'S editorial staff or by mechanical men contributing to its columns, are based upon definite practice in successful manufacturing plants. Mere discourses and theories are always eliminated. MACHINERY deals in facts—describes not proposed methods, but accomplishments—and herein lies its greatest value to its readers.

Application of Interchangeability to Drill Chuck Manufacture

First of Two Articles Describing the Tooling and Gaging Equipment Used by the Marvin and Casler Co., Canastota, N. Y., in Manufacturing the Casler Twin-screw Drill Chuck

By FRED R. DANIELS

MACHINE parts that engage each other in operation, such as a screw and nut, a dovetail and its slide, or any mating parts of special or irregular section, cannot be interchangeably produced except by the exercise of the greatest care in every manufacturing operation. When manufacturing on an interchangeable basis, conditions are encountered that require methods entirely different from those used when interchangeability is not a factor. The present article is intended to give a comprehensive idea of the methods followed in securing interchangeability in the manufacture of a device in common use in machine shops, and presents a complete description of the machining, gaging, and assembling methods followed by the Marvin & Casler Co., Canastota, N. Y., in the manufacture of the Casler twin-screw drill chuck. Each unit of the chuck will be considered separately up to the time of assembly, and all important tolerances will be given so that the procedure can be followed in detail. A variety of jigs, fixtures, and gaging methods are employed which are both novel and effective, and by the use of which all parts of one chuck will interchange with similar parts of any other having the same drill shank capacity.

Construction of the Chuck

A brief description of the construction of the chuck and its method of operation will make the reasons for following certain manufacturing methods more readily understood. The chuck consists of a cast-iron body with slots for two steel jaws, which operate radially. On the inner surface of each jaw a V-groove is machined, by means of which the drill shank is held. The jaws are manipulated by two steel screws located on opposite sides of the slot in which the jaws are fitted. One of these screws is termed the primary screw, and contains right-hand threads on one end and left-hand threads on the other; this screw engages the jaws and draws them together or opens them, according to the direction in which the screw is turned. The secondary screw is located on the opposite side of the jaws; its function is to equalize the amount of strain produced by the primary screw on the jaw teeth. Only one end of the secondary screw is threaded; the other, which is plain, fits in a circular groove in the right jaw, and the head of the screw bears against the shoulder produced by this groove to assist in tightening the chuck. By this construction, the sidewise strain which would ordinarily be produced on the jaws by the primary screw is distributed, so that a greater holding power and a better operating condition is obtained.

The secondary screw constitutes a lock for the chuck, and must be turned before it is possible to open the chuck by means of the primary screw. The shape of the jaws is such as to fit the vertical gash and the T-slot in the body, this gash and slot being clearly shown in Figs. 3 and 4. The jaws will be dealt with in the second installment of this article. In the upper right-hand corner of Fig. 1 is shown a cap-plate which is screwed to the large end of the chuck as a means of preventing it from spreading under strain.

This brief description of the construction of the chuck, in conjunction with the illustration Fig. 1, should be all that is necessary to enable the machining and gaging operations to be followed. For the purpose of describing the manufacture of this type of chuck, the intermediate size—having a drill shank capacity up to ¾ inch—has been selected, and all tolerances given are applicable to this size of chuck.

Preliminary Operations in Making the Chuck Body

The body of the chuck is made of close-grained cast iron. It is machined from the solid, there being no cored sections in the casting. The castings are first centered at both ends on a Whiton centering machine. The small end of the body is then recentered to obtain a uniform distance between centers regardless of variations in the rough over-all length of the body. This recentering operation is performed on an upright drilling machine, the table of which contains a plug center so that the work may be located on it in a vertical position while the small end is being recentered with a combination center-drill.

A Porter-Cable lathe is next employed for rough- and finish-turning the two diameters of the body and for rough- and finish-facing the ends. The turning tools are carried on the front cross-slide of the lathe, and the facing tools, on the cam-operated back-slide. This cam is a two-throw cam having a 1¼-inch rise. The work is held between centers and is driven by a special lathe dog and a driver attached to the faceplate. After the small end of the body has been rough-turned and rough-faced, it is necessary to reverse the work to perform similar operations on the large diameter of the body. In performing the finish-facing and finish-turning operations the same procedure is repeated. The diameter is finished to within limits of ± 0.005 inch, which furnishes sufficient leeway for truing up and grinding for finish, the latter operations being performed after the chuck is fully assembled. A complete set of profiling and snap gages is employed to hold the work within the established limits.

After the work has been faced, a projection is left on each end surrounding the center, which could not be removed during the facing operation. This projection is next removed with a ¾-inch drill. The next operation consists of finish-grinding the small end to length, the work being done on a Blanchard grinder and held to limits of ± 0.002 inch, by the use of suitable length gages of the regular type.

The four cap-plate screw holes are next drilled in the large end of the body on a Henry & Wright drilling machine, after which the work is located in a special drill jig by means of two pins which fit two of these cap-plate holes. This jig in which all the remaining drilling operations are performed is first used to drill the shank hole in the chuck body. After the shank hole is drilled, the jig is placed on its side and two 7/16-inch holes are drilled through the body. This operation is performed by running the drill half way through the casting and then reversing the jig and drilling in from the opposite side as a precautionary measure for preventing the hole from running out. These two holes are indicated at *A*, Fig. 1, and from them the operating screw recesses are subsequently machined. The two recesses, however, are not of the same diameter throughout; the one in which the primary screw is assembled has a shoulder to fit the neck of the screw, as indicated at *U*, while the other recess is a straight gash.

By removing the drill bushing from the drill jig used in the preceding operations, both these holes are next counterbored to 25/32 inch in diameter, which produces the shoulder previously mentioned by means of which the primary screw is located in the chuck. The stop on the drilling machine spindle is set so that a liberal amount of excess stock is left on this shouldered section of the recess, which is subsequently finished to length. This procedure is also followed in counterboring the secondary recess simply because it is convenient to do so with the work located in the jig. Another operation is then required to clean out the shoulder section left in the secondary screw recess.

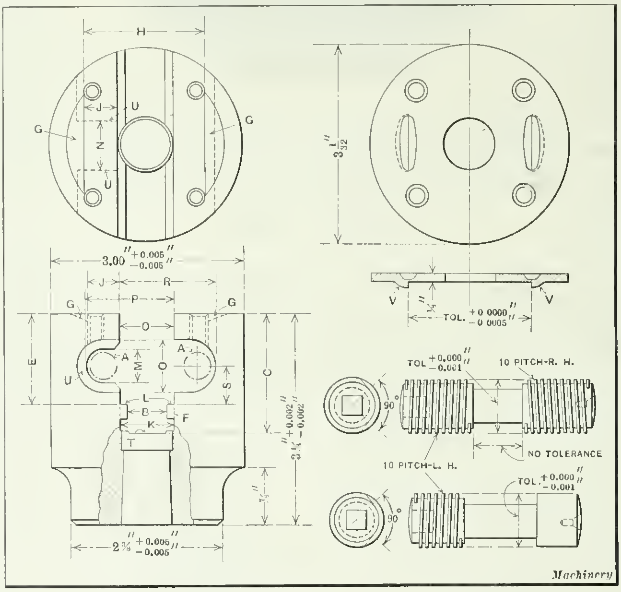


Fig. 1. Casler Drill Chuck Body, Cap-plate, and Operating Screw

The finishing of the shoulder for the primary screw is of great importance, for it must be located centrally and finished to within limits of + 0.003 and + 0.006 inch in length. The basic length of this shoulder and of the neck of the screw (on which no tolerance is allowed) is the same, so that the limit set for the shoulder is apparently in the wrong direction, that is, it is larger rather than smaller than the basic dimension. But this is done designedly so that during the assembling operation the screw may be forced into place and turned until the faces of this shoulder become burnished. It is claimed that the surface produced by thus operating a hardened steel member against a cast-iron surface has high wearing qualities comparable to a chilled or casehardened surface. A set of special gages is used to check the location of this shoulder and to hold it within the required limits.

Fixture Used in Milling the Jaw Gash

Up to this stage in the description of manufacture there is no particular difference between ordinary manufacturing methods and interchangeable manufacturing procedure. From this point on the machining operations performed on the body of the chuck determine to a large extent the degree of interchangeability obtained, and for that reason particular attention will be called to the gaging methods which have been devised for locating the various body surfaces in contact with which the screws and jaws operate. The location of the jaw gash and operating screw recesses is important from the standpoint of the running conditions of the chuck, whereas the tolerances on these machined surfaces are the main consideration for establishing interchangeable manufacturing conditions.

The operations already performed on the screw holes, that is, drilling and counterboring, do not in any way affect the accuracy with which the screw recesses are finally finished, and so cannot be considered from an interchangeable manufacturing basis, being merely a preliminary series of operations. The milling of the gash in the body in which the jaws function is performed on a Briggs miller, equipped with a special string milling fixture, as shown in Fig. 2. The method of clamping the work in the fixture can be clearly seen in the illustration, and a number of gages employed in connection with this operation are also shown in this view.

There are a number of pack-hardened studs *A* driven into the cast-iron body of the fixture, and when the work has been put in place a pair of small pack-hardened steel plugs, such as shown at *B* and also on the table of the machine, are dropped in between adjacent pieces of work, one on each side. There is a binding screw for each piece of work, located directly opposite the center of these two small plugs as shown at *C*, and these screws operate "evener" clamps, one of which is shown at *D* at the end of the fixture, so that the pressure exerted on studs *B* is distributed to both sides of the fixture. This affords an effective means of holding the work securely without injuring the exterior surface.

Before the "evener" clamps are tightened, an aligning gage *E* is employed to position the work so that the gash will be machined parallel with the screw recesses. These screw recesses, it will be recalled, were drilled and counterbored in a fixture which made use of the cap-screw holes in the end of the chuck body to locate the work; these same cap-screw holes are now utilized in locating the work during the milling of the jaw gashes. The aligning gage consists merely of two pairs of accurately spaced steel pins, one pair of which *L* is mounted in an adjustable member of the gage, so that in case the diameters of the chuck bodies vary, suitable adjustment may be made to agree with the resulting spacing of the pairs of holes on each side of adjacent bodies. As soon as one pair of bodies has been aligned and clamped the gage is removed and the holes in the second body become

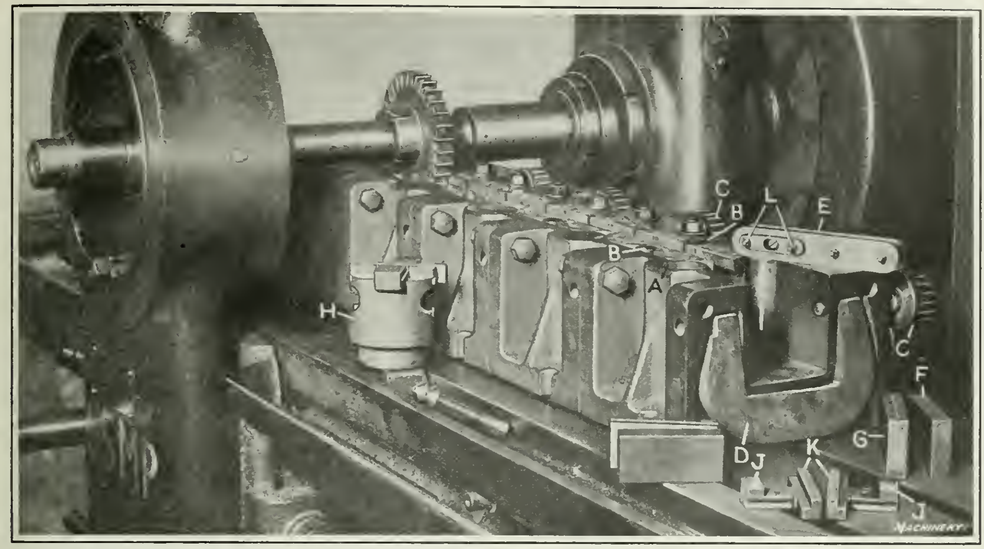


Fig. 2. String Milling Fixture in which the Bodies are held while the Jaw Gashes are being milled

the locating centers for aligning the next body, and so on until the entire string is aligned.

Milling and Gaging the Slot

There are two cuts taken in milling the jaw gash, the first of which mills the gash to the width *B*, Fig. 1, and to the depth *C*. For this operation a single inserted-tooth cutter is used in connection with a special arbor. The fixture has a tongue which fits in a T-slot of the table, so that by using a special arbor, only slight adjustments are required for establishing a central location for the cutter. In taking the second or finishing cut, the same fixture is employed, but the arbor carrying the single cutter is replaced by one having two side milling cutters for milling the slot to width *D* and to depth *E*. The illustration Fig. 2 shows the separate arbor with its two side milling cutters, used in taking the second or finishing cut. The limits for width *B*, Fig. 1, are ± 0.005 inch, but for width *D* the total tolerance is only — 0.002 inch, which it will be noticed is an extremely close fitting allowance. For that reason the practice of employing two side milling cutters spaced by washers of suitable thicknesses, rather than a single cutter enables the reduction in width, due to wear and grinding, of the cutting edges to be compensated for by simply changing the spacing washer. Depth *E* has a tolerance of 0.008 inch, and produces the vital registry surfaces *L* from which the work is located during subsequent milling operations and against which important operative surfaces of the jaws function. The limit on dimension *C* is ± 0.005 inch and as this surface does not come in contact with the jaws, a tolerance of this liberality is permissible.

Several gages are shown on the milling machine table in Fig. 2; *F* is a "Not Go" gage for width *B*, Fig. 1, and *G* a combination "Go" width and limit height gage for this same gash. A similar pair of gages is employed to inspect the depth and width of the second or finish cut, these being shown near the front corner of the fixture. In addition to these gages for width and depth of the gashes, a unique gaging method is used to inspect the central location of the gashes. The gages used for each cut are of the same design, and it has been endeavored to illustrate their use by showing one pair of these gages located on the work *H* as in actual gaging, and another pair lying face upward on the table so that the principle employed to check this location may be clearly understood.

The two gages are shaped to resemble somewhat the letter T, and there is a lug on the vertical and on the horizontal parts of each gage. Lugs *J* have an inner angular surface while lugs *K* are parallel, and their total width is such that when matched together they will slide into the particular gash in which they are used. The upper surfaces of these gages are graduated so that when the pair is slid into the gash, with the gages resting on the top of the body as shown at *H*, the angular surfaces of lugs *J* will be tangent with the circumference of the body, and if the gash is properly located the graduated lines on the two gage members will align. The graduations are so placed on the gages that the location can be readily determined within very close limits. The importance of holding this central location to within a tolerance as small as 0.005 inch will be fully realized as the progress of the subsequent milling operations is followed.

During the milling of this jaw gash, the four cap-plate holes are tapped in a drilling machine located conveniently in relation to the Briggs miller. The next operation is of minor interest and consists of reaming a clearance hole

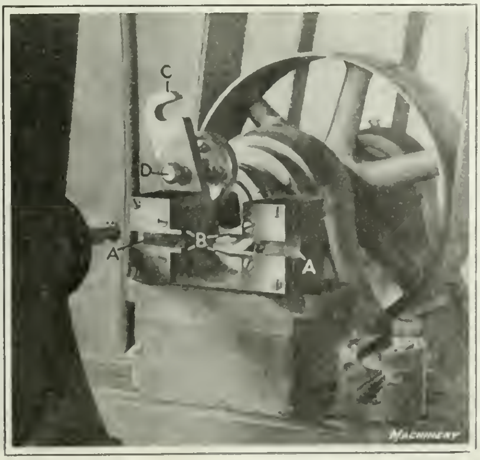


Fig. 3. Cradle Fixture in which the Work is located during the T-slotting Operation

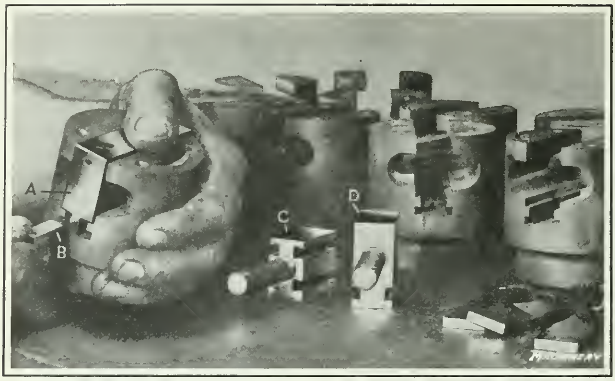


Fig. 4. Gaging the Central Location of the T-slot with Relation to the Jaw Gash

for the shank of the maximum size drill for which the chuck is intended. This clearance cut is indicated in Fig. 1 by dotted lines *F*. In describing the construction of the chuck, it was stated that a cap-plate is attached to the end of the chuck body to prevent it from spreading when in use, and the next operation on the body, which is performed on a Whitney hand miller, consists of straddle-milling the gashes *G*, Fig. 1, in which the cap-plate tongues fit when the plate is assembled. These gashes must be accurately machined and spaced to gage dimensions. The work is located in a vertical position in a fixture which carries a tongue that fits into the previously machined jaw gash. A limit snap gage is used to maintain the proper width between cuts to within a tolerance of 0.0005 inch, the limits being from plus 0.001 to plus 0.0015 inch for distance *H*. The cap-plate is a "snap" fit in these gashes, and the corresponding dimension on the cap-plate has an even closer limit, as may be seen by referring to the sectional view of the cap-plate shown in the upper right-hand corner of Fig. 1. The central location of these cuts in the body is checked by gaging dimension *J*, from the side of the jaw gash to the vertical side of the cut, a limit snap gage being employed to hold this dimension within limits of ± 0.0035 inch. A combination contour and depth gage checks the depth of these gashes.

Fixture and Gaging Methods Used in T-slotting the Body

The T-slotting operation by means of which slot *K* is milled is performed on a No. 1½ Garvin duplex miller provided with a fixture as illustrated in Fig. 3. This fixture is in the form of a cradle with clearance slots *A* for the T-cutter and steel plates with locating fingers *B* which are the proper distance apart to accurately fit width *D*, Fig. 1, so that the body may be slid into the cradle, guided by these fingers until the inner vertical surface of each finger abuts against the bottom of the jaw gash, that is, against surfaces *L*. With the work thus located in the fixture, the relation of the T-slot to the jaw gash and seat *L* may be definitely established. A leaf *C*. Fig. 3, with a floating plug *D* that enters the shank hole of the chuck clamps the chuck body in such a way that the two locating surfaces previously mentioned snugly engage the steel fingers *B*.

The width, height, and central location of this T-slot must each be held within very close limits, and a number of interesting gages are employed to check this T-slot. These are shown in Fig. 4. The thickness and width gages are of the same type and are shown strung together lying on the bench. There is a "Go" and a "Not Go" gage for width and a "Not Go" gage for height of the slot. The checking of the central location of the T-slot is an interesting process, and in the illustration the inspector is engaged in checking this central location. A steel gage-block *A* fits the jaw gash and seats on surface *L*, Fig. 1. The gage has a tapered tongue which extends down to the bottom of the T-slot. The angle of this tapered tongue is located symmetrically with relation to the center line of the gash and two flat graduated steel pieces such as shown at *B* are used in connection with the tapered tongue on block *A*. One side of each of these steel pieces is machined at the same angle as the surfaces of the tongue so that the flat steel pieces may ride on the angular surfaces of the tongue; and if the slot is centrally located, corresponding graduation marks on each steel piece will coincide when they have been slid in as far as possible. The graduations are so calibrated that the amount of error can be read to thousandths of an inch.

The width of the T-slot has a tolerance of + 0.015 inch, and the height a tolerance of + 0.001 inch. The shallow groove formed at the bottom of the T-slot in this operation receives a slight tongue on the jaws. However, surface *T*, Fig. 1, is not a functional surface since there is a slight clearance between it and the jaw. The distance from surface *T* to the bottom of the T-slot is 0.015 inch, which leaves a clearance for the jaws of about 0.01 inch. At this stage of the machining operations composite functional surfaces have been produced, so that a functional gage must be employed to check the entire T-slot and its relation to the jaw gash. This functional gage is shown at *C*, Fig. 4, one side of which is a "Go" gage and the other side a "Not Go" gage. Another gage of somewhat similar type to the functional gage is shown at *D*, but the slots in the side are not gaging surfaces —they are merely clearance cuts so that the height from the bottom of the T-slot to the top of the body (that is, distance *C*, Fig. 1, minus 0.015 inch) may be gaged to within limits of ± 0.005 inch.

Fixture Employed for Milling the Screw Recesses

The next series of milling operations includes the operations by means of which the previously drilled 7/16-inch holes and the 25/32-inch counterbored holes for the operating screws are milled open. These are the final machining operations performed on the chuck body, the work being done on a No. 1 Garvin duplex miller shown in Fig. 5. A rather in-

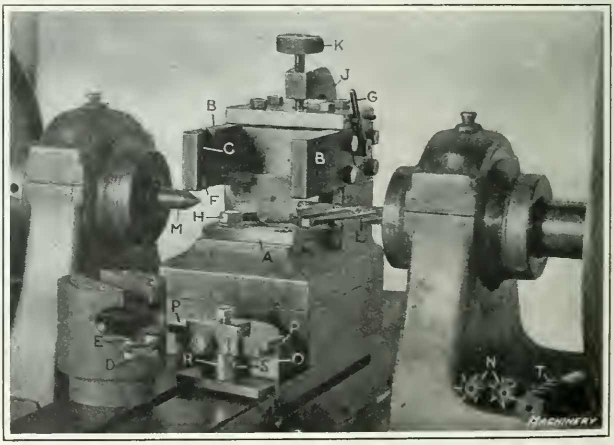


Fig. 5. Fixture in which the Chuck Bodies are held for finishing the Operating Screw Recesses

teresting fixture has been devised for holding the work during the several milling operations performed on this machine. The fixture has a steel block with a locating tongue *A* which is an accurate fit in the jaw slot so that the work may be inverted and seated on this block. Two arms *B* on the upper part of the fixture extend to the front over the center line of the machine spindles, and these arms contain vertical grooves *C* which in conjunction with the horizontal seat or block are employed to maintain an exact perpendicular position for the work.

An accurately machined slide *D* is pushed into the T-slot of the work and protrudes from the body about as shown in the illustration. This auxiliary slide has a semicircular groove *E* at each end so that when the work is inverted and seated in the fixture, these grooves will engage ears *F*, located at the lower end of grooves *C*, and will insure parallelism of the T-slot with the center line of the machine spindle. It is evident that slide *D* is of such a length and width as to fit nicely in the vertical grooves of arms *B*. There are two sliding square fingers resembling keys which operate in the arms of the fixture by means of a pin-lever *G* so that they may be advanced to slide over the top of the extending ends of the auxiliary slide and thus prevent the work from rising from its seat. With the work thus located, cradle *H* is advanced against the chuck body to clamp it securely in place. This cradle is operated by a hardened detent which extends backward through the base of the fixture so that its extending end may be engaged by the lower end of lever *J* which is pivoted on the fixture. Then by operating the knurled screw *K* so that the horizontal end of this lever will be raised, the lower end will advance the cradle by means of the detent previously mentioned. This permits the cradle to center itself on the chuck body, and equalizes the pressure exerted by screw *K*.

Screw-recess Operations, Tolerances, and Gaging Methods

The first operation performed in this jig is that of milling out the stock in the primary screw recess, which was left after the 7/16-inch hole was drilled through this side of the body—that is, the finishing of dimension *M*, Fig. 1. In performing this operation, the milling cutter *L*, Fig. 5, is advanced until it is centered by the regular lathe center *M*, so that the cutter will be prevented from running out. The position of the milling machine head was changed in taking the photograph, to obtain a better view of the fixture.

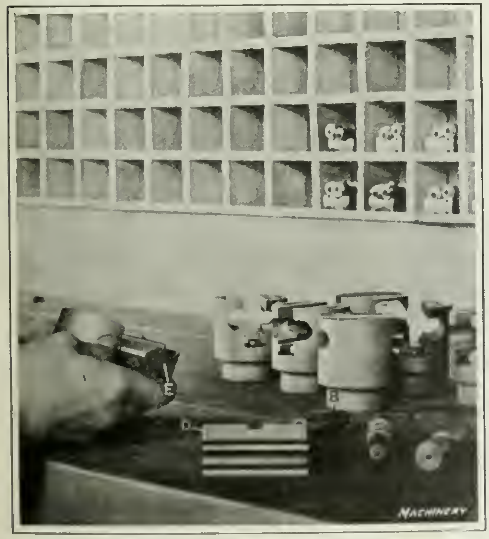


Fig. 6. Gaging the Operating Screw Recesses with Reference to the Side of the Jaw Gash

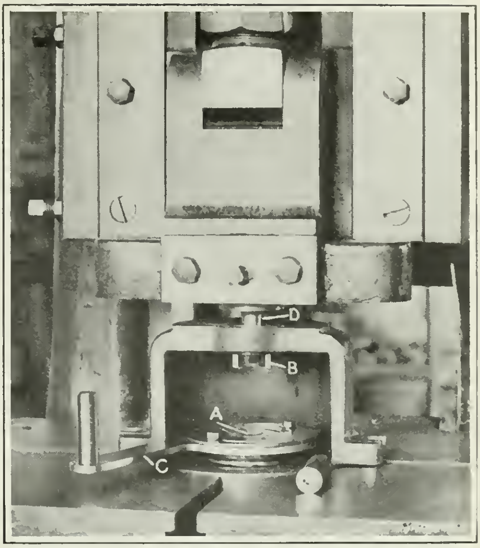


Fig. 7. Clamping Fixture in which the Operating Screws are held while broaching the Wrench Hole

With the cutter advanced and centered, the work is slid down between the arms of the fixture and over the milling cutter until the jaw gash in the chuck body encloses the tool. The diameter of the primary screw neck has a clearance in the recess milled at this time, so the tolerance on the diameter *M* of the recess (see Fig. 1) is not of so much importance as the straddle length of this recess, that is, the distance *N* between shoulders, which is finished in the next operation. The plus limit for dimension *M* is 0.005 inch and the minus limit 0.016 inch.

The recess for the body of the primary screw and the shoulders for the neck recess are rough- and finish-milled, using the two end-mills shown at *N*, Fig. 5, to replace the milling cutter and center with which the machine shown in the illustration is equipped. In setting up for the finishing operation, a special centering gage *O* is used to locate the heads of the milling machine so that the ends of the milling cutters will be located equidistant from the center of the fixture. In obtaining this location for the end-mills, the gage, which has the contour of one-half the chuck body with the slide *D* assembled, is located in the fixture in place of the chuck body. It will be noticed that the projections *P* fit the vertical slots in the fixture arms and that their top surfaces may be engaged by the sliding fingers operated by pin-lever *G* to hold the gage in position. Stud *R* carries a steel pin *S*, and in locating the spindle heads one end-mill is advanced until the end of this pin is just touched by the cutter. Stud *R* is then revolved 180 degrees and fastened, and the other end-mill is similarly advanced to come in contact with the end of the pin *S*. The gage is then removed, the distance between the ends of the cutters measured, and each head is relocated at one-half the difference between this measurement and the desired length of the primary screw neck recess. This results in centrally and accurately locating the end-mills for the finishing operation.

The length of the neck of the primary screw has no limit allowance, so that the plus limits for dimension *N*, Fig. 1 (0.003 and 0.006 inch), represent an over size. In assembling, this necessitates forcing the primary screw between the shoulders of the recess; and as the screw is a hardened steel member it acts as a burnisher, finishing the shoulders of the recess and producing a hardened wearing surface on them. These surfaces *U* are burnished by simply working the screw until the desired fit has been obtained.

In milling the seat for the body of the secondary screw, the milling cutter *T*, Fig. 5, is used, and in this operation only one cut is required, since there is no shoulder to be accurately finished to a straddle length as in the case of the primary screw. It is obvious that this condition was responsible for the use of a roughing and a finishing cut on the primary screw recess. The limits on the diameters *O*, Fig. 1, of the recesses for the two operating screws are + 0.005 and + 0.012 inch, and of the corresponding diameters of the screws + 0.000 and — 0.001 inch. Fig. 6 illustrates the type of gages employed to test the accuracy of the operating screw recesses. There is a combination "Go" and "Not Go" gage *A* for inspecting the straddle length of the shoulder; one "Go" and one "Not Go" plug gage for the diameters of the screw recesses, shown at *B* and *C;* a limit gage *D* for inspecting dimension *P*, Fig. 1; and a similar gage *E* for checking dimension *R*. The limits on dimension *P* are — 0.0055 and + 0.0045 inch and for dimension *R* + 0.0015 and + 0.0065 inch. Both of the gages used in checking dimensions *R* and *P* slide on surface *L*, so that when these dimensions come within the "Go" limits, dimension *S*, which is the distance from the center of the operating screws to the important surfaces *L*, will be within the established limits of ± 0.002 inch.

In reference to the checking of dimensions *P* and *R*, Fig. 1, the previously gaged surfaces of the jaw slot are the registry surfaces so that the operating screw recesses become symmetrically located and within a close functional tolerance. After the chuck body has reached the final stage in its manufacture, it is given a complete inspection. This is a bench job and completes the work on the body except that performed after assembly, as previously stated.

Machining the Operating Screws prior to Cutting the Threads

The primary screw with its right- and left-hand threads and the secondary screw having a left-hand thread at one end and a plain cylindrical diameter on the opposite end are illustrated in the lower right-hand corner of Fig. 1. These screws are made from Midvale special screw stock containing 0.80 to 0.90 per cent carbon. The operations performed on these two screws are substantially the same except in respect to the plain end of the secondary screw; consequently the description will be confined to the primary screw and the method of manufacturing it.

The stock is roughed out to length, one end chamfered, the other rounded, and a hole drilled in the rounded end, during the first operation which is performed on a Jones & Lamson single-spindle flat turret lathe. The blanks are next set up in the clamping fixture shown in Fig. 7, where the hole in the end that was drilled during the first operation is broached square, this being the chuck wrench socket. The work is performed on a Bliss No. 21 power press, and is seated within the clamping fixture at *A*, being supported at the other end by the hollow center *B*. When the work is properly located, the lever *C* is tightened and the work held in alignment with the square broach which operates in sleeve *D* as a guide. The blanks are then centered on the opposite ends, and the over-all length corrected to limit gage measurements, this work being done on a Pratt & Whitney screw machine.

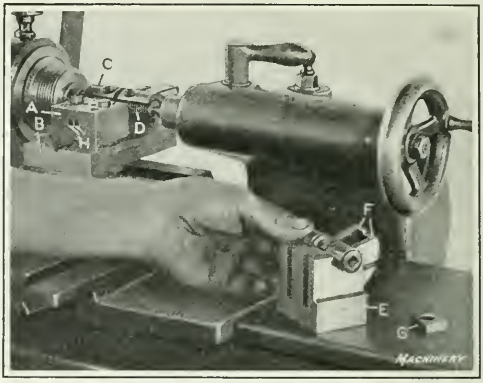


Fig. 9. Gaging Equipment used for testing the Screw and for centrally locating the Tool-block

The next operation is performed on a Pratt & Whitney hand screw machine, and consists of rough-turning the neck, after which the set-up shown in Fig. 8 is employed to finish-turn the outside diameter, form the shoulders on each end of the threaded portions, and turn the neck to nearly its finished diameter. There is a limit on the large diameter of 0.002 inch, but none on the diameter of the shoulders, which is the same as the root diameter of the screw, and none for the length of the neck. It has already been mentioned that the length of the recess in the body in which this neck fits is purposely made over size so that the wearing surfaces of the shoulders of this recess may be burnished or glazed to increase their wearing qualities. The equipment used on the Porter-Cable lathe shown in this illustration, consists of a square center as a driver, a special tool-head *A* in which the shouldering tools and the forming tool for the neck are carried, and two turning tools and tool-holders (one of which is clearly shown at *C*). The turning operation is performed simultaneously with, and independently of, the operations performed by the tools carried in the tool-head. In setting up the machine, a Koch indicator is used as shown in the illustration, to enable a more accurate setting of the tool-head to be made. It will be seen that the neck-forming tool may be adjusted in its angular slot by means of screw *D*, independently of the shouldering tools. The finished diameters are checked by limit snap gages.

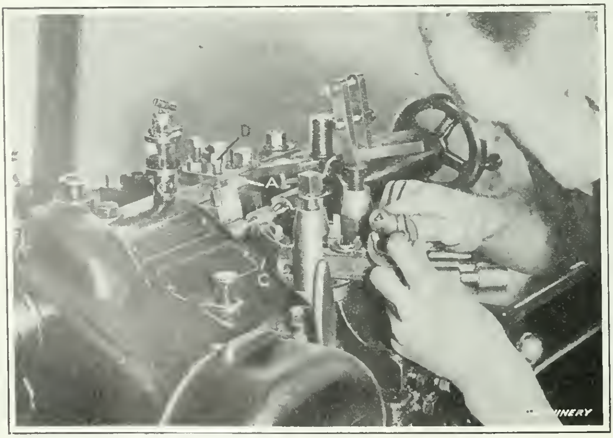


Fig. 8. Lathe equipped with Special Tool-head for forming the Shoulders, turning the Ends of the Screws, and finishing the Neck

Cutting the Threads in the Operating Screws

The screws are now ready to be threaded, and this operation is done on a thread-cutting lathe made by the Automatic Machine Co., equipped with a Pratt & Whitney square thread tool-holder. A square center is used to drive the screw blanks and a master screw employed to set the Rhodes threading tool used. There are 10-pitch square right-hand threads cut on one end and left-hand threads of the same size on the other end; the equipment for both is the same except as it may be varied to meet the opposite hand of the threads.

It is important that the threads in operation start engagement at the same time, that is, the beginning and end of the threads must bear the same relation to each other on opposite ends of the screw; otherwise simultaneous engagement and disengagement with the two jaws will not be realized. This relation is 90 degrees, as indicated on the end views of the screws, Fig. 1. The next operation, therefore, consists of straddle-milling the ends of the threads on a Whitney hand miller equipped with an arbor on which there are four cutters, so that the operation may be done at one setting by simply turning the work through 90 degrees after the two adjacent ends of opposite-hand threads are milled, to bring the opposed ends of the threads under the cutters.

Final Machining Operations on the Screws

The operation of finish-facing the neck and finish-turning its diameter is performed on a Porter-Cable lathe and is illustrated in Fig. 9. The tool-block *A* is mounted on a special plate *B*, at the rear of which a Koch indicator is attached in line with the center of the tool-block. The tool-block contains two square slots *H*, which are machined at an angle, so that the two facing tools may be adjusted to suit the length of the neck. This angular position of the tools also provides the necessary clearance. It is necessary not only that the length be precisely obtained, but also that the neck be centrally located on the screw so that corresponding points in opposite-hand threads will bear the same relationship to the center of the screw.

For obtaining this condition a gage *C*, in the form of a section of a hollow cylinder is laid on the screw *D* while it is held between centers on the machine. This gage is provided with two short pins projecting from its inner wall, which are accurately spaced from a central groove in the gage. By laying this gage on the work and turning it slightly until the pins bind in the opposite-hand threads, it is a simple matter to adjust the carriage of the lathe laterally so that the center of the tool-block will coincide with the center of the screw regardless of the location of the neck as machined in previous roughing operations. In obtaining this central location for the tool-block and tools, the point of the indicator is brought into contact with the central slot in the gage, and the carriage adjusted as required.

The effectiveness of this simple method of locating the neck with regard to corresponding points of the threads is then checked by means of special aligning gage *E*. This gage consists of a block, in the cradle of which the screw neck fits, and two tumblers *F* in each of which there is a pin which engages with the opposite-hand threads as the screw is turned. Then by continuing to turn the screw, the tumblers will be raised and the differences between the angular elevations of the top surfaces noted. This difference indicates the amount of inequality between the center of the neck and similar points on the screw thread with which the pins are in engagement. Since the tumblers are suitably graduated, the amount of error can be read in thousandths of an inch. The width between shoulders (on which there is no tolerance allowed) is checked by the plain master block *G*. This facing operation is of paramount importance in securing the desired functional qualities of the chuck and in promoting interchangeability, for even though the threads are accurately cut, any deviation from the central location of this neck will cause the screws to bind in use.

After being burred and given a final inspection, the screws are heat-treated by hardening at 1420 degrees F., and quenching in oil, and are finally drawn at 750 degrees F. in a nitrate solution for a period of thirty minutes. The screws are then wired, brushed, and ground on the outside diameter on a Brown & Sharpe cylindrical machine, using a square center as a driver, a Norton 46-J wheel, and a limit gage for holding the diameter within a minus tolerance of 0.001 inch. This provides a minimum clearance of 0.005 inch and a maximum clearance of 0.013 inch between the screw and its recess in the chuck body.

Making the Cap-plate

The cap-plate, which is attached to the top of the chuck body to prevent its spreading under strain, is shown in the upper right-hand corner of Fig. 1. This plate is made from cold-rolled steel, and is first blanked and pierced on a power press, after which the lugs *V* are produced by an embossing punch and die. These bosses are milled to within limits of + 0.000 and — 0.0005 inch, on a Whitney hand miller, and suitable limit gages are used to check this dimension. The screw holes are next countersunk, the piece burred and inspected, and its top surface disk-ground. This completes the machining operations on the cap except for finishing the diameter after assembly.

The second installment of this article will appear in the March number of MACHINERY, and will deal with the machining and gaging methods used in the manufacture of the drill chuck jaws as well as with the special equipment employed, concluding with a complete description of the assembling process.

* * *

BRITISH STANDARDS FOR MILLING CUTTERS

The British Engineering Standards Association has recently issued report No. 122, 1920, dealing with British standards for milling cutters and reamers and giving the results achieved in the standardization of the nomenclature and definitions of these tools. A large number of tables of dimensions and tolerances are included and an index is added for ease of reference. The work was undertaken in response to a direct request from the small tool and machine tool makers of the country, to fill a recognized need. A fully representative conference was convened, as is the usual custom of the association before embarking upon any new work. Committees were appointed to carry out the various sections of the work, and these met in different parts of the country in the various centers of the tool industry, thus saving much time to the members and bringing them into close touch with actual practice.

The committees were thoroughly representative, including as they did manufacturers of the tools, makers of the machines in which they were used, and representatives of the users. The tools considered were divided into four classes: Non-relieved cutters; end-mills; form relieved cutters; and reamers.

The report commences with definitions of the various classes of milling cutters and reamers, followed by a valuable series of definitions of various types of each class, each type being accompanied by a clear explanatory diagram. It contains fifty-eight tables giving the standard dimensions and tolerances of the various tools, including tables of Brown & Sharpe and Morse tapers. Standard dimensions of arbors, keys, and keyways are also given.

A report covering so wide a field of industry is sure to be susceptible of amendment, and it is hoped that experience in its use will indicate the directions in which any revision may be called for; and in order that any advance in manufacturing methods may be given effect to, an opportunity is afforded at least once a year for the revision of all specifications issued by the association. The price of the report is 1s. 3d., and copies may be obtained on application to the Secretary, British Engineering Standards Association, 28, Victoria St., S.W. 1, London, England.

* * *

Many engineers are firmly of the opinion that lacing must be used on belts exposed to steam, like those used on pulleys in laundries, etc., as they believe that belt cement will not hold under such conditions. That depends on the kind of cement used. Not all belt cements are made of the same ingredients. Steam will not dissolve a belt cement made on a pyroxylin base, because it is waterproof, and therefore not affected by moisture.

Methods in a Tractor Engine Plant

Battery of Drilling Machines Arranged for Continuous Operation

REPEATED reference has been made in the columns of MACHINERY to the increased rates of production which may be attained through the use of equipment that provides for the performance of machining operations according to the so-called continuous principle, that is to say, a method of procedure that reduces non-productive time of the machines and their operators to a minimum. An ingenious application of this continuous principle has been worked out in the Avery Co.'s engine plant, Milwaukee, Wis., for performing drilling and reaming operations in valve stem guides.

The equipment developed for this purpose is illustrated in Figs. 1, 2, and 3; referring to Fig. 1 it will be seen that there are eight vertical drilling machines of the standard type built by the F. W. Lindgren Co., Rockford, Ill., mounted around the circumference of a special turntable *A*, which is arranged to rotate continuously. This table is driven by an electric motor mounted beneath the floor, and there is a set of change-gears in the driving train, to provide for rotating the table at various rates of speed. The same electric motor that rotates the turntable also furnishes power to drive the individual machines. For rotating the table, the power is carried through a triple reduction gear to give a sufficiently slow speed. The drive to the drilling machine spindles is through a single reduction gear, and thence to a gear at the top of a vertical shaft at the center of the turntable, which meshes with a driving gear at the base of each drilling machine. This gear at the center of the turntable continues to mesh with the driving gears on the machines as the turntable carries them around their circular line of travel. Alternate machines on the turntable carry a twist drill in the spindle, and the other machines carry a reamer, and each work-holding fixture is provided with a pilot that enters a locating bushing in the drilling machine table to center the work under the spindle of the machine. This equipment was designed and built under the personal supervision of James H. Pinson, manager of the Avery plant.

Interchangeable Fixtures which Obviate Necessity of Resetting Work for Reaming

All of the fixtures are interchangeable between the machine tables, so that after the drilling operation has been completed in a piece of work, it is not necessary to unload the piece from a drilling fixture and reload it in the reaming fixture. Instead, the method of procedure is to lift the work and fixture as a unit from the table of the drilling machine, enter the pilot into a locating hole on the table of the next machine that carries a reamer, give the fixture about one-eighth turn to clamp it with a bayonet locking mechanism, and then pull down a lever that engages the feed mechanism on the machine. After this has been done, the operator's attention is no longer required until the machine has completed its traverse around the circuit on the turntable *A*. During this cycle, the machine will feed the reamer down to the end of its stroke and engage an automatic trip that returns it to the starting position, so that when the finished piece of work gets back to the loading station of the battery, the operator merely lifts the fixture off the table, drops another loaded fixture into place, and engages the power feed.

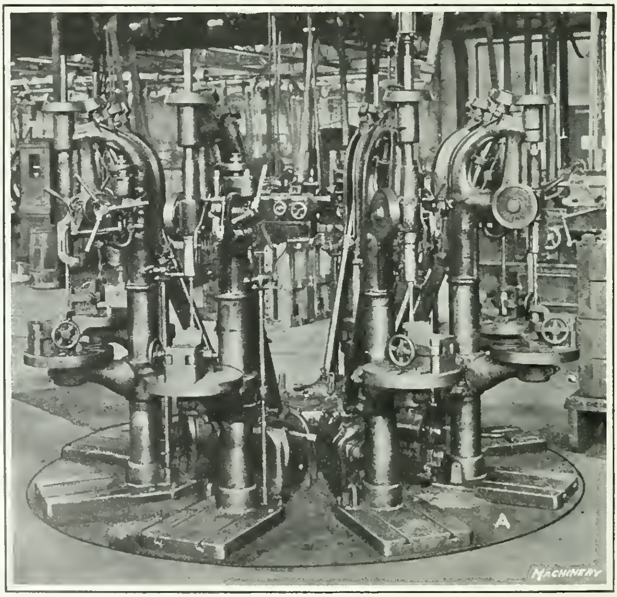


Fig. 1. Special Arrangement of a Battery of Drilling Machines equipped for Continuous Operation in drilling and reaming Valve stem Guides

Extra fixtures used in this way enable the attendant to occupy his time in unloading finished pieces of work and in setting up fresh castings in their places, so that these loaded fixtures can be set into position as soon as there is a

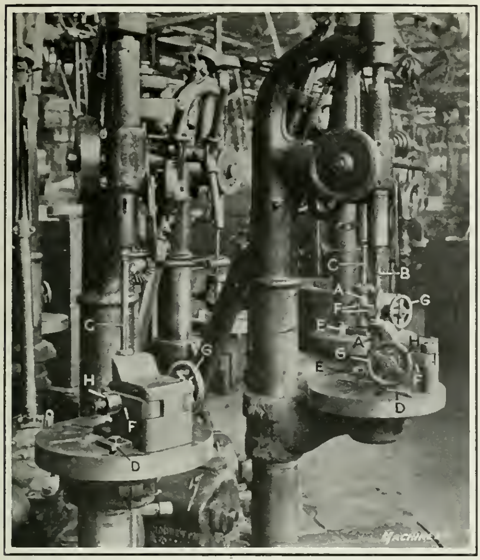


Fig. 2. Close-up View of a Drilling and a Reaming Machine showing Arrangement of Interchangeable Work-holding Fixtures

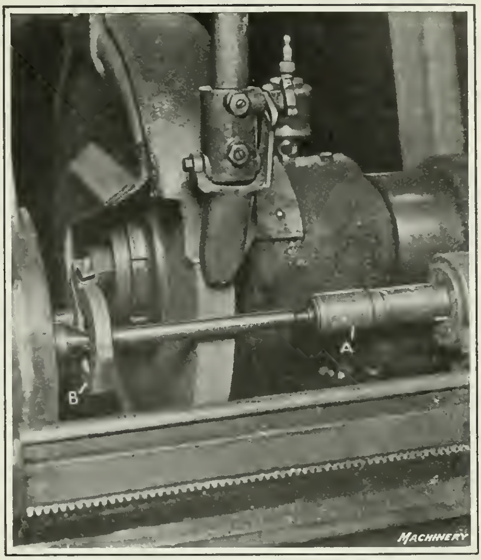


Fig. 3. Special Grinding Machine Center used for holding Tractor Engine Valves for grinding their Stems

place made vacant on one of the drilling machines. As previously stated, the turntable runs continuously, and the work makes two turns around the circuit. At the first turn, the drilling operation is performed; then the fixture holding the drilled piece of work is transferred to the table of a machine in the spindle of which there is a reamer, and it makes another circuit on the turntable in order to have the hole reamed. A fixture containing a drilled piece is transferred from a drilling machine to a reaming machine, and a fixture containing an undrilled casting is set up on the vacant drilling machine table. With such an equipment the operation is essentially continuous, and a gratifying rate of output can be secured.

Arrangement of Fixtures to Facilitate Continuous Operation

Having made this preliminary statement concerning the general procedure in operating this battery of machines, a detailed description can be presented of the equipment. This is best shown in Figs. 1 and 2. Fig. 2 shows a close-up view of two machines, one of which is used for drilling and one for reaming. In this illustration, the work is shown at *A*, while the twist drill for performing the first operation is shown at *B* and the reamer for taking the second cut is illustrated at *C*. It has already been stated that beneath the fixture there is a pilot, shown in Fig. 4, that is interchangeable in locating holes in all of the drilling and reaming machine tables, so that any fixture will fit any table. The fixture is dropped into place with the pilot in the hole, after which it is turned until further movement is prevented by engagement of the side of the fixture with a stop *D*, Fig. 2, and at the same time an extension on the base of the fixture has slipped under a bayonet lock *E* that holds it down in place.

Method of Clamping the Work

Clamping of the work *A* is accomplished by means of two jaws *F* actuated by a handwheel *G*. It will be seen that the work *A* has a small collar on it, and this collar prevents the

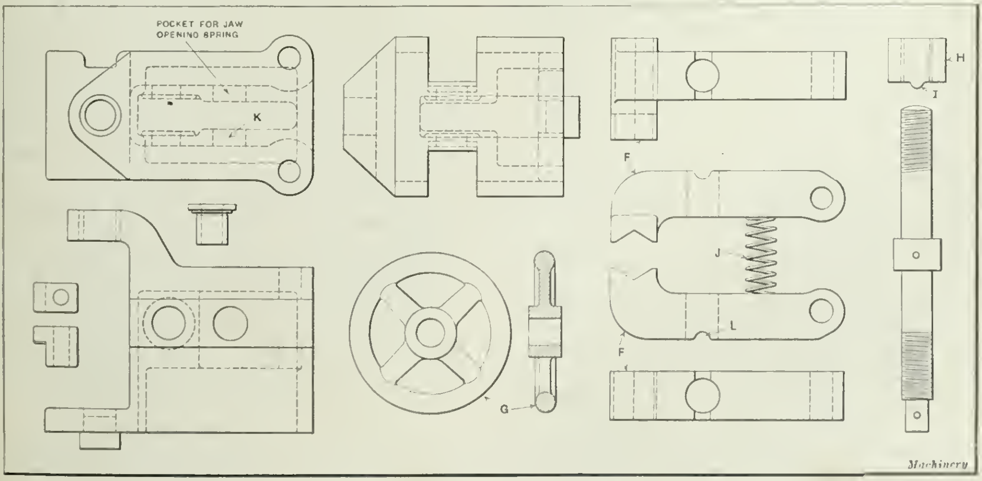


Fig. 4. Details of the Interchangeable Work-holding Fixtures used on Machines shown in Figs. 1 and 2

work from slipping through the jaws before they are completely tightened. Handwheel *G* actuates a screw that is threaded right-hand at one end and left-hand at the other, so that rotation of the handwheel results in turning this screw and drawing in two nuts *H* that pull jaws *F* together to grip the work.

From Figs. 2 and 4 it will be apparent that jaws *F* are pivoted at the back of the fixture, and in order to clamp the work, they must swing about their pivotal supports, thus changing their angular position. The nuts *H* engage the outside of the jaws, and this change in angularity would result in failure of the nuts to bear uniformly on the jaws unless special precautions were taken to compensate for this objectionable tendency. The means that were adopted for this purpose are illustrated in Fig. 4. It will be seen that the nuts *H* are furnished with a convex semi-cylindrical fulcrum point *I* that enters a corresponding concave semi-cylindrical bearing in the outside wall of jaw *F*. In this way the bearing between each nut and the jaw is between the fulcrum *I* and bearing *L*, and as a result changes in the angular position of the jaws do not affect the uniformity of the bearing between the nuts *H* and the jaws. A spring *J* which fits into pocket *K* opens the jaws when handwheel *G* is turned to release the clamping nuts *H*.

Special Tail-center for Holding Valves while Grinding the Stem

After the valves for Avery tractor engines have been machined, they are casehardened, and the stems are then finished to size by grinding. For the performance of this grinding operation, a practice was formerly made of leaving a small amount of excess metal at the lower end of the valve-stem, in order that a center hole could be machined in this metal to receive the tail-center of the grinding machine; and after the stem of the valve had been ground, this excess metal was broken off and the lower end of the valve-stem faced off smooth on a grinding wheel.

So far as the performance of the grinding operation was concerned, this practice was entirely satisfactory, but experience showed that when the excess metal carrying the hole for the tail-center was removed, the bottom of the valve-stem was no longer protected by an outer surface of carburized and hardened steel, and as a result it soon became battered through the action of the lifter-rod. Evidently, such a condition was undesirable, and Fig. 3 shows the means that were ultimately developed for overcoming the difficulty. The end of the valve stem is now chamfered and fits into a conical-shaped cup-center *A* that is provided with roller bearings to support the thrust, so that frictional resistance between this rotating member and the stationary body of the center is reduced to a minimum. At the opposite end of the valve-stem, it will be seen that an ordinary driving dog *B* is used to rotate the work, and the operation, aside from the method of supporting the tail end of the work, is quite an ordinary job of cylindrical grinding.

* * *

On January 1, 1920, a law went into effect in Sweden, providing for an eight-hour day in all the industries, and prohibiting over-time except under certain conditions for which special license was required. This law has not met with the favor either of the employer or of the workman, and a special government commission has investigated its operation with the result that it has been recommended that the law be suspended and revised. The commission recommends that the length of the working day be made dependent upon mutual agreement between employers and employes, and that provision be made for working over-time whenever circumstances make this necessary. The commission further found that in no industry had the shorter working day produced greater efficiency on the part of the employes, and there had been a considerable decline in production, several large plants being on the verge of closing down due to their inability to earn enough to meet the increased costs.

PROLONGING LIFE OF DIES

A patent has been issued to H. R. Reinhardt for a method of prolonging the life of dies, punches, and other similar tools for drop-forging and heading operations. The method was recently described in an article that appeared in the *American Drop Forger*, and is based on the fact that tools of this type will withstand wear better and last longer if, while being used, they are kept heated at a temperature above that of the atmosphere and lower than that used in the heating process. Roughly speaking, the temperatures used in the method, vary from 300 to 1100 degrees F., depending upon the characteristics of the steel from which the die or tool is made. Some specially compounded steels may be kept at a higher temperature than the maximum stated, but it must be somewhat less than that used in hardening.

Determination of the proper temperature requires a knowledge of the composition of the steel or of the hardening temperature, and this information can generally be obtained from the manufacturer of the steel. In using the method in connection with ordinary straight carbon tool steels largely used for drop-forging dies, that is, steel containing from 0.75 to 0.90 per cent carbon, which is heated to from 1400 to 1475 degrees F. in hardening, and whose tempering heat does not exceed 750 degrees F., a very high degree of toughness and resistance to wear is imparted to the tool by keeping it at a temperature of from 400 to 500 degrees F. while it is being used. In this instance, the lighter the dropping weight of the machine in which the tool is being used, or the lighter the stock and the easier the flow of the metal, the nearer to the stated lower limit the tool may be heated. It is preferable to keep tools made from carbon steels at a lower temperature than those made from alloy steels, because the continuous application of the former at a temperature nearer to that used in the hardening process, will result in a reduction of their hardness.

Dies or tools made of chrome-nickel, carbon-chromium, chrome-vanadium, cobalt-chromium, tungsten, or molybdenum steel alloys will, in some cases, scarcely be affected by temperatures ranging up to 1100 degrees F. Tools made of tungsten high-speed steel for heavy forging, trimming, and blanking operations will give much longer service if heated to this temperature, the period of their usable condition being more than doubled. Tools made of the cheaper grades of high-speed steels, not containing tungsten, may be kept at a temperature of 850 degrees F. without losing the required degree of hardness.

Heating the tools and dies and maintaining the temperature while being used may be effected in various ways. One method, which serves well for all temperatures, is to apply to the tool or die, a jacket tightly packed with a suitable layer of infusible earth or fine molding sand, and then heat it through the use of gas burners. In this way, the tool can be heated uniformly and kept near the requisite temperature for hours. An electrically heated apparatus could also be employed. Where it is more convenient and the tool does not require to be heated above 600 degrees F., an oil, molten lead, or lead and tin bath may be used.

In this connection, it may be noted that a compound of fourteen parts of lead to eight parts of tin melts at about 420 degrees F. and a combination of thirty-eight parts of lead with eight parts of tin, at about 510 degrees F. These temperatures are required frequently, and the molten condition of the compounds serves to indicate the temperature of the tool. The heating of the tool and of the packing or bath is controlled by means of a suitable instrument set in a recess in the tool, packing, or bath. and provision may be made for continuously indicating the temperature of the tool by providing a suitable temperature-indicating instrument. The inventor claims that high-speed steel die-blocks are so tough under a maintained heat that, without losing the essential hardness, they will bend rather than break and crystallization seems to be entirely eliminated.

Increasing Production by a Rational Piece-work System

By JOHN C. SPENCE, Superintendent Grinding Machine Division, Norton Co., Worcester, Mass.

IN a former article, in the December number of MACHINERY, it was mentioned that one of the causes for curtailed production was willful restriction on the part of the worker. This restriction can be practically eliminated by the management of any shop where the latter, rather than a trade union, has the right to determine the methods whereby the work in the shop is to be performed.

During the years of the writer's experience with shop men, he has found that two classes of workers are inclined to restrict output: First, day workers who appear to believe that whenever they can loaf a little there is some peculiar gain to themselves, and who also appear to think that as piece-work prices sometime may be set on the work that they do, it may be advisable not to speed up production too much; and second, piece-workers who are afraid that if they earn "too much," piece-work prices will be cut or some new method devised for doing the work which will make it convenient to introduce a new price.

Piece-work the Best Plan for Increased Production

Piece-work plans of some kind offer the best means for stimulating the day worker to increase his efforts and thereby increase production. In discussing this subject, I confess that my sympathies are more with the worker than with the old-type executive, and that the objection of workmen to piece-work plans is largely due to the methods applied in the past in this connection. "Unscientific" and "unscrupulous" are the words that best describe piece-work rate settings of the past, and it will take a long time before the worker will really gain that confidence in the management which is found only in a few plants throughout the country, and which has been created by absolutely fair dealings in connection with piece-work. The only method whereby it is possible to make men produce to the full extent of their ability, consistent with health, is to make them confident that no matter how much they earn through increased speed, piece rates will not be reduced except upon fair principles.

Past Experiences Showing Possibilities of Increased Production

Since 1914, piece-workers in many cases have doubled their output and have consequently doubled their wages, because piece-work prices are practically the same now as in 1914. This 100 per cent increase in production has been possible because of the fact that the cost of living and the price of labor went up, and the piece-worker was able to increase his speed and his earnings without danger of having the piece rates cut. The result was twice the production and twice the wages, but the direct labor cost was not increased. If on the other hand, there should be a reduction in wages, it is likely that there will be a gradual reduction in the production of piece-workers, because they will naturally adapt themselves to a figure that they believe the management will not call "too much" in regard to their earnings. It is here that the writer believes that the greatest opportunity lies for a live management to obtain one of the great benefits of the war. In taking advantage of this opportunity, a plan such as outlined in the following will serve at least as a guide.

The "Proving" or "Trial" Department

A part of the shop is set aside as a "proving" or "trial" department. One or more of each of the principal machines used in the shop are placed in this department and some of the best men in the shop are sent to operate these machines. Assuming that the men operating the machines in this department are of such quality as would be satisfactory to the management, if the whole shop were manned by men of this type, it would be reasonable to assume that their output could be considered a fair measure of a fair day's output for any man in the shop; and the management must be prepared to be satisfied with the output of these men, which is checked for errors by a good foreman and a rate-setting department. The output from this department should be called "a standard day's work" or "a fair day's work" and the hourly rates should be so set that a "fair day's pay" would be paid to the men in this department.

When the proving department has performed an operation that seems reasonable to the rate setters, a piece-work price should be set by dividing the hourly rate of the men in this department by the number of pieces completed by them per hour. This gives a fair piece-work price for the type of man that it is desirable to fill the shop with. Sometimes there may be a few piece prices that are too high, but even in that case a good deal is to be gained by the management if no change is made, as the men will appreciate that the management will stick to its word.

Complaints that Piece-work Prices are too Low

If the proving department is properly on the job, there will doubtless be a great many prices that the shopmen will consider too low. In order to meet this condition, a record should be kept of all piece-workers, and an investigation should be made of the work of all those who earn less than, say, 80 per cent of what has been estimated to be a fair day's pay. Let the proving department again do the jobs on which the men in the shop had failed, and then let the man who did the job in the proving department go to the man who failed in the shop and show him how he can earn more money. Should it turn out that the proving department cannot make good on the second trial, it is evident that the price is too low and that it should be raised.

What is a Fair Day's Pay?

The most difficult problem of all is to determine what is a fair day's pay. The only rational basis that we have at present to base any opinion upon is the cost of living. The fair day's pay should be based upon the cost of a list of common necessities, well defined, so that prices may be obtained for comparison over any period of years. Indefinite items such as rent and clothing can be omitted, because these may safely be said to vary directly with some of the necessities that can be definitely priced. By such a comparison of the cost of necessities, an index figure can be obtained which may be used as a standard. If this index figure shows that the cost of living has gone up 10 or 20 per cent, there will have to be a corresponding raise in piece-work prices. If the index figure goes down, circumstances may determine whether or not it is deemed advisable to reduce the piece-work rates.

If the management of an industrial plant would openly and frankly discuss this question of reduction of piece-work rates, and present definite reasons why a reduction is not only justified, but necessary, there would be less trouble from lack of confidence on the part of the workers toward the management. Furthermore, if the related industries of a community were governed by such definite facts in their wage-paying policy, and always submitted definite proofs of any action taken in regard to wages, there would be less labor trouble.

Full Information and Open and Aboveboard Methods are Necessary

The workers should receive full information relating to the methods used for setting and changing rates, and should be made to understand that while on account of lack of facilities all piece-work cannot be set by the proving department, the latter will sooner or later try every operation in order to determine whether or not the piece rates once set are fair both to the management and to the workers. Meanwhile, the worker should be guaranteed that no piece price will be changed unless it has actually been demonstrated by the proving department that it is erroneous. With this assurance, the workers will know that as the proving department will some day try each operation, they can gain nothing by holding back, but can earn a great deal more by exerting themselves in accordance with their ability.

When the workers realize that if piece-work prices are set too low, the rates will be investigated upon request and corrected and that other piece rates will not be cut just as soon as the operator shows an ability to earn a high wage, there will be astounding increases in production.

Many managers do not seem to realize that the man who earns the highest pay on a piece-work basis is the best man in the shop, other things being equal. Why should that man be penalized by having his rate cut? Most managers will say that it is done in order to equalize the pay between the men and that excessive earnings on the part of one man cause dissatisfaction and friction. This appears to be wrong reasoning. When the earnings are based on actual results, the other workers realize that the man who earns a high pay is an exceptional worker, and they will think more of the management that permits this man to continue to make his high rate of pay without a cut, than they will of the management that tries to force him down to the level of the rest.

* * *

STANDARDIZATION OF SCREW THREAD SYSTEMS

In a lecture given by Sir Richard Glazebrook, late director of the National Physical Laboratory at Teddington, England, before the Institution of Mechanical Engineers, the lecturer dealt with the possibility of obtaining uniformity in screw thread systems in England and in America. Experiment has shown that for many purposes the U. S. threads are interchangeable with the Whitworth thread, provided the pitches are the same, and with one exception, the pitches of the American series agree with the British standard Whitworth system. The one exception is the half-inch, for which a pitch of 13 threads is now standard in America in place of the original 12 threads of the Whitworth system. The hope was expressed that it is not too late to ask American manufacturers to reconsider this point and thus secure uniformity. With the fine threads, the case is different. The American Commission has adopted as standard the series standardized by the Society of Automotive Engineers, which are in all cases from 2 to 4 threads per inch finer than the British standard fine series. Here again the hope was expressed that steps would be taken to bring about uniformity before British manufacturers are irretrievably wedded to either series. The lecturer also took the view that the limits suitable for various classes of work are fairly definite and do not depend on the nationality of the manufacturer. It is hoped that as far as possible all nations will adopt the same limits for such articles as screws and nuts for the parts of automobiles and for other machinery that has a wide area of distribution.

USING ALUNDUM AS A POLISHING ABRASIVE

The abrasive action of any polishing grain is dependent upon the amount of crystalline aluminum oxide present, says a recent issue of *Grits and Grinds* in which the suitability of alundum as a polishing abrasive is discussed. It is stated that alundum contains about 92 per cent crystalline aluminum oxide, whereas the best grades of Turkish emery contain at the most 65 per cent corundum, which is the form in which crystalline aluminum oxide occurs in emery.

A large percentage of the impurities in emery is magnetic iron oxide which is mixed in the grains of emery and makes them porous. On the other hand, alundum grains are solid and tough crystals. Since emery is a natural mineral, its quality varies a great deal, but as alundum is a manufactured product, it can be held to a uniform formula, and the crystal structure and percentage of aluminum oxide held within close limits. These properties have their effects on the use of abrasives for polishing wheels. Emery, because of its low corundum content and porosity of the grains, is not strong enough to remove a large chip, but breaks off more quickly than electrically fused aluminum oxide. Because of this, emery wheels do not give the production possible with alundum wheels.

Preparing Glue for Polishing Wheels

Maximum production can be obtained with alundum grain only by the use of a good glue and by the proper application of the glue and grain to the wheel. With a little care exercised along these lines the production per wheel has been increased from 100 to 500 per cent. When a weak glue is used, many abrasive particles are thrown off before their full value has been obtained. Either flake or powdered glue should be used, there being various kinds of glue on the market especially manufactured for setting up abrasive polishing wheels.

Ground glue should be soaked in cold water for about two hours, and flake or sheet glue over night. The common mixture is one pound of glue mixed with one pound of water. This formula can be changed to make a thicker or thinner glue to meet conditions. Cooking is best done in a pot surrounded by a hot water bath, the temperature never being allowed to exceed 160 degrees F. Glue cookers having automatic temperature controls can be obtained, and their use is recommended where considerable polishing is done.

The glue should be cooked from one and one-half to two hours at a temperature of between 150 and 160 degrees F. It can then be cooled to between 130 and 140 degrees F. and used. Only enough glue for use during one day should be mixed, as glue that has been allowed to stand hot for ten hours, then cooled over night and reheated in the morning, is of no value. The glue remaining in the pot each night should be thrown away and the pot thoroughly washed before putting the glue to soak for the next day. Wheels are best set up in a room assigned for this purpose, the glue being applied to the wheel by using a brush. The wheel is then rolled in the alundum contained in a long box.

Preparing the Abrasive and Drying the Wheels

The alundum should be heated so that it will not chill the glue when applied, as chilled glue loses some of its holding power. A convenient way of heating the abrasive is to have steam-pipes run through the bottom of the box in which it is contained. Cold air drafts should not be permitted to blow through the set-up room.

After the wheels have been set up and the abrasive pounded into the wheel face, they should be hung up in a drying room for at least twelve hours. Good results cannot be obtained by using wheels that have not been properly dried as the wheels gum over and cannot be used as long as if they were in proper condition. Best results are obtained when the wheels are allowed to dry for twenty-four hours.

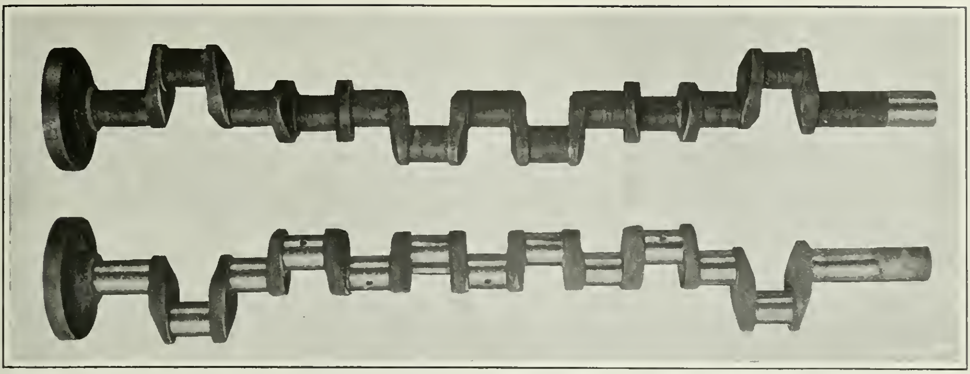


Fig. 1. (Upper View) Crankshaft Ready for Copper-plating Process, the Bearings having been covered with Tape. (Lower View) Crankshaft after the Webs and Ends have been copper-plated to prevent Carburization

Heat-treatment of Low-carbon Steel Automobile Crankshafts

Practice of the H. H. Franklin Mfg. Co., Syracuse, N. Y., in the Heat-treatment of Crankshafts, Including the Copper-plating, Carburizing, and Hardening Operations

By FRANKLIN D. JONES

THE use of casehardened crankshafts in the motors of Franklin cars is a recent change that is a departure from the general practice among automobile manufacturers. The chief reason for using low-carbon steel crankshafts, which are casehardened, is to obtain harder and more durable bearing surfaces than are found on the crankshafts commonly used in the construction of passenger cars. Tests have shown that a casehardened crankshaft will run 50,000 miles, or the equivalent of that distance in revolutions, without readjustment of either the connecting-rod or the main-line bearings. In other words, the hardened crankshaft practically resists all wear during the life of the motor, or at least, wear that seriously affects the motor's operation.

The steel used in these new crankshafts has a carbon content of about 0.20 per cent, and about 0.45 per cent of manganese, and conforms to the S. A. E. specification No. 1020. The crankshafts made of this steel are machined as close to size as practicable before heat-treatment, and then after the carburizing and hardening operations, the bearing surfaces are ground to size, and the flanged and threaded ends are finished, thus insuring accurate alignment.

Copper-plating the Crankshafts

The first operation on the rough drop-forged crankshafts is sand-blasting, the object being to remove all scale and rust preparatory to the copper-plating process. The car-

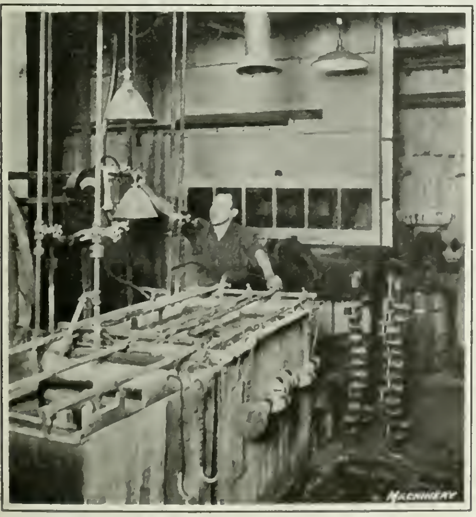


Fig 2. One of the Tanks employed for the copper-plating of the Crankshafts

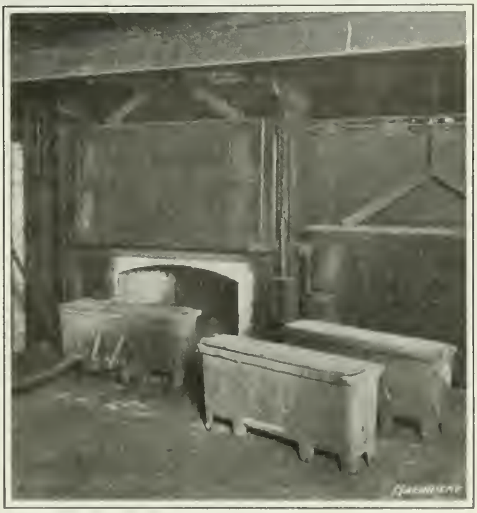


Fig. 3. Carburizing Furnaces and Boxes in which Crankshafts are packed

burizing and hardening is confined to the bearing surfaces of the crankshaft, the idea being to harden only those surfaces that are subject to wear. By leaving the other sections soft, the toughness and elastic properties of the unheat-treated forgings are retained. In order to prevent the sections other than the bearings from becoming carburized, different kinds of protective coatings were tested, and copper-plating was found to be superior to any of the other methods employed.

The first step in connection with copper-plating the crankshafts is to cover the bearing surfaces to prevent them from receiving a copper coating. Ordinary electricians' tape may be used for this purpose, as illustrated in Fig. 1 (upper view), which shows a crankshaft with the bearings covered, ready for the copper-plating process. The lower view of the same illustration shows a crankshaft after the webs and end sections have been plated and the tape has been removed from the bearings. Another method of protecting the bearings against copper-plating is by means of hinged steel clamps or sleeves having rubber linings. These rubber linings prevent the bearing surfaces from coming into contact with the plating solution, and they also insulate the steel clamps against the action of the electric current so that the clamps are not plated. These rubber-lined clamps can be applied to the crankshafts more rapidly than the tape and are to supersede the use of tape.

When the bearings have been properly covered, the crankshafts are thoroughly cleaned by immersing them in an alkaline solution. This bath is steam-heated and has an electric current passing through it, which, by generating hydrogen gas, greatly assists in removing any oil or greasy substances from the surfaces. The crankshafts are next washed in cold water, and are then immersed for a few minutes in a bath of diluted muriatic acid. After another immersion in the cold water tank, they are ready for copper-plating.

One of the plating tanks is illustrated in Fig. 2. Two crankshafts are placed in this tank at one time. They are suspended on hooks in the plating solution, between the anodes or copper plates, which may be seen in the illustration, extending slightly above the surface of the solution. These plates supply the copper which is gradually deposited upon the work by the action of an electric current of 200 amperes and 2 or 3 volts. This current passes from the copper plates to the crankshafts, and then through the hooks holding the crankshafts to the cross-bars, which connect with the return wires. The solution in the tank is heated by a steam coil to accelerate the plating process. A coating of copper varying from 0.0025 to 0.003 inch thick is deposited upon the unprotected surfaces of the crankshaft in from forty to sixty minutes. This is a thick enough coating to resist the action of the carburizing compound during the heat-treating operations that follow.

Carburizing the Crankshafts

After the crankshafts are copper-plated, they are ready to have the bearings carburized. The carburizing boxes and the furnaces used for this purpose are shown in Fig. 3. Each of these boxes holds two crankshafts, and each furnace has a capacity for fourteen shafts. The crankshafts are carburized to a depth of about 1/16 inch, which requires from twenty to twenty-two hours, and a temperature ranging between 1650 and 1700 degrees F. The crankshafts are allowed to cool in the boxes; then, after the straightening operation, they are sent to the machine shop for removing the surfaces of the flanged and threaded ends, for although these surfaces were copper-plated, they are liable to be slightly carburized, and are removed by machining to permit readily refacing the flange and finishing the thread after the hardening operation; the flange and threaded end will then be in perfect alignment with the bearings which are finished by grinding after hardening.

The crankshafts are now ready for the final heat-treatment, which consists of heating them for approximately three hours to a temperature of about 1450 degrees F., and then quenching in water to harden the carburized surfaces. In order to prevent excessive springing or distortion of the crankshaft at the time of quenching, it is held in a special fixture or "hardening die," which is shown in Fig. 4, with a crankshaft in place, ready to lower into the quenching bath. This die or fixture is of very heavy construction, and it is provided with hardened steel V-blocks, which grip all of the main-line and crankpin bearings in order to hold the shaft rigidly and prevent it from springing excessively when

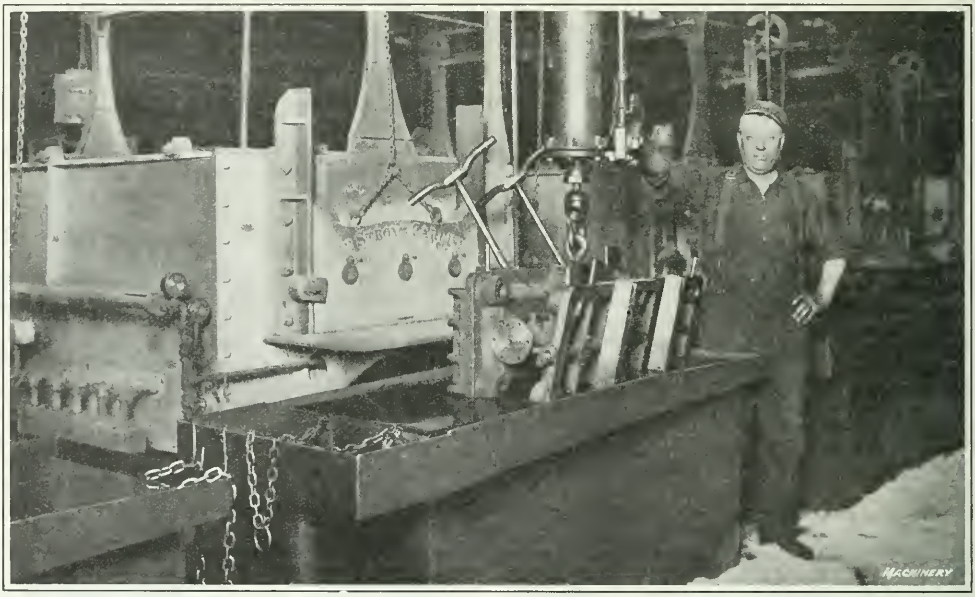


Fig. 4. Special Fixture or Hardening Die which grips the Crankshaft to prevent Distortion when it is quenched for hardening

immersed in the bath of water. This hardening die has a hinged cover and quick-acting clamps, so that the red-hot crankshaft can be withdrawn from the furnace, placed in the die and submerged in the water about twenty-five seconds. As the clamping blocks are V-shaped, practically a line contact is obtained, so that there are no soft spots large enough to affect the wearing qualities of the bearings. These crankshafts are hardened to a scleroscope reading of 75 to 85.

The carburizing operation does not affect the length of the shaft particularly, but there is a rather decided longitudinal shrinkage as a result of the final quenching after hardening; but as this is fairly uniform, it is controlled readily by making a suitable allowance when machining the crankshaft. Both the main-line and crank or "throw" bearings are finished by grinding. An allowance of about 0.035 inch is left for this final grinding operation to care for the distortion of the shaft that often takes place during heat-treatment.

The heat-treating department of the Franklin plant is exceptional, both in regard to the completeness of the equipment and its arrangement. One of the important features in any heat-treating department is the means provided for quenching. In the Franklin heat-treating department there is a complete and satisfactory system for furnishing the quenching tanks with an ample supply of oil or water, as the case may be. One of these quenching tanks is located in front of each of the hardening furnaces (see Fig. 4). At the bottom of each tank there are two parallel pipes connected with the supply pipe and provided with numerous perforations so that the cooling oil (or water) is uniformly distributed as it enters. When the tank overflows, the surplus is caught by a large channel or trough surrounding the top, and is conveyed to the outlet at one end, where there is a conical-shaped screen for catching all dirt or foreign material. This return pipe conveys the heated oil to a pump which forces it through a series of cooling coils suspended beneath the roof. These coils consist of oil-pipes surrounded by larger pipes which are filled with cooling water. After the oil passes through these coils, it flows back to the storage tank from which it is again pumped to the various quenching tanks.

* * *

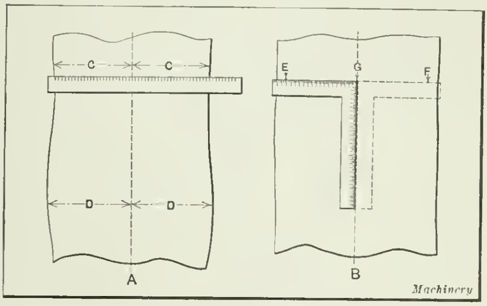
SQUARE ENDS FOR BELTS

Cutting the ends of a belt when putting it into service seems such a simple thing that often the operation does not receive the consideration necessary to insure efficient working of the belt, and, as a result, much of the difficulty experienced with otherwise good belts can be traced directly to the fact that their ends are not cut and joined accurately. It is just as easy to make a belt joint that will cause the belt to run like one of the endless type as it is to join the ends by careless "rule of thumb" methods. When a belt runs "wobbly," that is, when it slips back and forth across the pulleys, neither its best service nor its longest life is being secured and, of course, a belt that will repeatedly jump off the pulleys cannot be tolerated. If the ends of the belt are cut square and are joined properly, the belt will run straight provided the pulleys are in correct alignment. In the following, a number of useful suggestions given in this connection by the Crescent Belt Fastener Co., New York City, are presented:

A square should always be used in cutting the ends of a belt preparatory to joining them, to insure that they will be cut at a true right angle to the center line of the belt. If a square is not employed, one or both ends are likely to be cut uneven or irregular, and these conditions cause the belt to slip from side to side of the pulley and impose irregular strains on the belt fibers, which no belt can endure indefinitely. Belts of widths up to about 18 inches can be cut sufficiently true by holding one leg of the square against one side of the belt, having the other leg project across the belt, and then cutting along the edge of the latter with a sharp knife held perpendicular to the belt. The knife blade should be wet occasionally to make it cut easily.

The ends of wide belts are more difficult to cut square on account of slight variations in their widths and because the sides may not be exactly parallel; however, satisfactory results are assured by following the method to be described. At any point on the belt near where it is to be cut, measure across and find the center as indicated by dimensions *C* at *A* in the illustration. Then at a point two or three feet back from these dimensions, locate the center again as indicated by dimensions *D*. Between these two points draw a clean sharp line. Next, by holding one leg of a square against the center line just made, trim off one-half of the end of the belt by cutting along the other leg. By laying the square on the other side of the center line, the other half of the belt can be cut. The square should be held firmly in position while cutting the belt, and if two small nails are driven in the belt on the center line, they will help to keep the square from slipping.

In cutting the opposite end of the belt, lay out another center line in the manner described, and at any point on this line other than where the belt clamps will come when joining the ends, locate a point as indicated at *G*. Then, again using the square as illustrated, draw a line *EGF* at right angles to the axis of the belt. It is sometimes easier to draw this line by marking points *E* and *F* and then placing a straightedge through them when drawing the line, but in such a case care should be taken to see that the straightedge is not warped. Do not cut on the line just produced, as it is intended to serve as a base line from which to measure the length of the belt after the latter has been placed in the clamps. The exact point where the belt should be cut can be determined after the clamps have been put on and the belt brought into position. Then, measure forward from line *EF* an equal distance on each side of the belt to the cutting point and scribe a line across the belt at this point. By using calipers, the measurement can be taken over the belt clamp, or by using a scale, it can be taken through the edges of the clamp. As a matter of convenience, always cut one end of the belt square and have it ready for making the joint before putting the belt into the clamps.



Laying out Center Line and Cutting Line on Wide Belt

* * *

DEVELOPING WATER POWER RESOURCES OF THE UNITED STATES

The last session of Congress having passed the water-power bill, the way is now clear for the development of the vast unused water power resources of the country. Heretofore government permits for the development of water-power sites have been revocable at will, and thus the businessman has hesitated to embark upon such ventures. The new water-power bill, however, removes this uncertainty, as licenses will now be granted for a term of fifty years, and at the end of such time may be renewed; or the Government, if it sees fit, may take over the development, giving, of course, proper compensation to the owners.

DIES FOR FORD AUTOMOBILE HUB PLATES

By C. J. HUEBER

An enormous number of hub plates are required daily to meet the needs of the assembling departments in the Ford automobile shops, these parts being of the dimensions shown in Fig. 1. It will be noted that several dimensions must be within specified limits. One manufacturer of these parts produces them on power presses in three operations, and two of the dies used for this purpose are described in the following: The first operation consists of cutting the blank to the outside diameter of the finished part, and is performed on a press equipped with a blanking die of standard construction.

The second operation on the plate consists of piercing a hole ¾-inch in diameter through the center of the blank, drawing the hub, and rounding one edge of the flange. The punch and die used in this operation is illustrated in Fig. 2. A noteworthy feature of the operation is that the diameter of the flange remains the same as that of the original blank, the hub being drawn from the metal between the inner portion of the flange and the hole pierced through the blank. As a result, it will be seen that the thickness of the metal constituting the hub is considerably less than the thickness of the flange. The hole is punched through the blank prior to drawing the hub, the purpose of the hole being to permit the metal to be drawn more easily near the center of the part without changing the diameter of the flange.

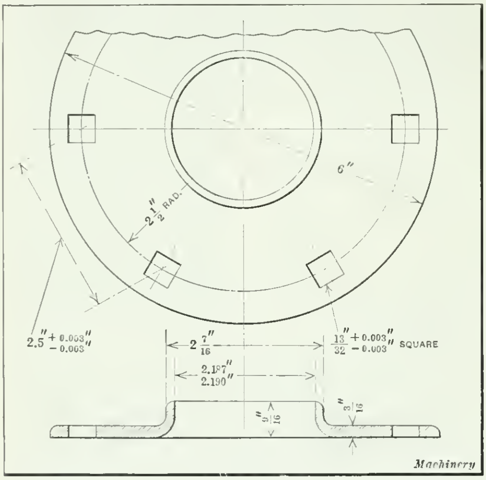


Fig. 1. Hub Plate of Type used on Ford Automobiles

In Fig. 2 the punch is shown in the position occupied at the end of a downward stroke. Prior to an operation, the blank is placed on the draw-ring *A*, which is raised by means of spring *B* and four pins *C* to a position in which its upper face is in alignment with the top surface of the punch *D*. The blank is located in the proper position on the ring by means of a slight recess in the upper face of the ring, which is of the same diameter as the blank. On the downward stroke of the press ram, the piercing punch *E* comes in contact with the blank, and while it is being forced through the blank the forming punch *F* holds the plate against drawring *A*, thus insuring that the diameter of the blank will remain unchanged while the hub is being drawn. The upper edge of the flange is rounded by punch *F* as the draw-ring comes in contact with die-block *G* at the end of the stroke.

On the upward stroke of the ram, the blank is stripped from punch *F* by block *H*, to which punch *E* is attached, block *H* being actuated by knock-out rod *J*. The latter is forced down by coming in contact with a cross-bar in the ram. It will be noted that spring *B* is mounted on a tube *K* instead of on a solid rod as is the customary practice.

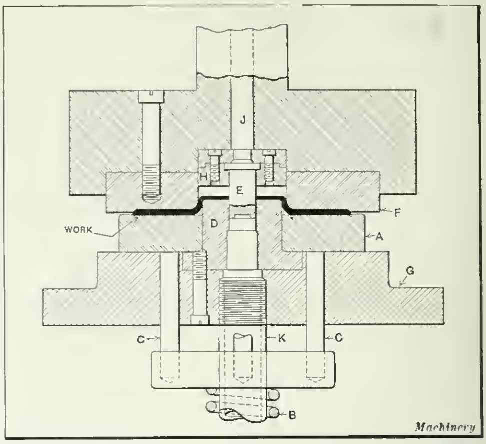


Fig. 2. Piercing and Drawing Die employed to produce Hub on Plate illustrated in Fig. 1

The slugs produced by punch *E* in punching the hole through the plate drop through this tube, and are thus ejected from the die. The press that performs the operation is inclined so that the finished pieces may slide on a conveyor, which carries them to the machine for the next operation.

In the third and final operation on the plate, the large hole is punched through the hub and the six square holes pierced through the flange. The punch and die employed in this operation is illustrated in Fig. 3. It will be seen that punches *A* and *B* are held to the punch proper by plate *C*, which is attached to the punch by means of fillister-head machine screws. Proper location of the blank in the die is obtained by the use of ring *E*. Punch *A* is of such length that, on the downward stroke of the ram, it finishes cutting through the hub just as punches *B* come in contact with the flange. This arrangement reduces the force of the blow on the blank, which would be very great if all the punches came in contact with the work simultaneously, and is a principle that should be adhered to in the design of all heavy piercing dies. It will be seen that holes are provided through the die-blocks *D* and *F* to permit the scrap to fall through the die. The finished part is forced from the punches on the return stroke by stripper plate *G*.

Dies to be used similarly to those described should be of generous proportions and so constructed that they can be easily reground or repaired. The dies described are being used continuously and render satisfactory service.

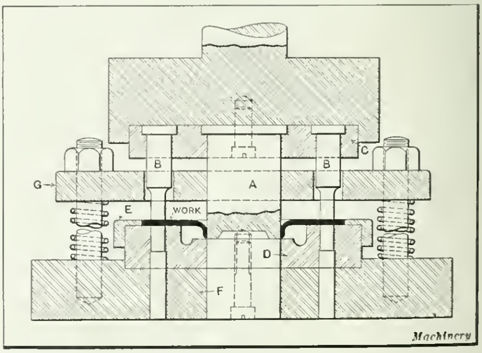


Fig 3. Punch and Die used to punch the Large Hole in the Hub and the Six Square Flange Holes

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, January 14, 1921

THE New Year note struck in the engineering trades is one of general depression, considerable unemployment, and short time. Many are expectant that this condition of things will result in a drop in prices, but with the present high cost of labor, fixed charges, and freight such a development seems remote. A falling market in materials appears probable, and this should enable manufacturers to make contracts and take the risk of such fluctuations as may occur.

Perhaps the brightest thing in the whole trade outlook is the greatly improved coal output, due in a large measure to a better spirit among the miners rather than any improvement in equipment. The textile machinery industry remains active, most firms having orders for some time ahead. Locomotive builders and electrical engineering firms are also busy.

Considered as a whole, the machine tool trade remains fairly quiet, and conditions generally are likely to cause anxiety for some time to come. The majority of manufacturing concerns shut down for one, two, or three weeks over Christmas and the New Year, but in many quarters it is not considered that a lengthy period of trade depression is likely, and in fact some very welcome signs are evident that industrial unrest is effecting its own cure. Meanwhile machine tool makers are rapidly clearing off orders on their books, and are securing only a small volume of new business. Short-time working is on the increase, and the hours are likely to be cut even more in the near future, unless there is a substantial improvement in trade generally.

One direction in which any activity of demand is noted is from the railway shops, the Indian and South African companies being the most in evidence, though some of the British railways are active inquirers. Many cancellations are reported in the shipbuilding field, and orders for machine tools from that source are few. Despite the slack conditions now prevailing in the engineering trades, it seems somewhat contradictory to relate that there is still a pronounced shortage of castings. Several users state that, in spite of inquiries soliciting work, they are unable to obtain castings on reasonably quick delivery.

Exports and Imports

The most recent returns show a growing divergence between the import and export tonnage of machine tools; imports dropped to a little over 800 tons in November, whereas exports reached 2800 tons. It is only in the machine tool trade and the trade returns enumerated under "unspecified machinery" that such a favorable discrepancy, to this country, is noticeable. In all other trades a marked decline is seen, if present export and import tonnage is compared with pre-war ratios. However, it is only reasonable to suppose that the condition of the machine tool trade, which may be considered as the prime mover for the majority of the other manufacturing trades, is an index of what may be expected generally as conditions improve.

Foreign competition is becoming more pronounced, and in this connection a comparison of three quotations recently given for a large multiple-spindle machine are of interest. In each case the quotation was for a machine of about the same merit in design, workmanship, and capacity. An English maker quoted £1870 with delivery in eight months; an American firm quoted £4800 with four months' delivery; and a German concern was prepared to deliver in nine months at a price of £3060.

Automobile Trade

The value of automobiles exported annually is now approaching twice that of pre-war trade—four million sterling in 1913—but against this must be set the fact that imports now represent twenty-seven million sterling. At the same time any falling off in the home demand for the larger types of automobiles appears to be counteracted by the increasing demand for the lighter cars with their cheaper running costs. At the moment, however, a slump prevails, and suspensions for from two to three weeks to save expenses are common.

Labor Conditions

Rumor has it that in the northern districts wages in the engineering trades will be reduced by 12½ per cent early this year. Mention has already been made of the improved conditions in the mining industry that may be attributed to a measure of payment by results. It has recently been put to the credit of certain leaders of labor that they at last realize the fallacy of the argument that the less work each man does, the more work there will be to go around and the less unemployment there will be. That realization, perhaps, is due to the incontrovertible logic of the fact that in the year during which there has been least ouput per man there has been the most unemployment.

To quote only one other instance to illustrate the good results that may be expected from the principle of payment by results, Dorman Long & Co., Ltd., of Middlesboro, have been enabled in the past year to extend considerably the application of the principle of payment on tonnage with a sliding scale based on the selling price of the finished material, which has been in operation for some time in their works. They state that both employes and employers have benefited by the higher wages that have been earned and the increased output obtained.

New Machine Tools

Alfred Herbert, Ltd., Coventry, has recently brought out a new universal milling machine. To avoid weakening of the column, the usual cupboard is omitted and a large overhanging arm fits into a tube that braces the main body of the machine. A new worm-gear generator is being produced by Smith & Coventry, Ltd., Manchester. This machine has an interesting type of gear-box, which gives twenty feeds. Another new machine for which this firm is responsible is a ball bearing bench drilling machine, which has spindle speeds up to 10,000 revolutions per minute. The capacity is for holes up to 3/8 inch in diameter.

An interesting type of special machine has been built by J. Tylor & Sons, Ltd., New Southgate, London, for continuously milling motor cylinder block castings. Two vertical milling heads, one roughing and one finishing, are set over a 10-foot turntable weighing 6 tons. The turntable accommodates eleven cylinder block castings, and the rigidity of the system allows a block to be rough- and finish-milled in 1 minute 45 seconds.

A large extension of the Edgwick works of Alfred Herbert, Ltd. has just been completed, which adds 64,800 square feet to the works. These extensions will enable the firm to improve deliveries considerably on its redesigned turret lathes, high-power single-pulley horizontal and vertical milling machines, and the new No. 5 automatic lathe which was exhibited at Olympia. The firm is putting through large lots of the No. 4 turret lathe.

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CANCELLATIONS

The new theory that an order for merchandise can be cancelled at will by the purchaser is undermining the stability of American business, and manufacturers' associations should adopt methods to prevent the continuance of this practice. The past six months have been a contract-breaking period never before paralleled in this country, for cancelled orders have run into hundreds of millions of dollars. While an accepted order is usually a legal contract that can be enforced in court if the seller so elects, most American business men prefer to take a loss rather than to sue a customer, and manufacturers have generally accepted the cancellations and pocketed their losses. But old ideals in regard to the sanctity of a contract underlie the foundations of business, and they should be re-established without delay. No industry that allows contracts to be broken with impunity by either the buyer or the seller can continue on a safe and permanent basis so long as that practice prevails.

In the machine tool industry alone the minimum amount of cancellations is placed at $25,000,000; the maximum at $50,000,000. The belief appears to have become general with some machine tool purchasers that it is allowable to cancel an order without regard to the amount of work done on it, leaving the manufacturer to foot the loss. Unavoidable delay in shipment is not a valid cause for canceling an order for a machine, any more than delay in the completion of a building is cause for the cancellation of such a contract. There is hardly a manufactured product into which so many factors enter to cause delay and to make control of the delivery date impossible as in the building of machine tools, and every user knows it. Yet some buyers have taken advantage of the least delay in delivery to cancel their orders, although a reasonable time allowance is only fair and what they would expect themselves, especially when the builder clearly acted in good faith and tried his utmost to live up to his contract. The golden rule is a mighty good standard, and often pays in dollars.

* * *

THE LOCOMOTIVE REPAIR SHOP THE KEY TO THE TRANSPORTATION PROBLEM

One reason our railroads find it difficult to cope with the traffic requirements of the country is that they lack locomotives. During pre-war years, American railroads acquired approximately 3000 new locomotives annually. In 1917 and 1918 the number acquired each year was less than 2500, and in 1919 the three leading locomotive building companies constructed less than 1000 locomotives for the standard gage steam railroads in the United States. These companies supply at least 75 per cent of all the locomotives used on such roads and their figures indicate a shortage at the present time of more than 2500 locomotives. The railroads acquired during 1920 about 1800 new locomotives at a cost of more than $100,000,000, so that, even this year there will be a shortage of new locomotives as compared with pre-war figures, and because of this shortage more service must be obtained from the locomotives now available.

There are several ways in which this can be accomplished, but the most important is that the locomotives now in use be kept in first-class condition through efficiently managed and well equipped repair shops. It is fully as important that the railroads appropriate some of their millions for new and up-to-date equipment for their repair shops as for new locomotives. If the latter are not kept in service with a minimum loss of time due to breakdowns, the available motive power will not increase in proportion to the outlay.

A locomotive held in the repair shop longer than absolutely necessary because of lack of proper machine tool equipment represents a double loss—one on the investment, earning nothing, another on the shipments which may be held up in the plants waiting for the material. Evidently the repair shop is the key to the situation.

* * *

THE METRIC AGITATION

Bills introduced into the United States Senate by Senator Frelinghuysen of New Jersey and in the House by Representative Britten of Illinois for the establishment of the metric system in the United States indicate that the advocates of the metric system did not become discouraged by the solid opposition of manufacturers that was offered to the measure when it was introduced last year. MACHINERY's position on this vital question was stated in detail in the editorial entitled "Inches versus Millimeters" in the April, 1920, number, and from this editorial we quote the following paragraphs which summarize the position taken by the manufacturing interests of the country:

"A change in the system of weights and measures is not a question for Congress to decide without hearing the opinions of manufacturers who are vitally interested. Members of Congress, however able, lack the special practical experience required to pass upon a question of such moment to our industries. The system of measurement used in engineering and industrial work is so closely interwoven with our whole mechanical and manufacturing progress that only engineers and manufacturers possess the definite knowledge, practical experience, and judgment to forecast the effect of so profound a change.

"The main question to consider is whether with the present advanced development of our industries, we can afford to make a change. If it is the judgment of a majority of those connected with our manufacturing and engineering interests that it would involve so much confusion and loss and would develop such mechanical difficulties as to completely overshadow any possible gain, then their judgment should prevail. When our manufacturers and engineers can see that the proposed change will benefit those who use their products or will increase their sales in countries using the metric system, they will need no urging to adopt it.

"Probably the best service MACHINERY can render its readers at this juncture is to place on record the opinions of some of the leading manufacturers and engineers in the machine-building field. Their opinions are unanimously for the retention of the present system of measurement. They believe that a change would cause great confusion and loss of time and money."

Machine Tool Prices

MANUFACTURERS of machinery of all kinds are interested in the prices of machine tools, not only because they are buyers of such tools, but also because the success of their business depends largely upon the development of the machine tool industry, on account of its basic relation to all other machine building industries.

Some machinery users believe that decreases in the prices of machine tools should parallel price decreases of commodities which have recently suffered marked reductions; but there are some very definite reasons for the maintenance of present quotations which are only too well understood by machine tool manufacturers and which should be understood in the industrial field generally.

No Profit in 1914 Prices

The prevailing machine tool prices are usually compared with those of 1914, and it is true that since then prices have practically doubled; but in most plants wages have been more than doubled, and the increase in the prices of most materials has been even greater. Foundry pig iron that sold for $12.50 a ton in December, 1914, was $42.50 on December 28, 1920, an increase of nearly 250 per cent. Steel bars that sold for 1.07 cents a pound in December, 1914, were quoted at 2.35 cents a pound on December 28, 1920.

Very little figuring is required to show that even without considering the improvements in design and construction during the past six years, the increases in machine tool prices have barely kept pace with the increased cost of labor, and have been less than the proportionate increases in material costs. The decrease in labor efficiency since 1914 has materially increased the unit costs, and with the general tendency toward a decreasing number of working hours the overhead costs have also increased. In 1914, machine tool prices were too low to permanently support the industry. Keen competition due to industrial depression forced manufacturers to accept prices which left them almost no profit, and it was not until 1916 that prices had risen to the level where a working profit appeared.

A well-known manufacturer figures that if 1914 prices had been based on costs with a fair profit, the actual increase in machine tool prices for the following six years would have been only 50 to 60 per cent, or about one-half the labor cost increase and one-third the material cost increase during that period.

Misleading Price Comparisons

Another erroneous price comparison frequently made is that of the 1914 with the 1921 machine tools, by size or designation. During the war practically all machine tools were improved in design, and better materials were used in their construction. Taking a specific case, a certain machine tool that weighed 15,200 pounds in 1914 was redesigned and now weighs 19,000 pounds; but it is known by the same designation as to size and other characteristics as it was seven years ago. Not only was the weight of this machine increased so as to afford increased strength and steadiness for greater production, but the speed also was increased nearly 100 per cent and the power from 8 to 20 horsepower. These changes necessitated gears made from higher grade material, properly heat-treated, and in one instance a rack was made to replace the type formerly used, the material for which cost three times as much as the other. These and other added costs should be considered when statements are made that a certain type or make of machine tool has been increased in price a given percentage since 1914. In many cases, like the example mentioned, it has also increased in weight, capacity, power and speed, is made from better material, will last longer and produce more. No such statements are correct regarding clothing, shoes, sugar, or other commodities which have greatly declined in price and with which the market position of machine tools is often compared.

Cost of Machine Tool Development Work

Machine tool prices, instead of being high as compared with pre-war prices generally, are low; and if the machine tool industry is to continue as the most important factor in the development of machine building, present prices cannot be reduced. Machine tool manufacturers in the past have turned a great part of their profits back into experiments and developments which insured further progress in the machine building industry. This work must not be curtailed. The remarkable advance that has taken place in the electrical industry during the past fifteen years, has been due, primarily, to the fact that manufacturers of electrical appliances have made enough money to permit extensive research and costly experiments, which, in turn, have made possible the building of more efficient electrical apparatus, ultimately reducing the cost of electricity to the user.

The same principle applies to the machine tool industry. The experiments that the manufacturers have made enabled them to develop new methods of machining, which, when used in their customers' shops, have often reduced the cost of the product by almost incredible percentages. No one acquainted with the facts will deny that had it not been for the development work of our machine tool builders, the quantity production methods in the automobile shops would have been impossible, the development of the automobile industry to its present proportions inconceivable, and the advent of the low-priced car improbable. The wonderful showing of our metal manufacturing industries during the war was also due, primarily, to the experiments and efforts of our machine tool manufacturers—and to the development work into which they had turned such a large part of their profits in the past. Our machine tool manufacturers must be allowed a sufficient margin of profit in the future to undertake expensive experiments and development work, to employ designers of the highest ability and skilled workers of the best type. Only under those conditions can the machine tool industry continue to be a training school for the men who will later be the leaders in the whole machine building field.

New Plant of the Foote-Burt Company

Features of a Modern Factory Planned with a View to the Convenient Handling and Progressive Routing of the Work

THE recently completed plant of the Foote-Burt Co., at East 131st St., and St. Clair Ave., Cleveland, Ohio, is typical of the progressive spirit that has made Cleveland the largest machine-tool building center of the Great Lakes region. Approaching the main entrance of this plant, one is impressed with the clean-cut substantial appearance of the building. With a total floor space of 131,000 square feet, it is one of the largest modern plants equipped for the production of drilling machines. The modern idea of constructing along lines which permit the work to pass through the shop with as little unnecessary trucking as possible has been highly developed throughout the plant, as will be evident from a study of the accompanying illustrations.

General Plan of Building

As shown in the plan view, Fig. 6, the width of the building is 236 feet 2 inches, and the extreme length 507 feet 4 inches. The office and drafting-room, each having an area of 5776 square feet, and the factory proper with an area of 117,340 square feet, are all under one roof. The heating plant, coal shed, transformer house, and chip storage building are located just across a spur track of the New York Central Railroad, which extends along a spacious platform at the northeast side of the plant. As indicated on the plan view the general office extends across the front of the building on the ground floor, while the drafting-room is located on the second floor directly over the office, the total height of office and drafting-room being approximately equal to the height of the adjoining assembly department.

It will be noted that there are two main aisles extending the full width of the building. These aisles divide the main factory into three sections, the section farthest from the main entrance being equipped for storage, while the various machining departments are located in the central section. The remaining section nearest the entrance is equipped for assembling. This arrangement permits the rough stock to enter at one end of the plant and advance to the opposite end during the machining operations, until it finally arrives at the

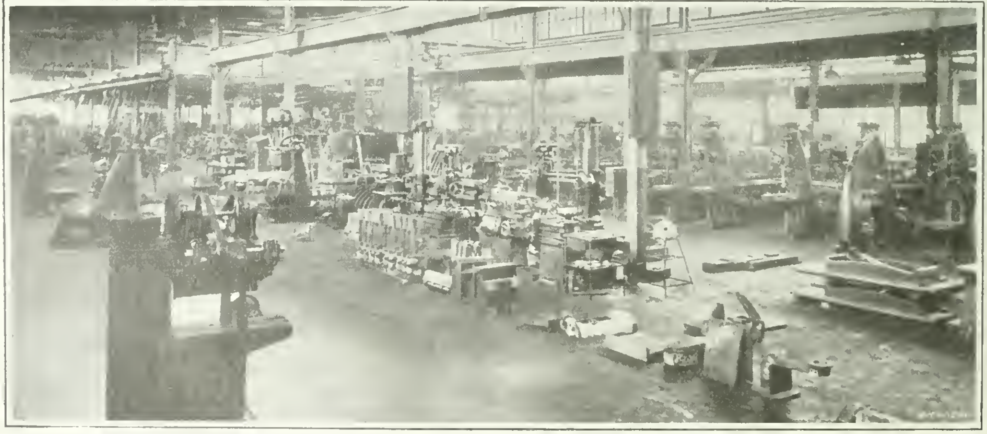

Fig. 1. General View in the Assembly Department of the Foote-Burt Plant

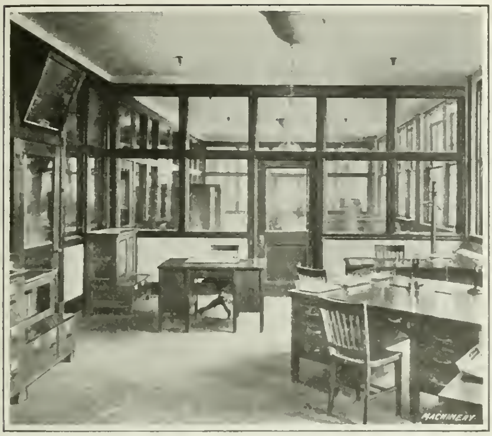

Fig. 2. Interior View of General Office

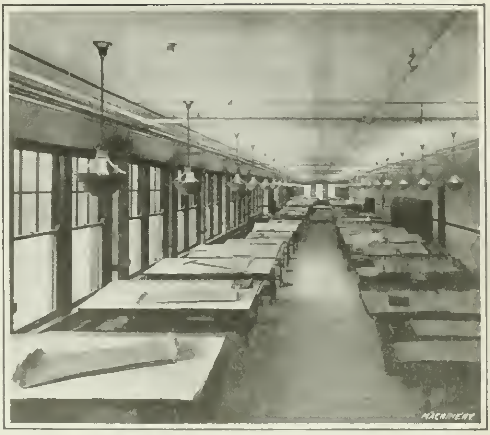

Fig. 3. Interior View of Drafting-room

assembly department, from which the completed machines are transported to the shipping department.

The General Office

At each side of the main entrance and extending the full width of the building, as previously stated, are located the general offices of the plant. Facing the northwest and provided with specially large windows, these offices obtain excellent natural lighting throughout the day. Referring to Fig. 2, which shows an interior view of one of the offices, one will be impressed not only by the convenient arrangement of files, desks, and other office furniture, but also by the sense of harmony so often lacking in business offices. Next to the superintendent's office, located at the northwest corner of the plant is another entrance by which members of the office or drafting-room may enter at the western side of the plant. Adjoining this entry way, and extending along the western side of the plant, are located the factory office, employment office, dispensary, and experimental department.

The Drafting-room

The drafting-room, being directly over the general office, obtains the same natural lighting advantages as the latter. It is approximately 235 feet long by 24 feet wide, and will accommodate 100 draftsmen. Referring to the interior view, Fig. 3, it will be seen that individual lamps suspended from the ceiling provide general illumination. A study of Fig. 6 will reveal the convenient position of the drafting-room in relation to the departments to which the draftman's work is most likely to take him.

Receiving and Storing Departments

With the preceding brief introduction to the executive and planning departments of the plant in mind, it may perhaps be well to continue our inspection of the factory by beginning at the receiving department. Here we find that all rough stock is received in the rear main aisle, the position of which is shown in Fig. 6. At one side of the aisle, and nearest the door opening to the railway platform, is located the receiving department. Then following in succession are the rough stock storage room, paint shop, machinery storage room, bar stock storage room, patternmaking room, and pattern storage room. With the exception of the paint shop and patternmaking room these departments are provided with 2- or 5-ton overhead cranes. The stock is actually handled in three separate divisions: that handled by the rough stock room just mentioned; that handled by the tool supply and general factory supply room, located next to the tool-room; and that handled by the finished stock-room located centrally in the assembly department.

Manufacturing Departments

The manufacturing or machining departments, as previously mentioned, are centrally located. In Fig. 5 is shown a section of the planing department. This illustration gives an idea of the excellent lighting conditions, the nature of

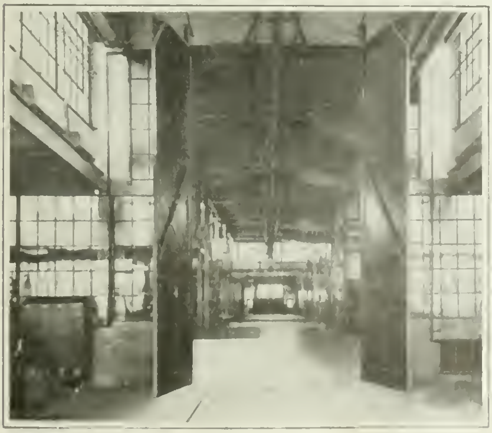

Fig. 4. Front Main Aisle in Manufacturing Section of Foote-Burt Plant

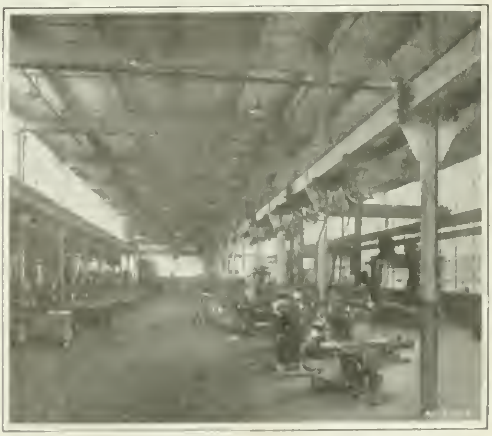

Fig. 5. Section of Planing Department in Foote-Burt Plant

the all-steel construction of the building, and the method of mounting shaft hangers on steel beams, no wood whatever being used. The manufacturing section includes the departments or rooms referred to in the following, which have been carefully located and equipped.

The planer department, occupying two bays, extends the full length of the machining department or from the rear main aisle to the front main aisle. This department is equipped with one 5-ton and one 2-ton overhead crane to provide for handling heavy work such as cast-iron machine bases. Next to the planer department and leading off from the rear main aisle is the drilling department. Beyond the drilling department, but in the same bay, is located the boring mill department. A 2-ton overhead crane is also provided for moving heavy work from the drilling department to the boring mill department or vice versa, as conditions may require. Next to the boring mill department and leading off from the front main aisle is the tool-room and tool supply room.

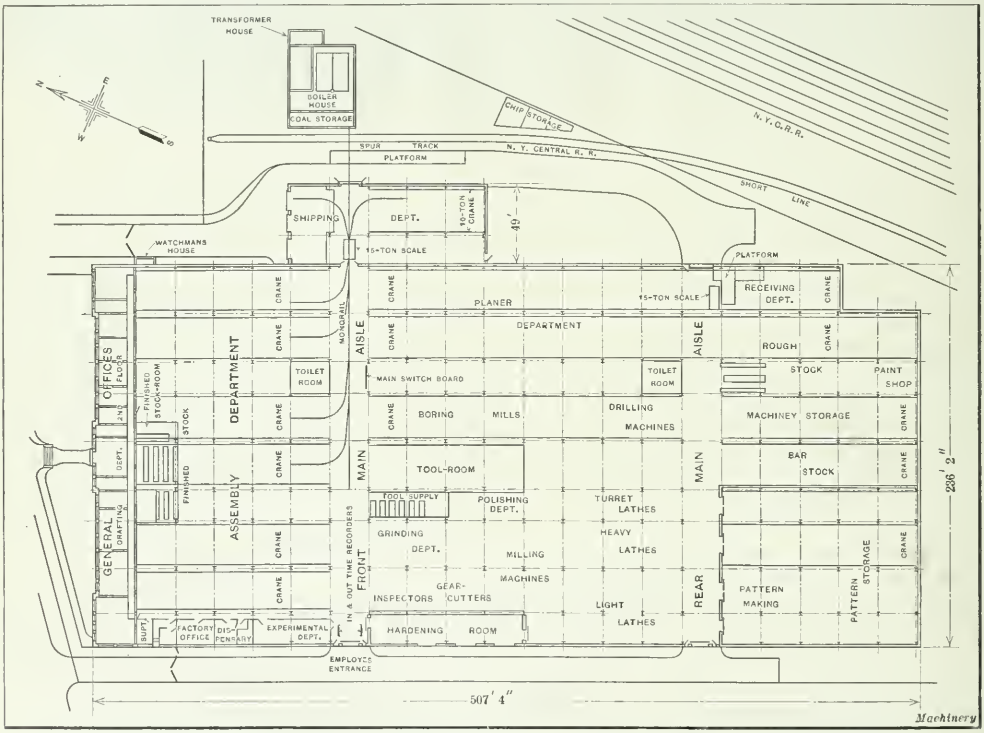

Fig. 6. Plan View of the Foote-Burt Co.'s New Plant in Cleveland, Ohio

In the bay adjoining the tool-room and next to the rear main aisle are located the turret lathe department and the polishing department. Next to these departments is the heavy lathe department, which adjoins the grinding department. This enables heavy work such as spindles, machine columns, etc., to be transferred directly to the grinding department after being rough- and finish-turned. At the western side of the machining section and next to the heavy lathe department is located the light lathe department, and between the light lathe department and the front main aisle are located the milling machine department, gear-cutting department, and the inspector's room. At the northwest corner of the machining section is located the hardening room. A door at one end of this room opens into the light lathe department, while a door at the opposite end opens directly into the front main aisle.

Assembly Department

Across the front main aisle from the machining section is located the assembly department, a section of which is shown in Fig. 1. Four 2-ton overhead cranes and two 10-ton overhead cranes are provided for moving the work through this department. From the assembly department the finished machines are transported to the shipping department by means of two 7½-ton monorail cranes. At the entrance to the shipping department and directly under the monorail is a 15-ton scale. The shipping department opens directly on the platform of the spur track.

* * *

COURSE FOR SAFETY SUPERVISORS

The second annual lecture course of the School for Safety Supervisors was started January 10 and will continue until April 4. The course is given for the benefit of managers, engineers, superintendents and safety men, by the Metropolitan Safety Council under the joint auspices of the National Safety Council and the Safety Institute of America. Twelve lectures will be given dealing with safety principles and various phases of safety work, in the Engineering Societies Bldg., 29 W. 39th St., New York City, and similar schools will be conducted in many other industrial centers. All companies who are members of the Metropolitan Safety Council are invited to send their safety supervisors, engineers, inspectors, superintendents, and managers to the school, and other industries in the Metropolitan District interested in accident prevention are also invited to avail themselves of the course. Certificates will be given to persons who attend nine or more of the twelve lectures. Experience has shown that such lecture courses are invaluable to those who have charge of safety in industrial plants. Further information in regard to the course can be obtained from the Safety Institute of America, 261 Madison Ave., at 39th St., New York City.

NEW ACTIVITIES OF THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

A number of activities have been planned for the National Machine Tool Builders' Association and are to be undertaken by Ernest F. DuBrul, the recently elected general manager of the association, who started on his active work in this capacity January 1, with headquarters at 817-818 Provident Bank Bldg., Cincinnati, Ohio. The work of the association naturally divides itself into three separate fields, one having to do with technical questions, another with financial and administrative matters, and a third with markets and selling problems. Mr. DuBrul expects to carry on active work along all these lines to such an extent as may be desired by the executive board and the members of the association.

Under the heading "Technical Questions," the most important are those relating to standardization, and it is expected that considerable definite work will be done along this line. There is also a great deal of research work in connection with the machine tool manufacturing industry that might well be conducted by the association instead of being undertaken by individual manufacturers.

Ernest F. DuBrul, the New General Manager of the National Machine Tool Builders' Association

Under the heading "Financial and Administrative Questions," which will receive the attention of Mr. DuBrul's office, will come such matters as cost systems, statistics, proper basis for financing machine tool businesses, traffic conditions, credits, legislative questions, taxation, production management, employment management, welfare work, and similar matters.

The third subdivision to which the association will devote its efforts relates to markets and selling problems, such as development of domestic and foreign markets, cooperation with the dealers' associations, and educational campaigns that will inform the user of machine tools more thoroughly about conditions affecting the machine tool trade and the economical use of machine tools. An important matter in this connection will be to point out that the useful life of a machine tool is determined not by its continued ability merely to remove metal, but by the economical results obtained from its use. Questions of advertising and salesmanship may also be given attention.

One of these activities has already been started, in that district meetings have been held in Chicago, Cleveland, Cincinnati, Worcester, and New York, at which the principles of determining costs in the machine tool industry were discussed. For this purpose, arrangements were made with C. H. Scovell of Scovell, Wellington & Co., New York City, to lead these meetings and explain the principles of proper cost methods to the members and their accounting staff much in the same way as a lecturer would present a thorough discussion on a subject to a post-graduate class. This question is considered especially important at this time in order that members should thoroughly realize the relation of their costs to selling prices.

At the meetings that have been held, Mr. DuBrul has made special reference to the ups and downs in the machine tool business, because the machine tool manufacturer is so far removed from the ultimate consumer. As aptly stated by Mr. DuBrul, "Machine tool builders are making machines for making machines for making articles that are used by the general public." This means that in times of depression there is little or no demand for the machine tool builders' product, because he is not making an article that is consumed from day to day like the manufacturer of hats or shoes. Mr. DuBrul further emphasized the importance of machine tool manufacturers thoroughly realizing at this time the definite relation between the cost of carrying idle plant and the price of the product, and that the machine tool industry must receive sufficient returns to permit it to continue to grow with the growth of the country.

Mr. DuBrul's training and experience make him unusually well qualified to handle the problems that must be dealt with by the National Machine Tool Builders' Association. He is an associate of the American Society of Mechanical Engineers and was for several years commissioner of the National Metal Trades Association.

* * *

WICACO SCREW & MACHINE WORKS OCCUPYING NEW HOME

The increasing business of the Wicaco Screw & Machine Works, Inc., Philadelphia, Pa., so overtaxed the capacity of the building space formerly occupied by it that some time ago it was found desirable to erect an entirely new office and factory building at Stenton Ave. and Louden St. The construction of the new home and the moving from the old has now been completed. The building is modern in every respect; it is made of brick and concrete, of fireproof construction, and is generously provided with windows to furnish adequate light and ventilation. The office portion of the building is three stories high, and has a total floor space of 8000 square feet, while the factory is two stories high and has a floor space of approximately 32,000 square feet.

The entire plant is heated by a hot-water system, and is electrically lighted. All machines and lineshafts are motor-driven, so that an engine and boiler house are not required for generating power. There are about 175 machine tools, including many automatics, screw machines, and turret lathes of modern design. A heat-treating department equipped with a number of gas furnaces and quenching tanks makes possible the hardening and tempering of tools and products. Large fireproof vaults are built for the storage of patterns and to serve as a tool supply room. An improved type of weighing scale has been installed, this scale being provided with an electrical attachment that facilitates the weighing operation. Shower baths and rest rooms are furnished for the comfort of office and factory employes, and there is an athletic association to offer recreation and amusement.

The firm is in a position to manufacture a diversified line of products such as parts machined on screw and grinding machines, gears, jigs, and fixtures, automobile parts, various types of special machinery, etc. It has an engineering department and drawing-room for designing tools and machines. The building occupies only one-third of a two-acre plot of ground, so that the plant can be enlarged as the business develops. As the property is situated along the tracks of a railroad, shipping facilities are excellent. The Wicaco Screw & Machine Works, Inc., was established in 1868 and incorporated in 1915.

* * *

The imports into Japan of machinery of all kinds amount to about $45,000,000 annually, of which the United States in 1919 supplied over $33,000,000 worth, the United Kingdom taking second place with $8,000,000 worth. These figures indicate that during and after the war the United States obtained a firm footing in the Japanese machinery trade which, if cultivated and retained, should become very valuable in our export trade. In 1920 machine tools were exported to Japan to a value of about $1,500,000, and all other metal-working machinery about $1,750,000.

The German Machine Tool Industry

From MACHINERY'S Special Correspondent

Berlin, January 10

A NUMBER of the machine tool builders in Germany have issued their annual reports for the business year 1919-1920, and it is possible from these to obtain an idea of the present status of the German machine tool industry. J. E. Reinecker of Chemnitz paid a dividend of 20 per cent, and the report says that the prospects are favorable for the future, the shops having a suffcient number of orders on hand to keep them busy until the spring of 1921. The past year was a favorable one for the company; large orders were secured from abroad and considerable profits were realized by the firm on the foreign exchange. Apart from the dividends declared, 3,000,000 marks will be used for re-equipping the shops with new machine tools. The company also reports having made arrangements with foreign dealers which will assure the favorable sale of their machines abroad.

Sonderman & Stier, Ltd., of Chemnitz, have increased their capital from 4,000,000 to 10,000,000 marks and acquired the factories of an old textile machine builder in Chemnitz. It is stated that the machine tool business of Sonderman & Stier during the latter months has been good.

The Zimmermannwerke of Chemnitz state that their foreign business during the past fiscal year was good. A dividend of 10 per cent has been paid, as compared with no dividends in the previous year. It is said that the products of the company are in considerable demand.

Schiess Ltd., of Düsseldorf report that their works were fully occupied during the past fiscal year as far as orders were concerned, but strikes and scarcity of coal caused the plant to be shut down for an entire month. A dividend of 8 per cent will be paid, as compared with no dividends during the previous year. The works are fully occupied at the present time, but the decrease in new orders points to lack of full employment during the next few months. The majority of the stock of this company was acquired a few months ago by the iron and steel dealers of Otto Wolf of Cologne, but has since been secured by the Deutsche Maschinenfabrik of Düsseldorf.

The Gildemeister Machine Tool Works of Bielefeld found foreign sales difficult on account of foreign competition, while domestic buyers were reluctant to place orders on account of the general economic conditions of the country. Special types of machine tools built by the firm found a ready sale, but new orders have not been booked to such an extent that continuous full operation of the works could be secured throughout the year.

Apart from the results obtained by some of these larger firms, the machine tool business in general continues to be dull. While some of the larger firms are still busy, by far the greater number of machine tool manufacturers are confronted with great difficulties, as there is hardly any domestic demand for machine tools, and foreign buyers are now inclined to hold off placing orders. There are many foreign inquiries, but they do not lead to much concrete business, and the stocks on hand are constantly increasing.

Prices for Machine Tools

The prices for machine tools have been considerably reduced. As an example, large planers 80 by 32 inches are offered at from 26,000 to 33,000 marks. A few months ago a planer of this size was quoted at from 50,000 to 70,000 marks. Sixteen-inch lathes now are quoted at from 10,000 to 15,000 marks, although lathes of some exceptionally well-known makers of the same size still cost 20,000 marks. Screw machines, 1¼-inch size, cost about 12,000 marks, and vertical turning and boring mills with a 4-foot table, 130,000 marks. The price per pound of the general run of machine tools may be said to average from 6 to 8 marks.

Small Tool Market

The news from the small tool market indicates a decided improvement in sales. Foreign buyers have placed a considerable number of orders, although these orders do not as yet keep the works going to full capacity. American competition is appreciable in the Scandinavian countries, Holland, and Switzerland. The German prices are such as to give German manufacturers a chance to compete, but both French and American competition is said to be keen. No figures are available for exports and imports of machine tools. All such statistical matter is to be worked out at one central office, but this office has not yet begun to supply the information to those interested.

Sales of Machine Tools by the German Government

Considerable discussion has been caused by the reading in the German Reichstag of the Kahn contract for the disposal of machine tools owned by the German Government. Mr. Kahn, a man twenty-nine years of age, with some capital, made a contract last September with the management of the German Works, Ltd., (owned by the German Government) according to which the works would sell to him all machine tools not needed in the works and all special machines for the manufacture of war materials. Approximately 47,000 tons of machine tools were involved, the idea being that these machines should either be sold as scrap or as second-hand tools. Mr. Kahn paid 1050 marks per ton for the machines as scrap; but the scrap value rose from 1500 to 1700 marks per ton, and he made millions of profit from the transaction. Inasmuch as the government works might as well have sold the scrap iron directly at the current market price, the contract has been severely criticized.

Mr. Kahn was also given right in the contract to obtain the machines at any time stipulated by him, so that he could take them when the prices of scrap iron rose, and could leave them at the works when the prices fell. He obtained still greater profits by reselling some of the machine tools and not scrapping them at all. It has been mentioned that 10,000 tons of machine tools thus disposed of at a price far below the market, would still net him over 30,000,000 marks. The contract runs until 1923, and in accordance with it Mr. Kahn has a monopoly on the selling as scrap or second-hand of all the machines to be disposed of by the German Works, Ltd. The contract was made without the knowledge of the German administration and of the minister of finance. In November the whole board of directors of the works were therefore forced to resign.

The Ford Co. in Germany

A great deal has been published about the Ford Co. entering the German industrial field. At first it was said that Mr. Ford intended to manufacture automobiles in Germany, but this has been officially denied. It is understood that the Ford Co. intends to manufacture the Fordson tractors in Germany and will erect a plant for an output of 100 tractors a day, working in cooperation with the important Berlin firm of Ehrich & Graetz. The idea is that the German Ford Co. will not only supply Germany but also other European countries with tractors from this factory. The tractors will cost about 20,000 marks, and this price, it is believed, will make them available even to the smaller farms.

The Siemens, Rhein-Elbe Union, Schuckert

The largest and most important industrial combination in 1920 is that of the coal, iron, and manufacturing industries represented by what is known as the Siemens, Rhein-Elbe Union, Schuckert. This combination includes two of the greatest German mining concerns—the Gelsenkirchener Bergwerksgesellschaft, owner of the richest coal mines of Germany, and Deutsch Luxemburg, owner of the largest iron mines; it further includes the important iron works of the Bochumer Verein, into which finally the Siemens-Schuckert works have entered, this latter being one of the largest of the German manufacturing concerns. The new combination occupies both in size and in wealth of natural and economic resources, in manufacturing experience, and in foreign selling organizations, the most prominent place of any industrial combination in Germany. Through the formation of this combination, 2,500,000,000 marks have been tied together in one concern.

The reason for this great combination is doubtless the economic position of the German industries. The situation is such that those concerns that do not control raw materials face a more and more difficult position, and the present combination now controls the entire industrial process from the coal and iron in its raw state to the finished machinery ready for domestic sale or export. It also makes it unnecessary to bring in a great deal of new capital and to keep large quantities of materials in stock in order to prevent a shortage. Another factor that has been considered in creating the present combination is that on account of the relatively small quantities of raw materials left at the disposal of the German industries, it is necessary that they be utilized in the most efficient and economical manner, and that any raw materials imported from abroad be finished into the highest types of machinery and devices. As somebody has said, "The German industry must be a finishing industry, and the future of the country must be based upon the manufacture and export of watch springs rather than of steel beams."

The Siemens, Rhein-Elbe Union, Schuckert combination represents a new step in industrial combinations in that it is not a combination of similar industries, but one of industries that handle the material from its original state in nature until its final disposition to the ultimate consumer. The aim of the combination is to cheapen the products by complete control of all processes from the beginning to the end. It is possible that this combination will prove the keynote of the new economical development of Germany. The individual enterprises entering into the combination will continue to work in an entirely self-contained manner, but will have the cooperation of all the other members, and all the financial problems will be handled at one central point.

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NEW OFFICERS OF THE AMERICAN SOCIETY OF MECHANICAL INSPECTORS

The American Society of Mechanical Inspectors, 57-59 W. 51st St., New York City, announces the election of the following officers for the coming year: President, Walter Thoma, chief inspector of the E. W. Bliss Co.'s plants; vice-presidents: Joseph Zeigner, chief inspector of the Doehler Die-Casting Co.; John E. Fitz Simons, chief inspector of the Pyrene Mfg. Co.; J. W. Gardham, chief inspector of the Maxwell Motor Co.; Alfred Hanson, gage engineer; George Allison, engineer of the Mergenthaler Linotype Co.; and Joseph Ludwig, assistant chief inspector of the E. W. Bliss Co.; treasurer, William Oulsnam; assistant financial treasurer, Carl Engstrom; and secretary, H. F. Winter.

ANNUAL MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS

The sixteenth annual meeting of the Society of Automotive Engineers was held in New York City, January 11 to 13, in the Engineering Societies' Building, 29 W. 39th St., New York City. The first technical session was devoted to aeronautic engineering. C. D. Hanscom outlined the development of wing sections during the past year, and Grover C. Loening presented a paper on the trend of structural design. Major Thurman H. Bane told of the recent work of the Air Service at McCook Field, his talk being illustrated with motion pictures. F. W. Caldwell covered the advances in propellers since the armistice.

The annual business meeting of the society was held Wednesday morning, January 12, at which the reports of the administrative committees were read and officers for 1921 elected. Three simultaneous technical sessions were held Wednesday afternoon, covering chassis design for fuel economy, body engineering, and commercial aviation. In the Chassis Session, A. L. Putnam outlined the many power losses, independent of the engine, which reduce fuel efficiency and deserve closer study; this subject was also discussed by J. G. Vincent. D. McCall White presented a paper on modern chassis construction. A. L. Nelson offered a paper on the fuel problem in relation to engineering. C. W. Spicer presented a brief contribution on the torsional strength of splined shafts, and a new principle of engine suspension was submitted by S. E. Slocum. H. M. Crane, who presided at the Chassis Session, proposed a method of rating racing cars that will encourage passenger car development.

In the Body Engineering Session, Charles A. Heergeist presented a statement on the reduction of body weight, and Andrew F. Johnson made some general remarks. George J. Mercer dealt with the subject of body lines and predicted the styles for 1921. George E. Goddard illustrated the steps in quantity production of all-metal bodies with some interesting motion pictures, and Kingston Forbes discussed the relation of the body engineer to the industry.

The Aeronautic Session, held Wednesday afternoon, was devoted to commercial aviation. Glenn L. Martin addressed the members on this subject, and Ralph H. Upson read a comprehensive paper on the application of aircraft to the transportation of the immediate future. The development of commercial air transport lines in Europe since the war was described by Professor Edward P. Warner, of the National Advisory Committee for Aeronautics, who recently returned from abroad.

At the Fuel Session, on Thursday morning, January 13, C. F. Kettering told of the results of fuel research work carried out under his direction. This session was continued in the afternoon simultaneously with the Highway Session. Dr. H. C. Dickinson presented some experimental studies made by the Bureau of Standards, and R. E. Fielder described a system of thermostatic inlet temperature control as installed on the Fifth Ave. busses in New York City. F. A. Howard, of the technical staff of the Standard Oil Co., discussed the volatility of motor gasoline. P. S. Tice presented some conclusions reached as a result of inlet manifold flow study, and A. W. Scarratt described recent tests on alcohol as an engine fuel.

H. W. Alden, in opening the Highway Session on Thursday afternoon, emphasized the responsibility of the automotive engineer in the making and maintaining of good roads. The Bureau of Public Roads has conducted an extensive practical study of highway design during the past year, and A. T. Goldbeck presented the data and conclusions. H. E. Breed, formerly deputy state highway commissioner of New York, presented a paper entitled "Variable Factors that Influence Highway Design," and W. E. Williams offered some additional suggestions.

The entertainment features of the meeting included a carnival and a dinner at the Hotel Astor.

Obtaining Production on the Vertical Turret Lathe

Application of the Bullard Vertical Turret Lathe to Machine Shop Practice, Including Typical Examples and a Description of the Tooling Used

WHEN machining certain types of work a number of advantages are gained by chucking the parts in a vertical position. They may be held rigidly and in such a manner as to allow heavy cuts to be taken without danger of the work being machined inaccurately or the setting destroyed. With the piece thus secured, an opportunity is offered for presenting the greatest number of tools to the work; this, however, is usually a matter of design of the machine. This article does not deal with the design of any particular machine, but rather with the method of performing machining operations on a vertical turret lathe. For the purpose of bringing out the various characteristics of a machine of the vertical type, the Bullard vertical turret lathe has been selected as a means of illustrating this type of work. In this machine, which is built by the Bullard Machine Tool Co., Bridgeport, Conn., the use of an auxiliary square turret or side-head, is the special means by which increased tool availability is realized. Among the advantages gained from vertical chucking, the possibility of increased swing is, perhaps, as important as any that might be mentioned. This fact rather classifies the vertical turret lathe as a producer of large work rather than of parts usually thought of as the product of a turret lathe or hand screw machine. For that reason, a following article will deal exclusively with locomotive machine shop work, in which this machine is found to be especially suitable.

In selecting examples for the purpose of illustrating the machining operations, it has been the intention to describe operations which will involve not only regular practice, but the use of special attachments such as the crowning attachment, thread-cutting attachment, and special turning tools. The tools can be readily presented to the work, so that, in general, the use of special tool-heads and similar equipment is not required. Unless it is for the purpose of materially increasing production, a large percentage of all typical vertical turret lathe work machined on the lathe here mentioned can be handled without the use of special tools.

Tooling Possibilities of the Vertical Machine

The tooling of a vertical turret lathe presents an opportunity for much variety in arranging the tools and sequence of operations. For example, in producing piston-rings from pot castings, it has been found that using a multiple parting tool in the side-head turret is one method of obtaining high

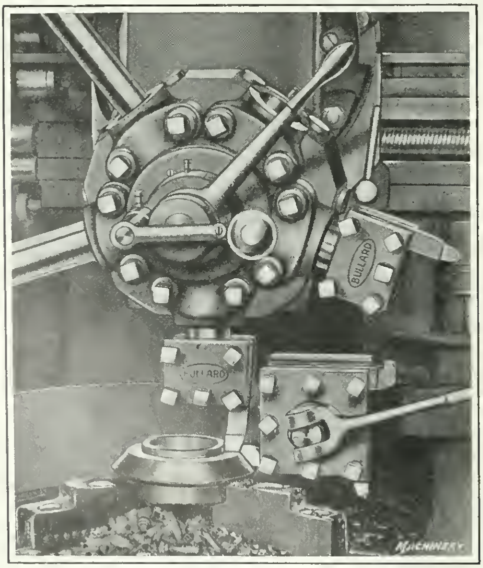


Fig. 1. Tools carried in the Main and Side-head Turrets used in Unison as a Forming Tool

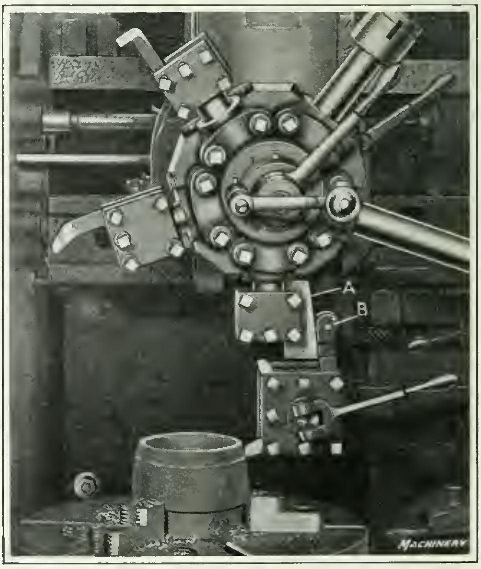


Fig. 2. Method of machining a Taper Surface by using a Special Taper Cam in the Main Turret

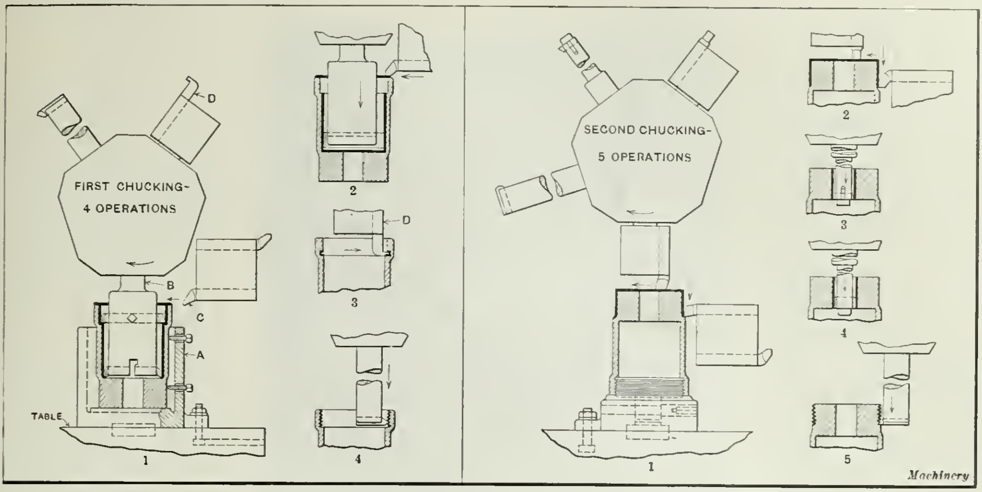


Fig. 3. Tooling Lay-outs for machining a Turbine Section in Two Chuckings

production, whereas the same job is successfully performed in certain shops by using a hook-shaped parting tool in the main turret and a single or double parting tool in the side-head turret, both working simultaneously. These things are, of course, determined by such factors as the number of operations necessary to finish the work, the possibility of varying their sequence to obtain a desired tool lay-out, and various other local considerations.

The simultaneous use of both turrets is well illustrated in Fig. 1, showing how two tools may be used where a special formed cutter might otherwise be required. The bevel-gear blank selected to bring out this tooling also illustrates the possibility of bringing the two tool-heads very close together. Fig. 2 shows how a tapered surface may be machined without the use of the regular compound feeds or forming attachment, by using both tool-holders. It will be seen that a steel block *A* has been secured in the main turret tool-holder, which acts as a cam against which a roller operates to guide the turning tool in the side-head turret. This roller is carried in arm *B* which occupies the place of a regular tool in the side-head turret. This is a simple and effective method of obtaining the desired results.

In the line illustrations showing the tooling lay-outs, the surfaces to be machined are indicated by heavy lines; also the direction of rotation of the turret and the direction of travel of the tools are indicated by arrows, so that the machining operations may be conveniently followed.

Thread-cutting Operations on a Vertical Turret Lathe

The tooling lay-out shown in Fig. 3 is for a turbine section, and is of interest because a special pot fixture is used to chuck the work, and the thread-cutting attachment is employed in machining the part. The part is made of cast iron and is machined in two chuckings, the first of which requires four operations, and the second, five. In the first chucking, after the work has been secured in the fixture *A*, a special boring-bar *B* is employed to rough-bore the two interior cylindrical surfaces of the casting. At the same time that this

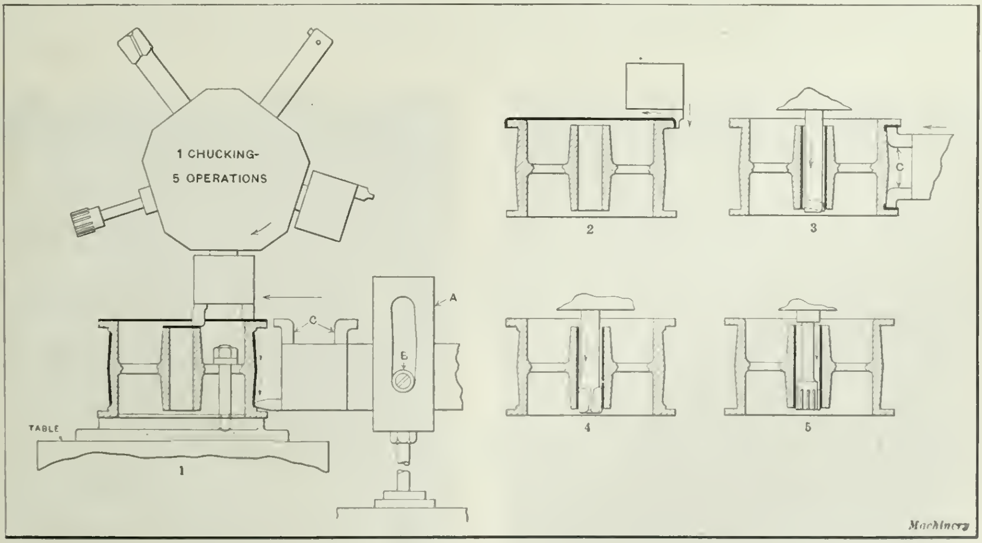


Fig. 4. Sequence of Operations and Tooling Arrangement for finishing a Small Flanged Pulley

bar is in operation, the end of the casting is rough-faced with tool *C* carried in the side-head turret. In the second operation, this surface is finished with a second side-head turret tool, while the smaller bore is being finished. This finishing operation employs the same special bar used in the first operation, with a finishing cutter substituted for the lower roughing cutter. In the third operation, tool *D* cuts the thread-clearance recess; while in the fourth operation, the thread is cut with the threading bit carried in the boring-bar. During the thread-cutting operation, it is, of course, necessary to employ the regular thread-cutting attachment.

The second chucking includes: (1) rough-facing and rough-turning the opposite end of the casting; (2) finish-facing and finish-turning; (3) rough-boring the central hole; (4) finish-boring the central hole; (5) cutting the exterior thread with a single-point tool, again using the thread-cutting attachment. In this chucking another special fixture is used which takes advantage of the previously threaded hole to clamp the work in place. The time required to machine this turbine section, including both chuckings, is one hour and fifteen minutes. While the detail of the part is not shown, its general shape may be clearly seen in the illustration. The casting is approximately 7 inches in diameter and 10 inches long.

The more common method of cutting threads is by the use of a collapsible tap or a threading die of the self-opening type. This method, of course, assures a faster production than the method of first chasing them. However, in some instances it is necessary in cutting threads of large pitch to use the thread-cutting attachment first, removing the greater part of the stock in order to preserve the cutting qualities of the tap or die.

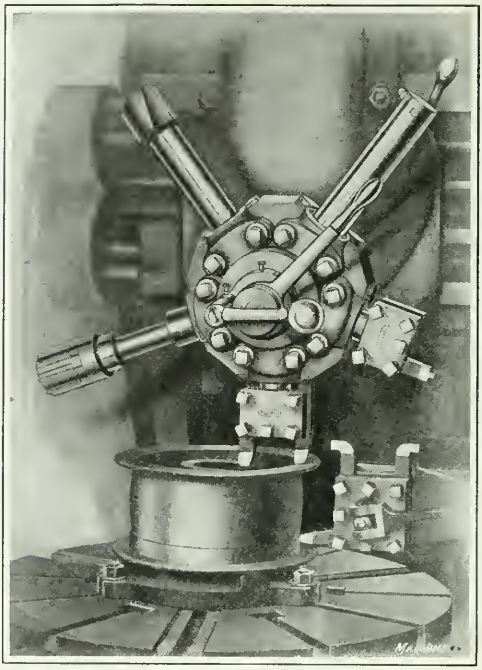


Fig. 5. Crowning a Pulley, the Tooling Lay-out for which is shown in Fig. 4

Crowning Operations on a Vertical Turret Lathe

The operation sheet for the woodworking machine pulley, Fig. 4, shows the tooling lay-out for the five operations in which the pulley is finished. The work is clamped by means of the pulley arms instead of securing it centrally, so that all five operations may be performed without relocating the work. In the first operation two tools are used in the main turret tool-holder, to face the end of the hub and of the pulley rim. While these tools are at work the pulley is being crowned by the round-point tool shown in the side-head turret, the feed being in the direction indicated by the arrows. This crowning attachment substitutes a cam-plate *A* having a suitable slot for the regular turret cross-feed gear, so that the guidance of the tool may depend entirely upon the curvature of the slot in this plate in which the guide post *B* operates. The second operation is rounding the pulley flange with the main turret forming tool shown, and the third operation consists of boring the central hole while the side-head turret with its straddle-tools *C* is squaring up the inner sides of the flanges. The fourth and fifth operations consist of rough- and finish-reaming the central hole. The time required to produce this pulley, which is approximately 14 inches in diameter, is twenty-four minutes, including chucking work.

The machining of crowned pulleys is one of the most common operations performed on a turret lathe. Fig. 5 shows the set-up for machining the flanged pulley, the lay-out for which is shown in Fig. 4, but this illustration does not show the crowning attachment for the side-head turret. This

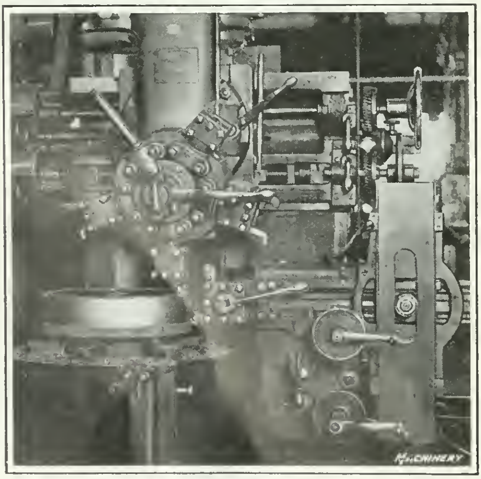


Fig. 6. Operation of Rough-crowning and Rough-facing Driving Pulley shown in Fig. 8

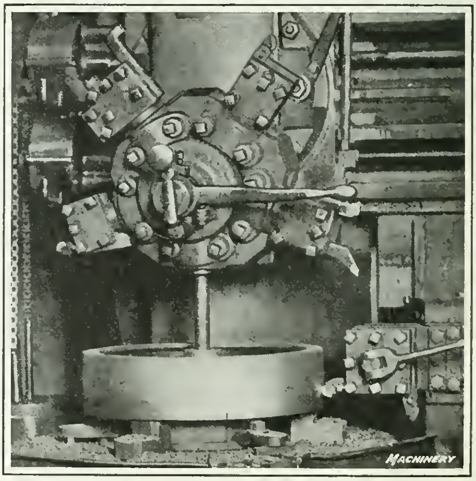


Fig. 7. Finish-boring the Hole and finish-crowning the Face of the Driving Pulley

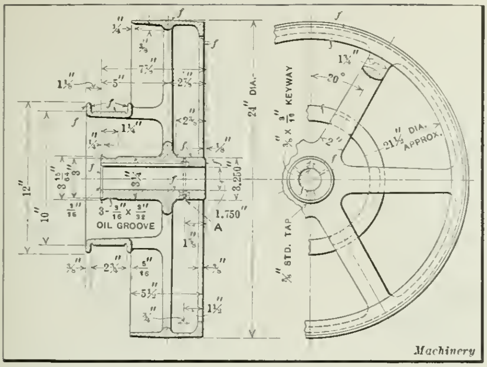


Fig. 8. Detailed Drawing of the Driving Pulley shown being machined in Figs. 6 and 7

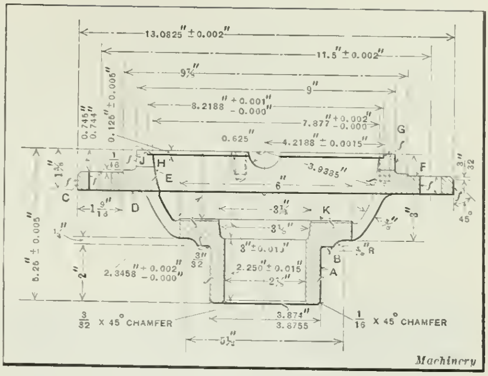


Fig. 9. Detailed Drawing of the Female Half of a Differential-gear Case

crowning attachment may be clearly seen, however, by referring to Fig. 6, in which another crowning operation is illustrated.

The cast-iron driving pulley shown in Fig. 8 is machined on one side with the set-ups illustrated in Figs. 6 and 7, which show, respectively, the rough- and the finish-crowning operations. The tooling lay-out, Fig. 10, shows the operations at the first chucking only. It will be seen that the design of the pulley is such as to make it a simple matter to secure it to the table of the machine. The work is clamped to the table by means of a small flange, and is secured centrally by jaws *A* which operate in radial slots in the machine table, engaging the inside wall of the pulley proper. It is not always that the chucking problem can be so readily handled, as will be seen in some of the examples to follow.

The first operation is that of facing the rim and the end of the pulley hub, the tool being fed clear to the center of the pulley, after being elevated to the proper plane for facing the end of the hub. At the same time that this facing operation is being performed the pulley is being rough-crowned by the tool carried in the side-head turret. This is the operation illustrated in Fig. 6, in which the crowning is shown partially completed. The second operation employs two tools in the main turret tool-holder for turning the hub and squaring up the inner surface of the pulley rim. In the third operation, three tools are used; tool *B* cuts the retainer groove shown at *A*, Fig. 8; *C* squares up the hub with the central web; and *D* rounds the end of the hub. The working position of tool *C* is indicated by dotted lines. In the fourth operation, the end of the hub and rim surfaces of the pulley are finish-faced, and in the fifth operation the central hole is rough-bored. The sixth operation is that shown in Fig. 7, and consists of finish-boring the shaft hole and finish-crowning the outside of the pulley. The time required to perform this series of operations is one hour and thirty-six minutes.

Machining Spherical and Irregular Surfaces

The plate or former employed in connection with the crowning mechanism suggests the use of a similar former for machining surfaces of special contour, after the principle utilized in profiling machines. A good example involving this principle is found in the case of tire-molds and tire-mold cores. The curved surfaces on each of these parts are machined by using a suitable cam-plate for guiding the tool in the roughing operation and a special formed tool for finishing, the tools for both operations being held in the side-head turret. Almost any surface of this nature can be machined by this means, including internal spherical surfaces. In such cases, however, a special tool is required to reach the surfaces that are to be machined.

An example in which interior spherical surfaces are machined is the female member of a differential-gear case, shown in Fig. 9. This gear-case is made of malleable iron, and is machined in the manner indicated by the tooling layouts shown in Figs. 11 and 12. In both chuckings, three special jaws are used to hold the work. In the first chucking, first operation, surfaces *A* and *B* Fig. 9, are roughed with the side-head turret tool, shown at work in the tooling lay-out, Fig. 11, while the central hole is being rough-bored with the tool carried in a combination boring- and reaming-bar. In the second operation these surfaces are finished by revolving the square turret to the next tool, and the hole is trued up by replacing the roughing cutter in the cutter-bar with a truing cutter. The third operation is that of finish-

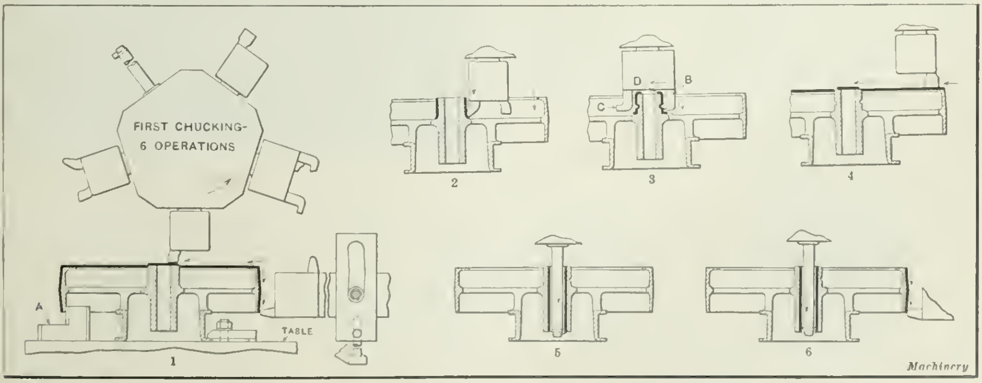


Fig. 10. Tooling Lay-out, showing the Operations Necessary to machine One Side of the Pulley shown in Fig. 8

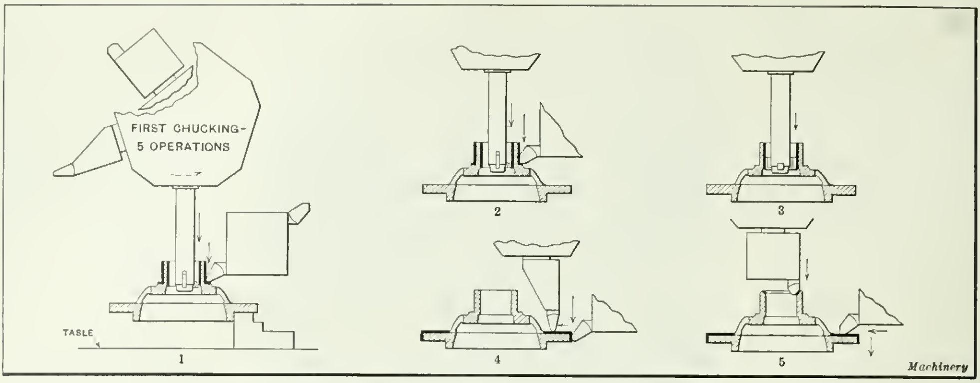


Fig. 11. Lay-out of Operations and Tooling used in First Chucking for machining Differential-gear Case shown in Fig. 9

reaming the hole, while in the fourth operation surface *C*, Fig. 9, is rough-turned at the same time that surface *D* is rough-faced, one tool being carried in the side-head turret and one in the main turret. In the last operation of the first chucking, surfaces *C* and *D* of the casting are finished with a side-head turret tool during the time that the 45-degree chamfer on the hole is machined with a tool carried in the main turret.

In the second chucking, Fig. 12, there are seven operations. After the work has been inverted and relocated on the machine table, the surfaces *F*, *G*, and *K* are rough-machined in the manner indicated in the first operation of the lay-out. This operation, it will be seen, is an excellent example of multiple tooling. The recess *H* is machined with a tool carried in the second station of the main turret, while surface *J* is being rough-turned and surface *F* finish-faced by tool *A*, Fig. 12. In the third operation, surfaces *G* and *K*, Fig. 9, are finished, and in the fourth operation use is made of a special hook roughing tool in connection with a special former plate, such as has already been referred to, for machining the interior spherical surface *E*. Practically the same mechanical principle is involved in this operation as in the crowning operation. For finishing this spherical surface, however, a special turning head is used, as indicated in the fifth operation. The operation of this turning head is governed by its connection with the side-head turret. There is a finger *B*, Fig. 12, held in the side-head turret, and by using a pull-pin, this finger may be connected to link *C* of the turning head. By this means the turning head may be disconnected as soon as the operation is completed, so that it may be swung out of the way. The sixth and seventh operations are those of reboring and reaming the central hole, using cutters in the combination boring- and reaming-bar *D*. The production time for the first chucking is eleven minutes, and for the second chucking, seven minutes.

A detailed view of the special tool-head used in finish-turning the interior spherical surface of the gear-case is shown in Fig. 13. The feed of the side-head turret is upward, as indicated by the arrow, and this results in rocking the two tools which are hung from center *A*, thus producing the desired curvature as the tools pass over these surfaces while the work revolves. It will be noticed that the tools are so mounted in the arm in which they are carried that suitable adjustments may be made for increasing the radial distance of the tools from the pivotal center. The application of this device is clearly shown in Fig. 14.

Machining a Pump Part having a Central Threaded Hole

It has been mentioned previously that where work is to be machined by threading or tapping, the most common practice is to employ a collapsible tap or self-opening die-head. In the example presented in Fig. 16, a pump part known as a lifter is shown, and in Fig. 17 are illustrated the tooling lay-outs employed in performing the machining operations on this part. The central hole in this casting is tapped by using a regular straight-shank tap with the shank reduced

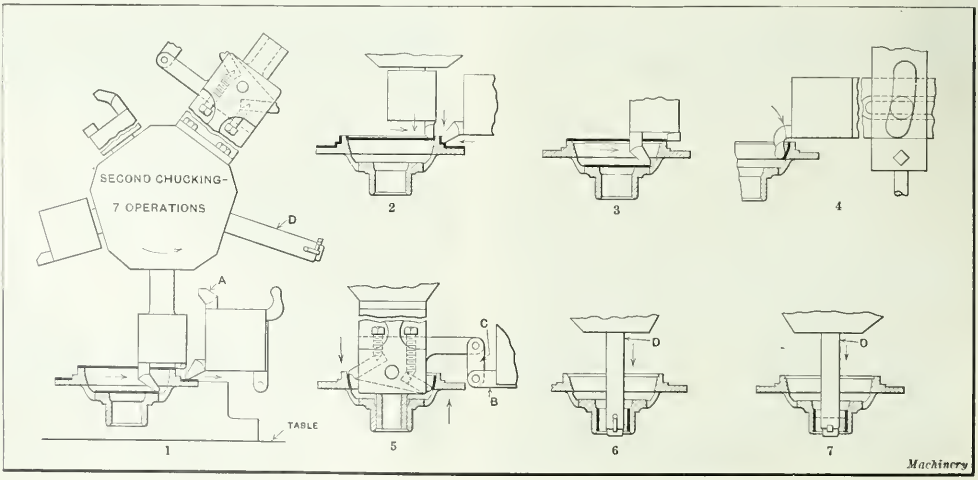


Fig. 12. Lay-out of Operations and Tooling used in Second Chucking for machining Differential-gear Case

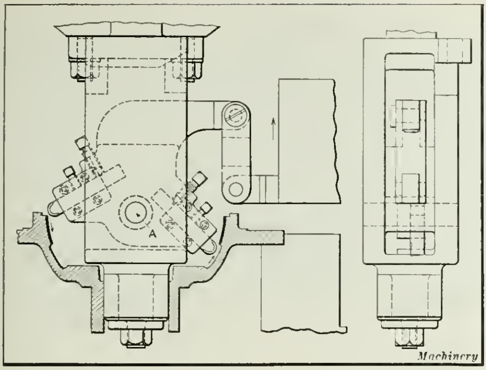


Fig. 13. Spherical Turning Tool-head used in machining Interior Surfaces of Gear-case shown in Fig. 9

in diameter, so that it may drop through the work at the completion of the operation. There are five operations in the first chucking, and these are plainly indicated in the illustration. The work is secured to the table of the machine by three special jaws. During the first operation, the upper part is rough-turned by using a tool in the side-head turret while a special forming tool is being employed in the main turret to produce the bevel at *A*, Fig. 16, and to rough-face surface *B*. The special boring-bar *A*, Fig. 17, is next used successively in the second and third operations for roughing and truing the central hole. The fourth operation is that of finishing the surfaces machined in the first operation, and the tools employed are mounted similarly to those previously used for these surfaces. The final operation in this chucking is that of tapping the hole.

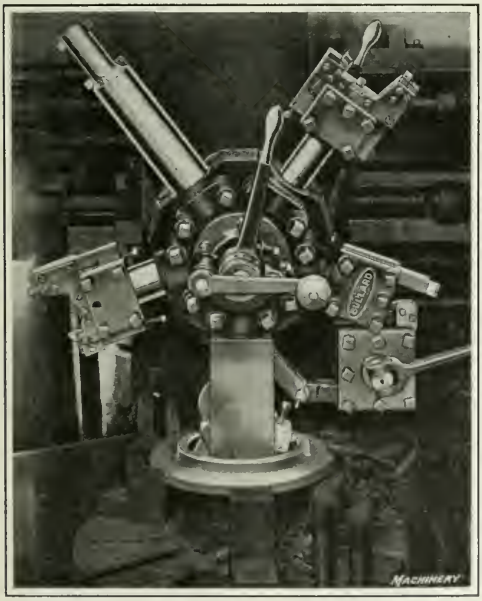


Fig. 14. Special Tool-head shown in Fig. 13, in Operation turning Spherical Surfaces of Gear-case

The second chucking employs a special fixture which makes use of a central threaded plug for the previously tapped hole, to locate and secure the work to the machine table. It is first rough-turned on the outside—simultaneously with the rough-boring of surface *C*, Fig. 16. The two tools, as in the majority of vertical turret lathe work, are carried, one each, in the main turret and the side-head turret. The second operation is that of finish-turning and finish-boring these surfaces, and the third operation produces the bevel at the upper end of the casting. On this job, a cutting speed of 45 surface feet per minute is employed, and the production time from floor to floor is from thirty-five to forty minutes per casting.

Machining Flanged Pipe Fittings, Valve Bodies, and Similar Work

In most cases the design of flanged pipe fittings, valve bodies, and other parts of this general class, is of a type that requires some special holding device, and for that reason would be of interest principally for bringing out methods of holding. In the machining operations on locomotive parts, which will be dealt with in a subsequent article attention will be paid to special means of holding, so that it is not necessary to emphasize this in connection with other types of work. It is evident that where a piece is of a specially irregular shape, the principal problem in machining it is to provide a rigid means of support. Of course, the shape of the work must be carefully considered, in order to permit sufficient swing. In this connection, attention is to be directed only to one such instance—that shown in Fig. 15. This is a three-way pipe fitting known as a double Y-branch, which stands 18½ inches high. The part was successfully

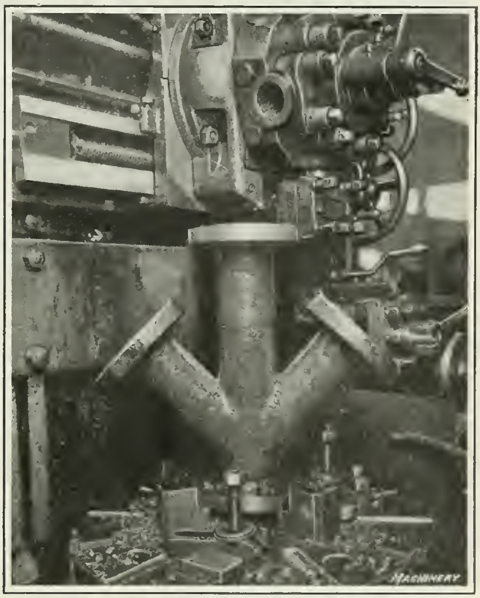


Fig. 15. Three-way Pipe Fitting, 18½ Inches High, which shows the Range of the Machine for High Work

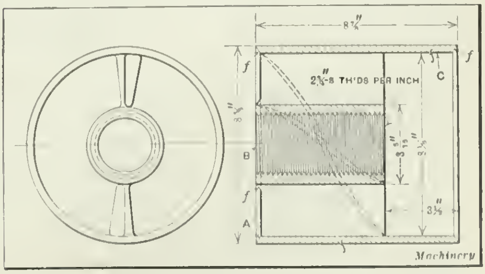


Fig. 18. Detailed View of a Pump Lifter, the Tooling Lay-out for which is shown in Fig. 17

chucked and machined as shown, but it was necessary, owing to the excessive height in proportion to the diameter of the work, to employ the low table speed of 22 revolutions per minute, the feed used being 0.027 inch per revolution of the table.

The locomotive valve body, shown in section in the tooling lay-out, Fig. 18, presents certain points of interest in its machining, due principally to its irregular shape. This part is machined in two chuckings. The lay-out of the first chucking illustrates the method of securing the valve body in a special holding fixture, from which it will be seen that two special straps *A* are used to hold the part down and prevent it from lifting. These straps are so shaped that they enter openings on opposite sides of the valve body, and engage an inner wall of the part, against which they are securely clamped by machine screws. These straps can be adjusted radially by means of safety set-screws *B*. The design of the valve body is such that screws may be employed to engage lugs on the inside of the work, thus forming adjustable stops against which the straps *A* clamp the work.

The holding fixture required for the second chucking is of much simpler construction than that used in the first chucking, since the design of the upper end of the valve provides a suitable locating surface for the work. This may be readily seen by inspecting the set-up for the second chucking. In the first chucking, the stem end of the valve body is faced with a tool in the main turret, while a tool in the side-head turret is being fed down to rough-turn the large diameter.

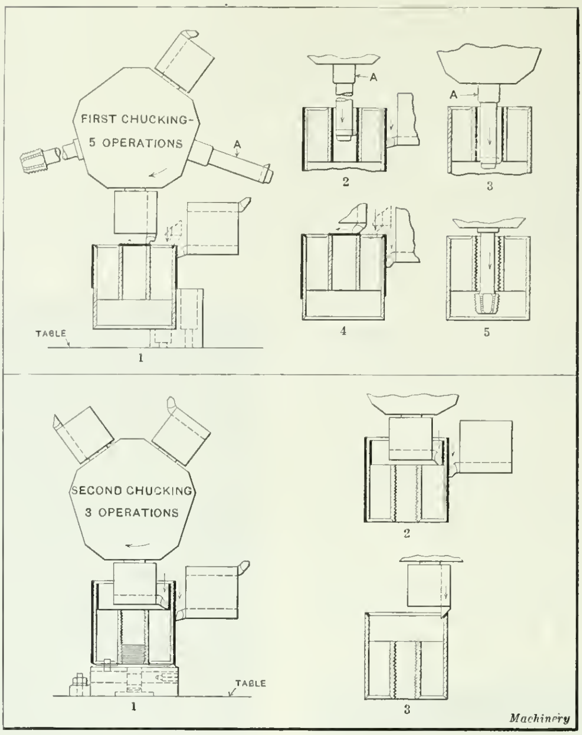


Fig. 17. Tooling Lay-out for Pump Part shown in Fig. 16, illustrating One Method of machining Work that requires a Tapping Operation

This same tool is also used in the second operation, during which the outside diameter of the lower part of the work is rough-turned, while a tool carried in the combination boring- and reaming-bar *C* rough-bores and finishes the small hole at the upper end of the stem. During this operation it is necessary to remove tool *D* from the side-head turret, because of its overhang and the design of the work. The third operation employs tool *D* to rough-face surface *E* and rough-turn the adjacent shoulder. While this operation is in process, use is made of a special centering pilot *F* carried in the main turret, which enters the previously finished hole in the stem, and acts as a center to prevent inaccuracies in this and subsequent operations on this end of the valve body. In the fourth operation, a special forming tool finish-faces the large diameter at both the top and bottom of the work, and also produces the bevel shown at the lower part of the work, indicated by the position of the tool, which is shown in dotted lines in its second position. In the final machining of the part, before it is reversed, a side-head turret tool finish-faces surface *E* and the adjacent shoulder, and in both this and the preceding operation the centering pilot *F* remains in the work.

There are two operations in the second chucking, consisting of rough-facing and boring the surfaces indicated in the first operation, and finishing these surfaces. These locomotive valve bodies, when made of steel, are machined complete in thirty-five to forty minutes, and when made from a copper-zinc composition, in fifty-five to sixty minutes.

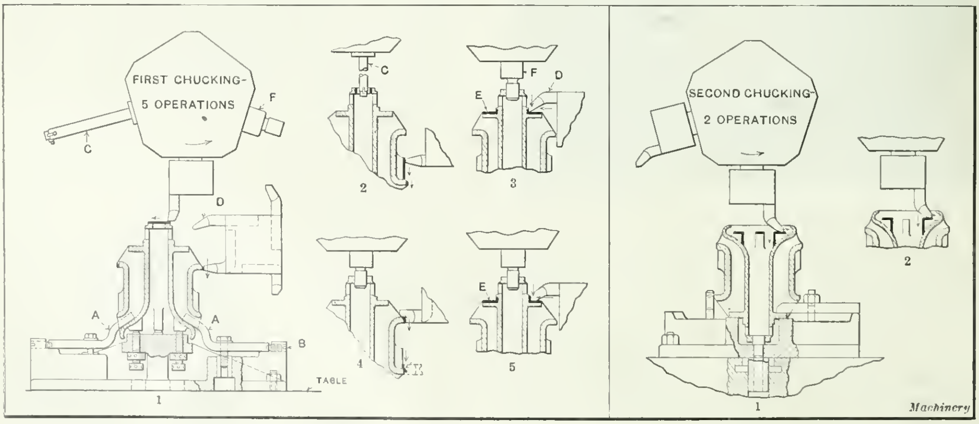
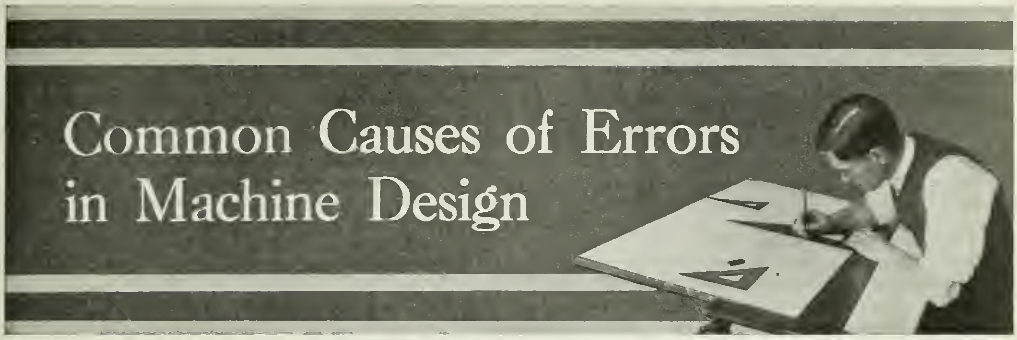


Fig. 18. Tooling Lay-outs for machining a Locomotive Valve Body. Attention is called to the Special Holding Means employed

Common Causes of Errors in Machine Design



Physical and Chemical Laws Affecting Design—Functioning of Parts—Clearance between Parts—Suitability of Materials—Strength of Parts—Durability—Adjustment—Simplicity

Second of a Series of Articles

By R. H. McMINN

THE first installment of this series of articles, which was published in the January number of Machinery, discussed errors that are commonly made in machine design, and their basic causes. Twenty-nine important factors which should be considered in the design of a machine were outlined, and the first two points, relating to authority affecting the design of a machine, and the completeness and accuracy of information required, were discussed in detail. The present installment will treat of physical and chemical laws affecting design; functioning of parts; speed and timing of relative motions of parts; positiveness of action; clearance between parts; suitability of materials; strength of parts; durability; adjustment; simplicity; accessibility of parts; and lost motion.

Physical and Chemical Laws Affecting Design

A designer should have as thorough a knowledge as possible of physical laws. If engaged only in mechanical work, he should know enough of physical laws pertaining to electricity to be able to use electrical equipment properly with other machines when required. A knowledge of certain chemical laws, such as those relating to combustion, is necessary in some lines in which the mechanical engineer works. A chemical effect, like rusting, is often evidenced or, as in casehardening, may be utilized in a machine which the mechanical engineer designs. But it is not sufficient just to know physical and chemical laws. The designer must recognize that a machine element under the prevailing conditions will act or be acted upon in a certain way because of one or more laws. He may know that "every body continues in a state of rest, or uniform motion in a straight line, unless it is compelled by force to change that state." However, he may overlook the fact that vibration is produced, because of this law, on a heavy rapidly reciprocating part, like a piston, due to the variation in the force necessary to accelerate it during each stroke.

One of the best safeguards against overlooking the effect of the action of certain laws in specific cases is a study of a thoroughly reliable and comprehensive treatise on the design of the kind of machine most similar to that which one is drawing. This will not only serve as a check on the work of the man who knows all the laws which should govern a design yet fails to allow for the effect of one, but will also be of even greater assistance to the man who may be ignorant of some of the laws which will affect results.

Functioning of Parts

The first step in design is the selection, arrangement, and proportioning of parts which, acting together, will best perform their functions in doing the work required. In order to be as sure of the successful operation of a new machine as possible, one should select, when possible, combinations of elements which have been used successfully before and which may be adapted to the conditions at hand. Not only must a careful analysis show that each element will efficiently perform its intended function but that no elements have been omitted that are necessary to fulfill the complete requirements. The machine may operate under variable conditions which may make the work variable and necessitate the addition of controlling devices. It may require means for reversing not thought of at first. In a self-propelled vehicle the main feature is the propulsion, but the vehicle must be guided, backed, controlled in speed, and stopped, all of these requirements demanding additional elements to perform the various functions.

In a punch press the main work is punching holes in metal, but the machine must be started and stopped at will, means must be provided so that the cross-head carrying the punch will stop at the top of any single stroke, and in some cases an automatic feed for the metal being punched is included in the design. The main work performed by an elevator is lifting and lowering loads, but the design must not only include devices for normal conditions of operation but also appliances, such as the safety stop and the slack cable device, which act only in the event of failure of some other element.

The consideration of what the complete requirements are in the design of any machine will therefore demand much thought. Since the design of most modern machines is the result of gradual development, it is probable that no one starting on the design of a machine new in kind to him will think

The author of the series of articles on "Common Causes of Errors in Machine Design" has made a careful study of drafting-room errors, their underlying causes, and the reasons why designs are not always what they should be. Draftsmen as well as experienced designers will benefit by studying these fundamental causes, which have been analyzed and recorded after a long series of observations backed up by years of diversified experience. While all designers realize the importance of preventing errors as far as possible, it is not generally appreciated that these errors can be reduced to a minimum by making a study of the fundamental reasons for them and by systematically applying such methods as are likely to prevent the occurrence of common errors.

of all the elements which should be included in the design without a preliminary study of similar machines.

Speed and Timing of Relative Motions of Parts

There is usually some determining factor that sets the speed of some elements of a machine, as, for instance, the number of revolutions of the crankshaft of a gas engine required for a certain service, the number of strokes per minute of a punch press needed for a given output, or the number of feet per minute lift wanted for an elevator cage. The speed of the other parts depends upon their function and point of application in the machine.

Members like cams, which operate other parts intermittently, must be arranged to perform their functions not only the proper number of times during a complete cycle of operations of the machine, but also at the proper periods of time. The first condition must be insured entirely at the time of design by providing for proper relative speeds of members. The fixing of the exact period of time at which one part will perform its function, in relation to the period of time at which the other parts perform their functions can often be set during assembly, but this possibility must be ascertained during design.

In Fig. 2 two cams *A* and *B* are keyed to the shaft *D*, which is driven by a gear *R* from a pinion *S* on another shaft *E*, which also carries a cam *C*. The timing of the action of cam *C* in relation to the action of either *A* or *B* may be adjusted within certain limits during assembly by varying the particular pairs of gear teeth in mesh, even when no attention has been given to the angular location of keyways in cams and shafting. But the timing of the action of *A* and *B* in relation to each other can only be accomplished by fixing their relative angular relationships on shaft *D*. This must be attended to by providing the proper angular location of the keyways in the cams and shafting.

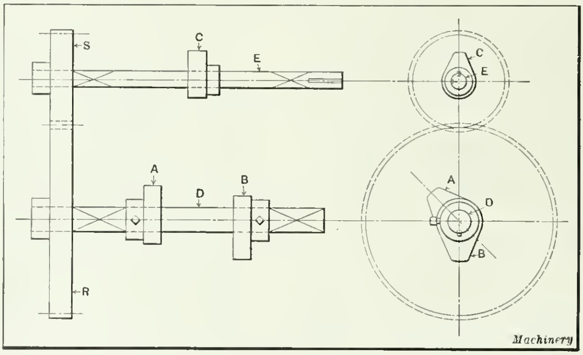


Fig. 2. Mechanism illustrating Factors controlling Timing of Parts

When the best results in timing the relative motions of the parts actuated by two cams like *A* and *B* are difficult to ascertain by drawing only, the cams are often set screwed on the shaft for purposes of adjustment and trial. If the turning moment on the cams is large, the location of keyways, which have already been cut in the cams, are marked on the shaft. The keyways are then cut in the shaft in the location thus marked for that and subsequent machines.

Positiveness of Action

The parts of a machine should generally be as positive in action as possible. This is especially true where a definite velocity ratio must be maintained between the parts. In ordinary cutting in a lathe, it is not necessary to have a precise ratio of forward movement of the carriage to the number of revolutions of the spindle. Here a slight slippage of the belt used to drive the feed-rod which produces the motion of the carriage and tool can do no harm; but in cutting threads it is necessary to connect the carriage positively through the lead-screw and a train of gears to the spindle which revolves the work, in order that the tool shall travel an exact amount forward for each revolution of the spindle.

Set-screws, when used in place of keys to prevent the turning of a part on a shaft, are intended to be positive in their effect, but frequently allow slipping under heavy loads. Parts actuated by weights, springs, compressed air, or magnetism must be checked carefully to see if they will work fast enough when used in conjunction with positively actuated parts having a high fixed velocity. Fastenings which depend on friction between the parts to hold them together are likely not to withstand vibration without loosening. In some cases, however, devices that are not positive are used purposely, such as friction clutches to eliminate the shock when starting a machine, friction brakes for gradual stopping, split wooden pulleys which are clamped on lineshafting for convenience, and belts because of their comparative flexibility in driving and simplicity in distributing power.

Clearance between Parts

The failure to allow enough clearance, or the occurrence of an actual interference between two parts of a machine, is one of the most common errors. The probable reason that interferences are often overlooked by draftsmen is because the necessity for determining clearances is not made a fundamental part of their earliest training in drawing. Their early drawing covers for the most part separate elements or a few elements associated together, and not a multiplicity of parts shown in difficult interrelation. Looking into clearance is therefore not second-nature. However, if a man is not definitely impressed with the grave danger of having an interference between the parts of the machine he is designing, he will find this out by bitter experience; but even such an experience will not suffice to keep him out of a similar difficulty in the future unless he incorporates in his work a definite system for looking out for clearances, just as he watches other points of design.

Avoiding Interference of Parts when Making Drawings

The designer is aided in avoiding interferences if he is accustomed to working up all views of an assembly or lay-out as he draws, instead of completing one view and then starting another. It is impossible for him to conceive of all points involved in difficult geometrical relations if he has only one view before him and the rest in his mind. The assembly should be made complete enough and there should be enough views so he has a clear conception of all parts and all spaces between parts. Members such as bolts, grease cups, chains, ropes, and belts, which are frequently represented only by center lines, or sometimes not even indicated at all, are often found to interfere with other parts of a machine. Likewise the slack side of a belt or other flexible member may depart considerably from the straight line by which it is often shown. On the first design of a machine not entirely familiar to the designer it is a good plan to go into more minute detail in drawing than one experienced with that kind of machine would have to do, because of the suggestions of possible difficulties which parts actually shown give and which parts not shown may not give. One of these difficulties is in the assembly of the parts. Often a bolt, indicated only by a center line, would clear other parts in its final location if there were a way to get it into the place intended. Likewise, it is not always as evident that a center line in motion will hit another part as it is that the grease cup, which the center line represents, will interfere with the part. When drawing work is abridged too much, it is likely to cause trouble. The drawing should be such as to lend every possible assistance in avoiding error.

All parts must not only clear in the positions in which they are shown on the drawing, but the path of all moving parts must be examined to see if they will clear all stationary parts and all other moving parts during any cycle of operations through which the machine must go. This may necessitate a number of separate lay-outs of various groups of parts viewed from different angles solely to determine clearances. Plenty of clearance must be allowed between unfinished parts and large castings which may vary considerably from the actual dimensions on drawings.

Liquids and Gases

Liquids and gases should be considered especially in reference to the subject of clearance. Air is not represented on a drawing, except sometimes in drawings of air-operated machinery. It occupies space, however, and nothing can be put into that space until the air is allowed to escape. If a shaft must be plunged into a deep hole in which it fits very closely, there must be some means for allowing the air to escape from the bottom of the hole. This is especially true if the shaft has an in-and-out movement in the hole during operation. Similarly, water cannot completely fill a piping system until the air is removed. The heating of a steam radiator is greatly retarded unless the air in it is allowed free escape.

Ordinary methods of finishing surfaces and holding them in contact are not sufficient to prevent liquids and gases from escaping between the surfaces because the space between the particles composing the surfaces is relatively large in comparison with a molecule of a liquid or a gas. Permanent joints which must be liquid- or gas-tight are made so by calking, welding, or the use of molten metal, such as solder or lead, to seal the joint. Joints that must sometimes be disconnected have rubber, asbestos, or soft metal gaskets which, when compressed, fill all the surface pores of the harder metals. Tapered threads are also used on screwed members to make tight joints. Some joints must hold gases and liquids but allow relative movement between the surfaces in contact. Thus leather cups are used for air or water pistons; fibrous or metallic packing is used for stuffing-boxes around piston-rods; ground valves have ground seats; and ground piston-rings work in ground cylinders.

Suitability of Materials

There are many chances of specifying a wrong material of construction unless this be given full consideration. The selection of any material for a certain purpose may depend on one or more qualities, such as strength; durability; flexibility; fire-resisting ability; cost; weight; ability to cast, harden, bend, or weld; electrical conductivity; insulating properties; or ease of machining. One of the considerations in the selection of a material is how it will be acted upon by other materials with which it must come in contact. Some metal alloys are especially prepared for their acid-resisting properties. In sliding contact, two unlike materials are used generally, because they have a lower coefficient of friction than two parts of like material and consequently require less work to move and wear better. However, cast-iron piston-rings are used on steam- and gas-engine pistons working against cast-iron cylinder walls with better results than rings of other materials. Brass is used in many places where cast iron might otherwise be used, because the former will not rust in the presence of moisture. A rawhide pinion may be used with a metal gear to reduce noise of operation.

If a designer introduces elements into a machine to perform functions or which will be surrounded by conditions with which he is not entirely familiar, it would be well for him to obtain a check on his own judgment regarding the selection of materials for these elements.

Strength of Parts

The strength of the parts of a machine or structure should always be carefully considered. In some machines, like typewriters and adding machines, the strength of many of the parts does not actually require figuring. One knows from experience that the smallest size that it is practicable to make some of the parts will be amply strong for the stress upon them. Even in larger machines there are parts which do not require figuring to determine that a certain size will be strong enough to resist the stress they must undergo. But it is well to form the habit of always considering the strength of a part, whether its safe proportions can be fixed by an instant's thought or require an elaborate calculation to determine.

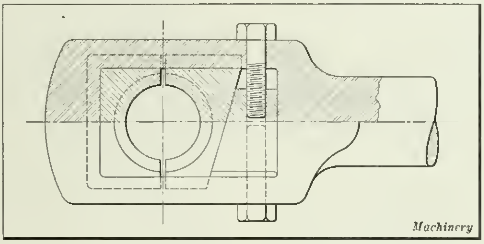


Fig. 3. Example illustrating Screw and Wedge Adjustment for Bearings

One of the important elements in figuring strength of members is in observing all the forces which are acting, what members they affect, and how they affect them. This can often only be positively determined by a thorough examination and analysis. The parts must be able to resist not only their normal working load but also any suddenly applied load which may come upon them. This may not come from outside sources, but may be produced by the sudden stopping of the machine itself, as from the momentum of heavy parts when a brake is abruptly applied. Also, the power required in starting a self-propelled machine, such as a street car, or any machine starting under full load from rest far exceeds the power required for normal running and gives a consequent higher stress in many of the parts. The stress produced by centrifugal force must be watched carefully in rapidly rotating parts. The weight of a member such as a beam, chain, or cable, which is supporting a load must often enter into the calculations in determining the total load to be resisted by the member, if its weight is an appreciable per cent of the other loads.

The proportions of some parts, such as shafting, must be such that under maximum loading a certain deflection from their normal shape is not exceeded, to prevent excessive binding in the bearings. The necessity of reducing vibration may require that parts like a machine frame be made heavier than needed by considerations of breaking strength alone. A member can be subject to one simple stress, such as compression, tension, shear, or torsion, or to bending (which combines tensile, compressive, and shearing stresses), to bending and torsion, and other combinations.

Initial Stresses

Some castings, notably wheels and pulleys, are subject to initial internal stresses due to unequal cooling, and therefore a conservative unit stress must be used in figuring their strength. Unequal expansion or contraction of connected parts in a machine due to a radical change in temperature may result in greatly increased stresses. In steam piping this must often be allowed for by expansion joints.

Stresses due to Assembling

The required size of a bolt or screw in a machine may depend upon its ability to resist breaking by over-tightening rather than upon any other stresses to which it is subjected. The thickness of the metal of a hub into which a shaft must be driven or forced must be sufficient to resist this process even when a much less thickness may be needed to withstand operating stresses. The strength of a part may depend primarily upon its ability to be carried through all the processes of manufacture and transportation without breaking, rather than upon any strain to which it may be subjected in the operation of the machine.

Factor of Safety

The allowable unit stress in any member is obtained by dividing the ultimate unit strength by a factor of safety. This factor under a steady load depends upon the elastic limit of the material and its reliability. When the load is not steady, the factor must be increased by an amount depending upon the variation in intensity, direction, and suddenness of application of the load. It must also be large enough to allow for overloads (if they are possible) and uncertainty as to exact methods of figuring the strength of some members. The factor to allow for any part depends somewhat upon how often a load is applied to it in relation to other parts of the same machine and upon what the consequences of its breaking would be either in cost of replacement, in delay to production, or in actual danger to life.

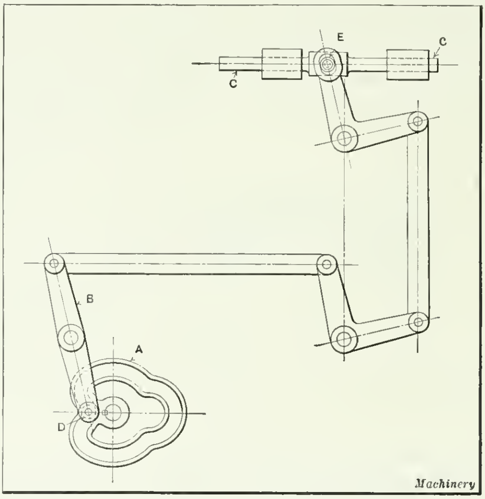


Fig. 4. Type of Mechanism in which Action of Driven Member is reduced somewhat by Lost Motion

Durability of Machine Parts

The durability of the parts of a machine is another important element to be considered. The limitation of the wear on any part may largely determine its size. The size of an engine crankpin which runs in one of the connecting-rod bearings is generally based on the allowable bearing pressure and then checked for strength and stiffness. The design of slides, clutches, and brakes partly depends upon allowing sufficient areas in contact to reduce wear. The teeth of gears operating under conditions where they are subject to the action of sand or similar materials should be made much larger than demanded by the initial strength needed in order to allow for the rapid wear, with consequent weakening, which is bound to occur. Parts may have to be increased in size or thickness to allow for rust or corrosion. The kind and grade of materials used as well as certain special treatments to which they may be subjected, as in hardening and tempering steel, also have an important influence on their ability to resist wear.

Adjustment of Machine Parts

Almost all machines require means of adjusting one or more members to take care of the variable sizes of the work handled, to make certain parts the exact size required, to locate a part more exactly than it can be done by other means, or for other reasons. It is difficult to align bearings unless they rest on the same rigid machine bed. In hangers for lineshafting the center of a bearing can be adjusted up or down by screws, and laterally by means of slotted holes in the top of the hanger. Thin liners of metal or cardboard are often used between the halves of bearings so that when the bearing wears, one of the sheets may be removed and the two halves brought closer together. Some important bearings have means of adjustment by screws and a wedge, like the connecting-rod bearing shown in Fig. 3.

Gas engines are provided with mechanism for adjusting the timing of the spark and varying the mixture of gas and air. Machine tools are provided with adjusting means to bring the cutting tool in contact with parts of different size and shape. The cross-head of a punch press often has a connecting-rod adjustable in length so that the punch, which is attached to the bottom of the head, may be made to enter the die to just the correct depth at the bottom of the stroke. The designer must always note whether any adjustments should be embodied in a new design, either by necessity or for convenience.

Simplicity of Construction and Accessibility of Parts

Simplicity of construction is one of the features to be sought in design at all times. The machine should have as few parts as possible and as few kinds and sizes of parts consistent with what the parts do. The first operative mechanism one may think of to perform a certain function may not be the simplest to be found. Possibly approaching the problem from an entirely different viewpoint may suggest a much simpler one. If thought directed to finding a better one fails, certain parts of the first mechanism can probably be combined to advantage. If a machine has parts remote from each other which perform the same functions, it is possible that by a relocation of certain groups some duplicate parts can be eliminated.

It is said that on one of the earliest steam engines a boy was required to move the slide-valve back and forth to produce the reversal in direction of motion of the piston. He observed that there was a part on the engine that moved in unison with the slide-valve, so he attached a stick between them, which did the work that he had been required to do.

Making parts symmetrical in as many ways as practicable may allow one kind of part to be used in more than one position on a machine. One should try to avoid making parts which require right- and left-hand patterns or dies, but must be sure to discover when they are necessary. The attempt to make a machine with the fewest parts does not mean only that as many parts as possible should be cast or formed integrally. Full consideration should be given to required differences of material, ease of machining and assembling, differences in wear of parts, and ease of adjustment and replacement.

It is important that the user of a machine be able to reach or remove certain parts of the machine easily. In fact, accessibility of those parts must greatly determine design if the machine is to be permanently satisfactory to the purchaser. A machine with a considerable number of parts cannot be made so that every part may always be reached or removed without removing any other part. However, parts which require frequent inspection, cleaning, tightening, adjustment, packing, lubrication, or removal for regrinding or replacement should be accessible by the removal of the least possible number of parts. One of the chief advantages of the Walschaerts valve gear, which is one of those displacing the Stephenson link motion in the control of locomotive slide-valves, is that the former is located outside of the driving wheels and hence is more accessible for repairs than the latter, which is placed between them.

Allowing for Lost Motion

The lost motion in any mechanism will often have to be taken into account. In Fig. 4, a cam *A* imparts to a lever *B* an oscillatory movement and, through a series of links and levers, gives a reciprocating movement to the rods *C*. The theoretical movement of the rods depends upon the arc of action of lever *B* and the arrangement and lengths of the other levers and links. The actual movement of rods *C* will be less than this because of lost motion. A part of this lost motion might be due to the distortion in the various members, if they are highly stressed, but the greatest part will be due to the working clearance at each pivoted joint and between the rollers *D* and *E* and the sides of the slots by which they are actuated. The clearance may be small at each of these points, but it has a cumulative effect. The wear at all such points will, of course, increase this lost motion. In mechanisms transmitting small forces, lost motion and wear can sometimes be allowed for by proportioning the movements to give a slight initial over-travel to such parts as rods *C*. If this is not permissible, provision can be made for adjusting the length of one of the lever arms and links so that the required movement may be imparted to the last member of the series.

When machine members transmit large forces, which are constantly reversed in direction, lost motion between the members tends to produce shocks on their bearing surfaces, thereby hastening wear and causing vibration. To avoid such conditions the bearings affected should be provided with adjustable means so they may always have the closest practicable fit on their journals. This is done on steam-engine connecting-rods in a manner similar to the example shown in Fig. 3.

If gears are members of a reciprocating mechanism, they will also allow lost motion unless the clearance between the sides of the teeth is kept at a minimum. They should therefore be accurately cut and mounted with shafts having exact alignment and center distances. The slightest lost motion of the spindle of a micrometer would introduce inaccurate readings. This is prevented by having two stationary nuts through which the spindle screws. These are pushed apart by a spring between them, or adjusted manually so that they press equally against the spindle threads in both directions. This prevents a longitudinal motion of the spindle without its being turned and hence registering its movement by the graduations provided. When it is necessary to devise a mechanism having a minimum of lost motion, one with the least number of joints should be sought. The type of joints that is selected should, if possible, be capable of adjustment for wear.

The next installment of this article, which will appear in the March number of MACHINERY, will deal with additional important factors in the design of a machine, such as frictional losses, lubrication, unbalanced parts, manufacturing operations, and other points.

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BLANKING, FORMING AND PIERCING DIE

By C. J. HUEBER

The die here described and illustrated has given excellent results in the production of metal flanges used in the manufacture of rubber-cushioned wheels for a vacuum cleaner. As shown in Fig. 1, the finished wheel is made up of four parts; a rubber cushion *A*, an assembling tube *B* which forms the bearing, and the two pressed-steel flanges *C*. The die shown in Fig. 2 is used to blank, form, and pierce one of the flanges *C* in one operation, and when in use is mounted on a single-action inclinable press.

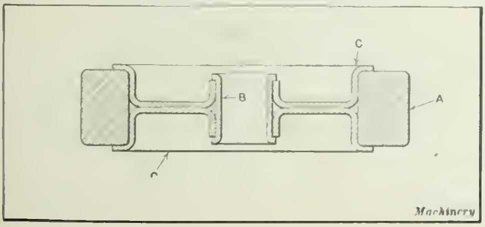


Fig. 1. Cross-sectional View of Rubber-cushioned Wheel

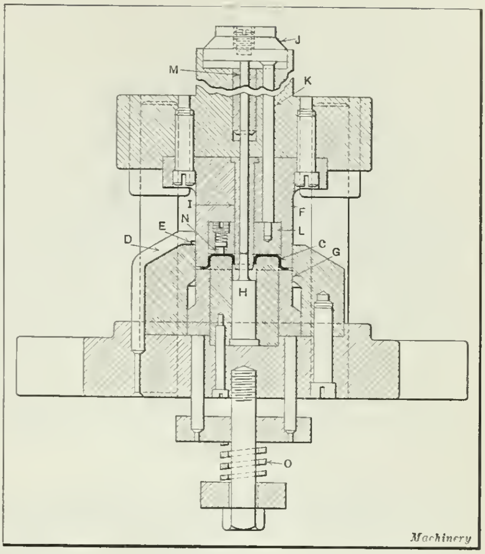


Fig. 2. Die used in blanking, forming and piercing Flanges C shown in Fig. 1

Cold-rolled steel 0.035 inch thick, cut or sheared into strips 3⅞ inches wide, is used for making the flanges. This permits a double run to be made on the stock, as the blank is approximately 1 61/64 inches in diameter. The stock is fed to the die and gaged by two hook pins *D*, only one of which is shown in the illustration, the other being located at the back of the die. These pins are under-cut as shown at *E* in order to strip the scrap from punch *F*. As punch *F* descends the flange is cut, the blank being held by draw-ring *G*. As the punch continues its downward stroke, the hole is pierced by punch *H*, and the hub of the flange is drawn around die *I*.

Flange *C* is completed by the downward stroke when draw-ring *G* is seated on the die-shoe. On the return stroke, knock-out *J* strikes a cross-bar on the press, which causes the stamping to be ejected from the punch by means of studs *K* and pad *L*. Knock-out *J* also actuates rod *M* which ejects the small slugs from die *I*. The small spring-operated pin *N* is also employed to overcome the difficulty arising from the tendency of the stampings to adhere to pad *L* due to oil on the stock. As customary in all drawing dies used on a single-action press, a spring *O* or a rubber bumper must be used for applying pressure to the draw-ring.

* * *

SAFE FOUNDRY PRACTICE

A booklet entitled "Safe Foundry Practice" has recently been published by the engineering and inspection division of the Travelers Insurance Co. This booklet describes the sources of accidents in connection with the production of castings, being devoted mainly to iron foundries. Many of the safety problems encountered in foundries where other kinds of metals are cast are also considered. The booklet also treats of safe wearing apparel of employes, and the apparatus essential to the work of the foundry. The hazards associated with chipping, grinding, and sand-blasting are dealt with, and helpful suggestions are given in regard to illumination. The safety problems that arise in the foundry yard are also discussed.

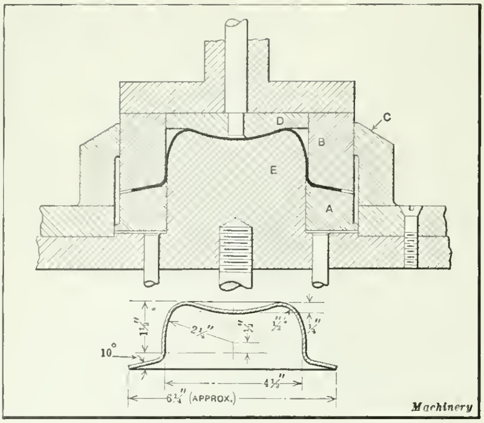


Fig. 1. First-operation Die for Hemispherical Shell

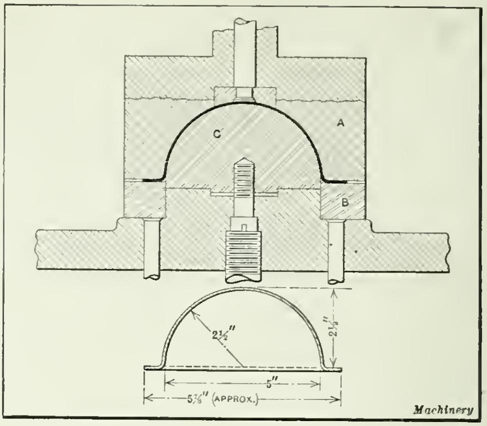


Fig. 2. Die in which Shell is formed to Shape shown

Dies for Hemispherical, Conical and Other Flanged Shells

By J. BINGHAM, President, B. J. Stamping Co., Toledo, Ohio

THERE are various ways of making hemispherical shells, but dies designed as illustrated in Figs. 1 and 2 may be used effectively to produce work of this kind. Of the two dies used in making these shells, which are for ball floats, the first is shown in section in Fig. 1 together with the work after the completion of the operation in this die. The shell is made from a 7 3/16-inch diameter blank of sheet copper, 0.007 inch thick, and its position in the die is shown in heavy lines. By referring to the dimensioned drawing of the shell, it will be seen that it is drawn straight for about ½ inch, and then is formed to a radius of 2¼ inches. It will be seen that the finished shell, Fig. 2, has a radius of 2½ inches, so that by first drawing the shell to the smaller radius, provision is made for stretching the metal to the finished size. In dies of this type it is necessary to provide full round corners in every part of the shell so that during the stretching operation, no drawing marks will be in evidence on the shell.

The combination die in Fig. 1 and the finishing die in Fig. 2 are of similar construction, and their method of operation is identical. The principal parts of the die shown in Fig. 1 are the forming die *E* which is made of cast iron, the drawing ring *A*, the punch *B*, and the blanking die *C*. The latter three parts are made of tool steel, and are hardened and ground. The drawing operation is accomplished by forcing ring *A* downward, drawing the blank over the die *E* against the pressure exerted by a rubber buffer attachment of familiar construction. The drawing punch *B* is welded to a wrought-iron holder, which is an economical construction. A machine steel former *D* is attached to the punch for producing the concave part of the shell. It will be noted that the blanking die *C* is also of a two-piece construction, the tool-steel and wrought-iron parts being welded together.

Referring to Fig. 2, when punch *A*, which is made of tool steel with a wrought-iron upper portion, is in its raised position, the shell, on which the first operation has been performed, is placed on the tool-steel die ring *B*, the concave part of the shell fitting over the convex part of the die *C*. Since the shell is ½ inch smaller in diameter than the finished part, it is evident that punch *A* can pass over the shell in this position, so that the surfaces of the punch and of the die ring can grip the flange under the pressure exerted by a rubber buffer attachment, and hold the shell securely. As the punch continues to descend, forcing the die ring down-

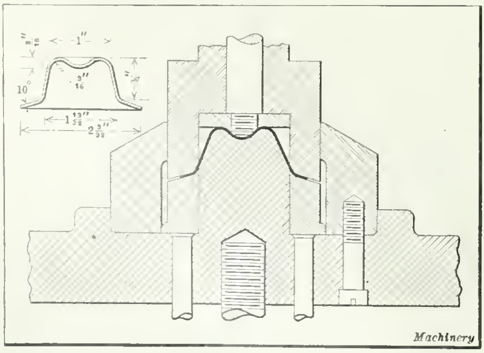


Fig. 3. Shell of Special Shape and Die used in partially drawing it to Shape

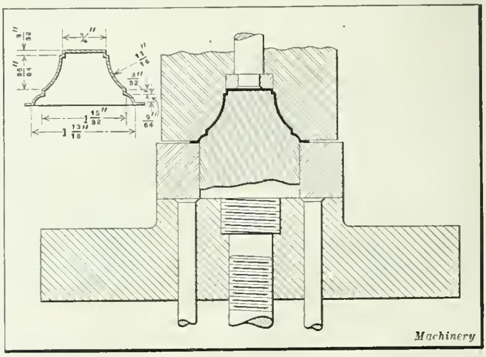


Fig. 4. Finishing Die for the Shell produced by the Die shown in Fig. 3

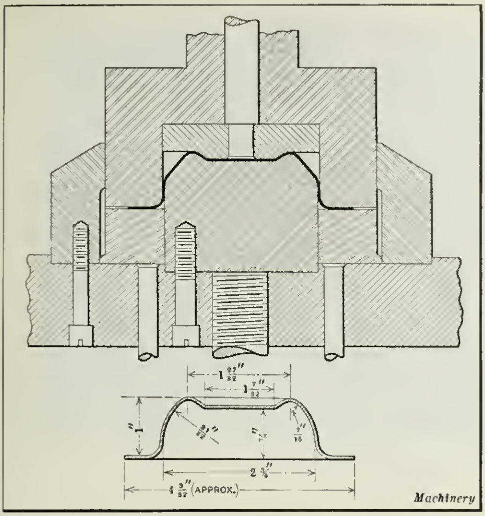


Fig. 5. First Die used in drawing a Flanged Conical Shell

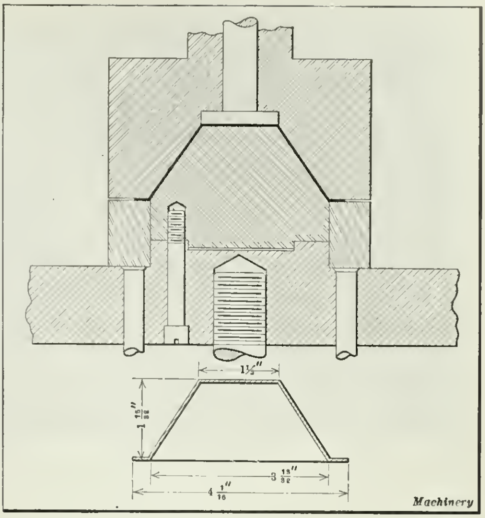


Fig. 6. Die in which the Conical Shell is completed

ward, the shell is simply stretched over the tool-steel die on which it rests. Not only is the shell stretched, but its diameter is also expanded, and it is this combination that enables a smooth shell, free from wrinkles, to be produced. After this drawing and expanding operation has been completed, the edges of the shell are trimmed, and the two halves closed together, thereby completing the copper float.

There does not appear to be any hard and fast rule governing the difference in diameter between the first-operation shell and the finished product, although it has been found by experience gained in making several balls by this method, that from 3/8 to 1/2 inch is a fairly close approximation. This amount, of course, depends upon the size of the shell; if the diameter is less than 3½ inches it is probable that the amount of expansion would be about 3/8 inch, whereas, for a 2-inch diameter shell it would not be advisable to allow more than 1/4 inch. The principal consideration, however, is to make sure that the punch can pass down well over the shell and securely hold it by the flange before the expanding and stretching starts.

The two dies shown in Figs. 3 and 4 are employed for making stove urns, and these flanged shells, while of special design, are produced on dies operating on the same principle as those previously described. For that reason a detailed description of their construction will not be given, but in order to make clear the application of the method explained in the preceding paragraphs to the manufacture of other shells of this general type, these two designs are illustrated, together with the dimensioned shells produced by each. The blank from which the stove-urn shell is drawn is 2⅝ inches in diameter, and is made of cold-rolled sheet steel, 0.022 inch thick.

Another set of dies which operates on the same principle as the dies already mentioned, is shown in Figs. 5 and 6. These dies are used in the production of a conical shaped shell for cream separators. It is imperative that these taper shells be drawn without wrinkles or drawing marks of any kind, and their tapered surfaces must be perfectly straight. These cream separator shells are made from cold-rolled sheet steel, 0.019 inch thick, the diameter of the blank being 4⅞ inches.

Accompanying each illustration there is a dimensioned drawing of the shell, so that an idea of the change produced by each operation may be readily seen. Two more dies of the same general classification as those previously mentioned are shown in Figs. 7 and 8. The work produced in these dies is shown in Fig. 7 in its preliminary stage, and in Fig. 8 the finished work is shown by a heavy line. These shells are oil-can breasts, and the metal is sheet steel, 0.018 inch thick, the size of the blank being 7 5/16 inches in diameter.

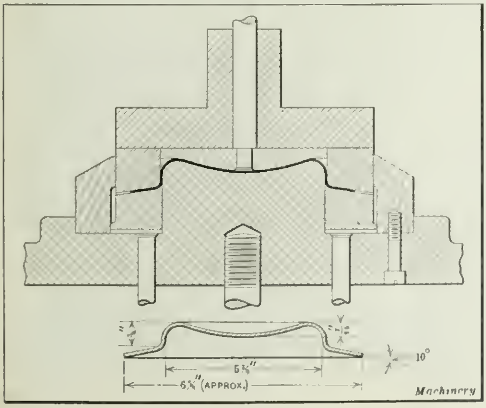


Fig. 7. Die used for partially forming Oil-can Breast

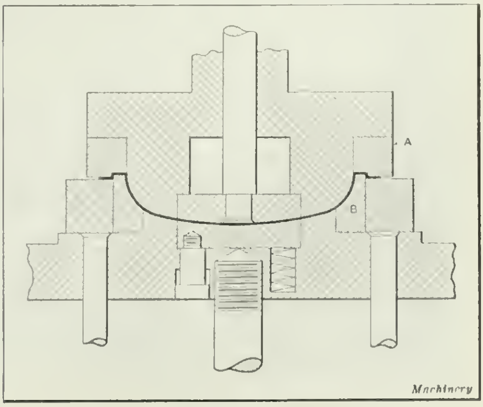


Fig. 8. Die used to finish-form Oil-can Breast

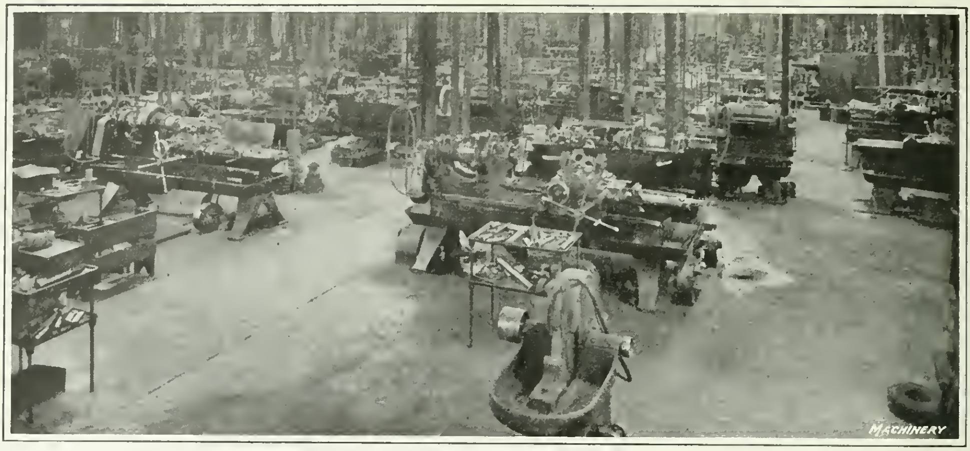


Fig. 1. Reproduction of Unretouched Photograph taken at Night which shows Effectiveness of Lighting System in Machine Section of the Acme Machine Tool Co.'s Plant, at Cincinnati, Ohio

The die used in the preliminary drawing operation presents no unusual features of construction, but it will be seen in Fig. 8 that the position of the work is inverted, and consequently the construction of the die is slightly different. The punch and die rings *A* and *B* form the shoulder flange and so are slightly different from the corresponding parts of the dies shown in the other illustrations. A spring pad in the die provides for lifting the finished shell from the die-nest so that it may be readily removed. The basic principle of operation, however, of all these dies is the same. All of the parts mentioned in this article have been manufactured by means of the dies illustrated, which have proved entirely suitable for work of this type.

* * *

PRODUCING DAYLIGHT EFFECT BY ARTIFICIAL LIGHTING

The lighting conditions in a machine-building plant have a far-reaching effect, both on the quantity and quality of the work produced. Realizing this fact, those in charge of shop construction and the makers of lighting equipment have for some time devoted considerable attention to the improvement of lighting systems. Designers and architects have progressed rapidly in the development of sawtooth roofs and other means of obtaining the best natural lighting conditions, and designers of artificial lighting systems have also made rapid progress, as is evidenced by the accompanying illustrations, Figs. 1 and 2.

These two illustrations are reproductions of photographs taken at night in the Acme Machine Tool Co.'s plant, Cincinnati, Ohio, considered by lighting experts one of the best lighted machine tool plants in the country. The photographs were not retouched in any way, and therefore bear testimony to the effectiveness of the type of lighting system with which the plant is equipped. From these reproductions of photographs taken at night with no illumination other than that furnished by the regular Cooper-Hewitt lighting installation, it is evident that practically a daylight effect is obtained. It will be noted that fine details stand out sharply and shadows are practically eliminated. Fig. 1 shows a night view of a machine section, and Fig. 2 shows a night view of the high assembling and erecting aisle. The complete lighting installation in each case consists of 138 Type P Cooper-Hewitt lamps. Practically all productive sections of the shop are lighted by these lamps at an average of 1.36 watts per square foot. The normal cost of maintenance of this lighting system is said to have averaged about $1.50 for each lamp per year.

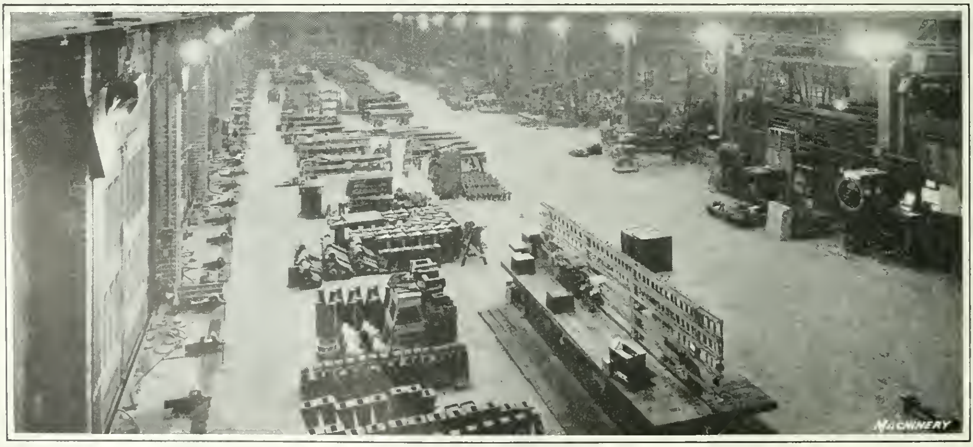


Fig. 2. Night View of High Assembling and Erecting Aisle reproduced from Unretouched Photograph taken with Artificial Illumination

Encouraging Industrial Cooperation

By A. H. DITTMER, President, Dittmer Gear & Mfg. Corporation, Lockport, N. Y.

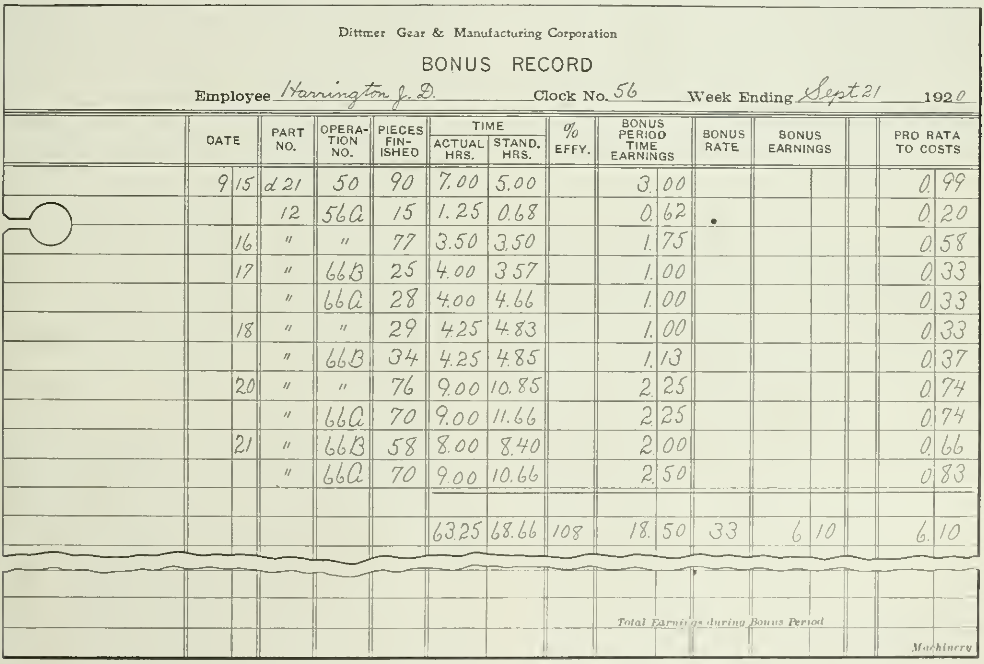
THIS article deals with a new idea in industrial management, which is in successful operation at the plant of the Dittmer Gear & Mfg. Corporation, Lockport, N. Y. This company has instituted what is known as a credit point bonus contest, which is closely identified with its regular bonus system. Before describing the credit point system, an idea will be given of the regular bonus system used.

Efficiency Percentages for Determining the Amount of Bonus

When a man is hired, he is given a flat hourly rate, and he receives this rate as long as he remains on work which is not classified under the bonus system. As soon as he has been put on a job that requires him to work under the bonus system, he is given an opportunity to fix a standard that will represent the amount of work that he should do in a given length of time working at a normal speed and under average conditions. The standard which he thus establishes, working to a stop watch, is accepted by the company as a 100 per cent efficiency mark. As long as the operator can produce 67 per cent of this established standard, he is paid his regular flat rate, but this 67 per cent is a low average for a workman to maintain, for a man whose production drops 33 per cent as compared with what he is able to do under normal conditions is not the kind of man that an efficient organization is desirous of keeping on its payroll, unless there is a good excuse for such a drop.

Starting with the low limit of 67 per cent of the established hourly standard, a chart has been prepared in which all the efficiency percentages up to 180 per cent are listed, and arbitrary bonus percentages given for each efficiency percentage, so that the amount to be added to the man's flat hourly rate can be readily calculated. There is no bonus for 67 per cent efficiency; for 70 per cent efficiency, there is a 1 per cent bonus; for 75 per cent efficiency, 3 per cent; for 80 per cent efficiency, 5 per cent; for 90 per cent efficiency, 10 per cent; for 100 per cent efficiency, 25 per cent; and for each per cent increase in efficiency above 100 per cent an additional 1 per cent in the bonus rate is made. This brings the bonus rating for the maximum efficiency of 180 per cent, provided for on the chart, up to 25 + 80 or 105 per cent.

Perhaps the method by which the bonus is figured will be better understood by taking a concrete example. The record of the earnings of each man working under the bonus system is kept on bonus record charts such as illustrated in Fig. 1. It will be seen that in this case the operator worked on a number of different operations during the week, and that in establishing the efficiency percentage, the total week's work is considered. Referring to the fourth item on this record, it will be seen that operation 66B was performed on twenty-five pieces in four hours' time. The standard established for this particular operation is seven pieces per hour, so by dividing the number of pieces of work by this standard, the number of standard hours 3.57 is obtained. This is slightly below 100 per cent efficiency as can be readily seen, but in the case of the second item the efficiency percentage is dangerously low. However, by considering the totals for the week it is seen that in 63.25 hours, the work of 68.66 standard hours was accomplished. Dividing the number of standard hours by the actual number of hours consumed, gives the efficiency percentage of 108 for the week.



Dittmer Gear & Manufacturing Corporation

BONUS RECORD

Employee Harrington J. D. Clock No. 56 Week Ending Sept 21 1920

	DATE		PART NO.	OPERATION NO.	PIECES FINISHED	TIME ACTUAL HRS.	TIME STAND. HRS.	% EFFY.	BONUS PERIOD TIME EARNINGS	BONUS RATE	BONUS EARNINGS		PRO RATA TO COSTS
	9	15	d 21	50	90	7.00	5.00		3.00				0.99
			12	56A	15	1.25	0.68		0.62				0.20
		16	"	"	77	3.50	3.50		1.75				0.58
		17	"	66B	25	4.00	3.57		1.00				0.33
			"	66A	28	4.00	4.66		1.00				0.33
		18	"	"	29	4.25	4.83		1.00				0.33
			"	66B	34	4.25	4.85		1.13				0.37
		20	"	"	76	9.00	10.85		2.25				0.74
			"	66A	70	9.00	11.66		2.25				0.74
		21	"	66B	58	8.00	8.40		2.00				0.66
			"	66A	70	9.00	10.66		2.50				0.83
						63.25	68.66	108	18.50	33	6.10		6.10

Total Earnings during Bonus Period

Machinery

Fig. 1. Record Sheet on which the Weekly Bonus Earnings are kept, and the Efficiency Percentages entered

Now by referring to the chart of bonus percentages for various efficiency rates, the payroll department will be able to see at a glance that an efficiency rating of 108 per cent represents a 33 per cent bonus rating. That is, 33 per cent of the man's flat rate earnings for the period that he has worked under the bonus system or, in this case $18.50, represents the bonus earnings during that period of time. In this case the bonus earnings are $6.10, which is in addition to his regular flat wage. In the column at the extreme right, the extra costs above the regular flat rate are pro-rated for each operation, so that the cost accounts may be correspondingly corrected; 33 per cent of the time earnings for the bonus period for each job gives this amount, which is added to the cost of each job.

It is not intended to re-establish standards for different operators. Most jobs have previously been rated, and this standard must be the one used for all operators, regardless of their flat wage rate. If in the case of a job on which no standard has been set, a man is timed and produces twelve pieces per hour, this is considered the hourly standard; to obtain the standard hours, the total number of pieces produced in any lot is divided by this standard per hour. For example, if there are 720 pieces in a job and a man in establishing the rate, machines 12 pieces an hour, then the standard hours for the operation is 60. By dividing the standard hours by the actual number of hours required to do the work, which in this case we may assume to be 48, the per cent of efficiency is found to be 125. It was previously stated that 100 per cent efficiency yields 25 per cent of a man's rating as a bonus, and that for every per cent rise in efficiency a one per cent increase in bonus is made, so that in the example cited, 125 per cent efficiency represents a bonus of 50 per cent.

Special Bonus Provision for Set-up Men

Obviously the bonus system for the machine operators cannot influence the earnings of the set-up men, and also has no connection with the work of other non-producers such as inspectors. In order to create an efficient organization, such non-producers must be taken care of in the credit point bonus system, which is to be described later, and so special means are employed to enable these men to receive similar benefits to those paid the machine operators. The inspectors share in the benefits of the credit point bonus contest through their endeavors in maintaining high-grade shipments, as will be referred to later. In the case of set-up men, the following special bonus system applies. Each set-up man has a group of machines under his personal supervision; if these machines run without loss of time for a week, the set-up man is credited with 100 per cent efficiency, and from this credit, lost time caused by machine repairs, absent operators, etc., is deducted. The set-up man is also credited with 100 per cent efficiency if the operators on all the machines under his supervision make an efficiency rating of 100 per cent.

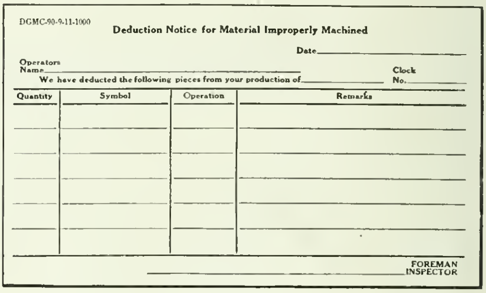
Both of these efficiency percentages are scaled down to 80 per cent, that is, if the set-up man registers 80 per cent on both these items he is paid his flat hourly rate. For each additional per cent over 80 for each of these items, he is entitled to ½ per cent of his rate as a bonus, so that if the set-up man registers 100 per cent for the week in both items, he receives a 20 per cent bonus. These bonus earnings are recorded weekly in a similar manner to the earnings of the regular productive man.

Rejected and Scrapped Material

It would, of course, be unreasonable to pay bonuses for rejected work; therefore, fair reductions must be made so that the company will not have to pay for work which is not properly machined. When it is necessary to make such a deduction in a man's earnings, the slip shown in Fig. 2 is made out in triplicate by the inspector, and one of these copies goes to the payroll attached to the bonus record, Fig. 1. The second copy is handed directly to the operator so that he may know before pay day all details in regard to the reason for making deductions. The third copy is retained by the inspector for future reference. After the proper deductions have been made in the payroll department, the bonus record with the deduction notice attached, is placed in the workman's pay envelope so that he can check up his entire bonus earnings without being obliged to ask for explanations from the clerical department.

The Credit Point Bonus Contest and its Conditions

Having described in detail the bonus system used in connection with the credit point bonus contest, the method of making awards under this scheme will be better understood. The contest was originally intended to run for a period of six months, but it is planned to renew the contest as soon as the present period has expired. In this way the contest constitutes an additional bonus system which takes into consideration not only the production end of the industry, but also all other factors which by special effort will add to the efficiency of the organization. A committee of men from the shop was selected for the purpose of conferring with the management in regard to improving the contest from time to time, for it was realized that such improvements would be necessary as the results of the contest became more in evidence. The general purpose of the contest is "to reward employes for initiative, loyalty, efficiency, and regularity, and to increase the efficiency of the plant in general."



DGMC-90-9-11-1000

Deduction Notice for Material Improperly Machined

Date__________________

Operators Name____________________ Clock No.________

We have deducted the following pieces from your production of__________

Quantity	Symbol	Operation	Remarks

____________________ FOREMAN INSPECTOR

Fig. 2. Record Form on which Deductions for Poorly Machined Work are entered

The contest is a means by which additional awards may be earned for various things such as attendance, efficiency, etc. The basis by which the awards are made is by points, each point representing an award of 5 cents. Besides the various factors which are subject to awards under this contest, provision is made for paying special awards for ideas suggested which will benefit the organization. All employes, with the exception of the executives, are eligible to partake in this contest. The same amount, 5 cents, is used when penalizing the men for breach of established rules and regulations of the company, as is awarded for meritorious service or evidence of cooperation and loyalty to the concern. The following classification of subjects to receive the attention of the management in conducting this contest has been made:

1. Perfect attendance. When no time has been lost through absence or tardiness for one month, 40 points; two months, 50 points; three months, 60 points. For each additional month, 5 points are added until 80 points per month are reached, which is the maximum monthly award for attendance. Exceptions are made in case of sickness, death, or other serious matters, provided the management is notified to that effect.

2. One hundred per cent efficiency in production. First week, 5 points; second week, 10 points; third week, 15 points; each following week 20 additional points. To be eligible for awards for efficiency, the employe must have registered at least 35 bonus hours per week; that is, it is necessary for an employe to actually work 35 hours each week on bonus

work in order to become eligible for awards, regardless of the bonus per cent that the man may have registered.

3. Continuous service (not being removed from the payroll for any reason). Such service receives awards regardless of the attendance record. For three month's continuous service, 20 points; for six month's service, 25 points; for nine month's service, 30 points; and for each additional six month's service, 70 points.

4. Suggestions submitted and accepted. No award is made of less than 10 points, and no award is paid for suggested plans of improvements already under consideration by the management. The awards are based on the value of the suggestion, and may be increased as the suggestion becomes of greater value to the company.

5. Rate of scrap as determined by material and labor losses. The determination of the rate of scrap is made near the termination of the contest, and awards are made as follows: 1 per cent or less, 100 points; 1 per cent to 2 per cent, 75 points; 2 per cent to 3 per cent, 50 points; 3 per cent to 4 per cent, 25 points; above 4 per cent no award. These awards are paid to every person in the plant. Employes not having served through the entire bonus period benefit proportionally to their length of service.

6. Maintenance of high-grade shipments. These awards are made to inspectors only. For 100 per cent shipments, 25 points; for 1 or 2 per cent rejections the award is determined by the money value of the rejected work.

7. Gold medal or honor productive man (man having highest record for efficiency in production during a month), 25 points; gold medal or honor non-productive man (set-up man having highest efficiency percentage, and inspector having highest efficiency for monthly shipments), 25 points. Non-productive men such as inspectors, set-up men, etc., obviously do not have as good an opportunity of registering large numbers of bonus points as do the productive men, and for that reason each class is given a like consideration in making gold medal awards. This same policy is followed in every case where prizes are involved. There is an honor roll maintained in connection with the credit point bonus contest which is posted every week, giving the time-clock numbers of all men who have registered an efficiency percentage of 100 or better. It is the average taken from these weekly honor rolls that determines the awarding of gold medal prizes.

8. Miscellaneous credits and penalties subject to the special attention of the management. (a) Clean and orderly machines, desks, benches, etc., penalty or award 5 to 15 points; (b) clean and orderly condition of floor around machines, desks, etc., penalty or award 5 to 15 points; (c) carelessness in handling blueprints, penalty 25 to 50 points; (d) failure to use the provisions made for handling work, penalty 5 to 15 points; (e) smoking inside the shop or mutilating bulletins or notices, penalty discharge and loss of all points; (f) carelessness in handling materials, penalty 5 to 15 points; (g) promptness in making out reports and for being up to date in work, award or penalty 5 to 25 points; (h) failure to turn in gages between day and night shifts, penalty 5 to 15 points.

Additional Facts Regarding the Contest

In addition to the foregoing eight classifications, special prizes are awarded to those registering the highest net number of credit points during the period of the contest. Three of these prizes are for producers and three for non-producers, and the management has reserved the right to name the amount of these awards, so that the awards may be made in proportion to the amount of profit realized by the company during the period of the contest. Such things as committee work, athletic showing, handling and returning of tools, etc., are especially awarded or penalized, and also such things as department efficiency, department attendance, etc.

While this system should work out to the decided advantage of the employe as well as the employer, a strict discipline must also be maintained. No cheating or evasion of duty, if discovered, will escape being penalized, and second offences result in discharge. Payment of credits and special prizes is made immediately after the close of the contest.

In the case of a break occurring in a man's attendance record, efficiency rating, or any other feature of the contest, whereby from consecutive records cumulative awards accrue, the minimum point award then becomes the starting point for all additional awards. In general, where penalties are inflicted for breach of rules, the matter is handled in such a way as not to inflict undue hardship, and in most cases warnings are given before penalties are inflicted. These conditions, of course, are brought to the attention of the management and they are dealt with as the severity of the case warrants.

Effect of Contest on the Appearance of the Shop

The impressive thing about this contest is that it works, and the results are evidence that it has gone a long way toward bringing about the object for which it was designed. The interior of the shop presents an exceptionally attractive appearance and there is a noticeable freedom from congestion. The thought is evidently uppermost in each man's mind that a contest is in operation and that they are all after the big awards. Then as constant reminders, a number of notices are hung from the walls which read "Let's Keep Her Neat and Clean," referring, of course, to the machine and its environment. Whenever any complimentary correspondence is received from a customer commenting on the quality of the work produced or the promptness of shipment, or any other similar matter, the substance of such communications is made known to the men in the shop, if in the judgment of the management such a step will serve to encourage the men and enlist their cooperation.

* * *

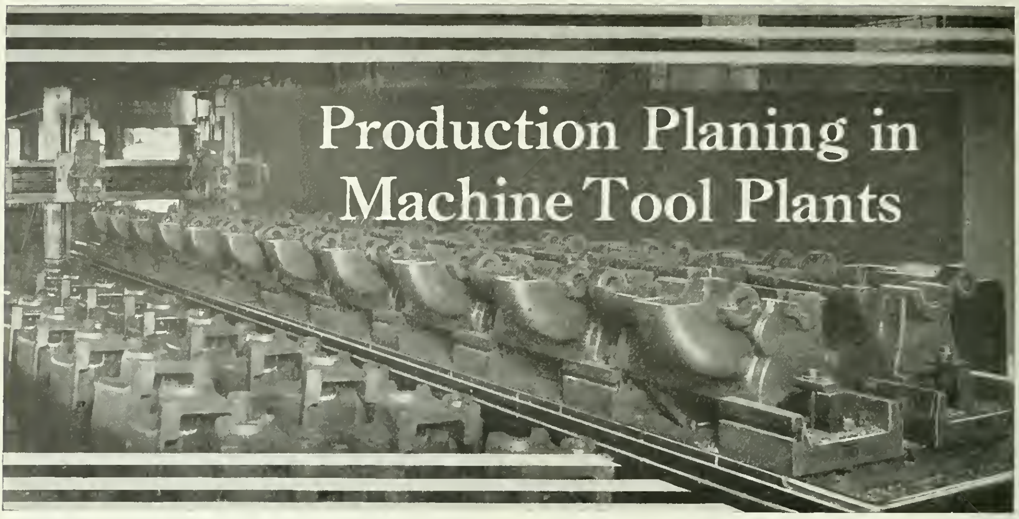
FOREIGN TRADE FINANCING CORPORATION

At the meeting held in Chicago last December under the auspices of the American Bankers Association, which was attended by representatives of finance, industry, and agriculture, it was decided to form a Foreign Trade Financing Corporation with an authorized capital of $100,000,000 for the purpose of meeting the present critical situation with respect to the foreign trade of the United States. It is recognized that foreign buyers require longer credit than can be supplied under our present system, even when they are able to furnish adequate collateral securities. It is believed that the newly formed Foreign Trade Financing Corporation will result in increasing our export markets and will thereby encourage production. It is proposed that the extension of credit by the corporation shall be confined to countries where there is a stable government, and that the operations of the corporation should be confined to financing for the benefit of future foreign trade. The secretary of the committee on organization of the Foreign Trade Financing Corporation is William F. Collins, 5 Nassau St., New York City, from whom further information may be obtained by those interested.

* * *

AMERICAN SOCIETY FOR STEEL TREATING

The American Society for Steel Treating, which has been formed by an amalgamation of the two former steel-treating societies with headquarters in Detroit and Chicago, has now settled down in permanent quarters at 4600 Prospect Ave., Cleveland, Ohio. The society is constantly increasing its membership, particularly through the action of the local sections or chapters. The first chapter to be established since the amalgamation of the steel-treating societies into the present organization was that in Syracuse, N. Y., where seventy-six applications for membership were presented at the opening meeting. The Philadelphia chapter is conducting a campaign to double its membership.



Production Planing in Machine Tool Plants

Methods Used in the Shops of Representative Engine Lathe Builders—Second of a Series of Articles

By EDWARD K. HAMMOND

PLANERS find extensive application in the shops of engine lathe builders, for use on such work as the machining of the ways of lathe beds; for planing the V-bearings in headstocks, carriages, and tailstocks, which fit the ways on the bed; for the planing of various slide bearings; and for the performance of numerous similar operations on the larger castings. In the first installment of this series of articles, mention was made of the fact that methods of production planing used by machine tool builders are probably as efficient as any that will be found in American machine shops, and this is particularly true of the work done in lathe-building plants. Manufacturers of this type of machine tool had for years been using methods that were well up to the average, but owing to the excessive demand for their product which arose during the war, production efficiency became so imperative that many methods formerly regarded as good enough were greatly improved to stimulate rates of output.

In the quantity production of duplicate parts, jigs and fixtures are almost universally employed for the maintenance of dimensions within limits that assure interchangeability. Furthermore, the application of such means for locating successive pieces for machining makes possible the saving of a great deal of time in setting up work on the machines. In planing operations, however, it is quite a general practice to set the work directly on the platen, dependence being placed upon the skill of the planer-hand to set up his job in such a way that the required degree of accuracy will be secured. In handling heavy work, it frequently happens that the weight of the piece to be planed and various other considerations prevent the employing of a work-holding fixture. Hence some users of planers seem to believe that it is not practicable to use fixtures on the planer; but this is not the case, and in this article a number of good examples are shown of the use of fixtures that locate the work without calling for as much care from the planer-hand as would otherwise be required, and that also save a great deal of time.

Planing Beds of 16-inch by 6-foot American Lathes

A typical example of the way in which quantity production methods have been applied in the performance of planing operations on lathe parts is shown in Fig. 1, which illustrates a 72- by 60-inch planer with a 40-foot table, built by the American Tool Works Co., Cincinnati, Ohio, and used in this company's plant for the performance of planing operations on American 16-inch by 6-foot lathe beds. Reference to this illustration will reveal the fact that there are twenty-four lathe beds set up on this planer at a time, the work being arranged in four parallel rows with six castings in each row. It will be seen that there are three heads on the cross-rail of the planer and two side-heads, all of which are frequently operated simultaneously. Such a procedure affords a possibility of attaining truly efficient results in the performance of production planing operations.

How the Work is Set up

Prior to the performance of the planing operation illustrated in Fig. 1, the lathe bed castings have been planed on their under side, which is used as a locating point. A better idea of the way that the castings are held on this planer will be gathered by reference to Fig. 2 which shows a close-up view of the tools and work. Here it will be seen that each casting is supported by two fixtures *A*, which are finished on their top surfaces to receive the previously planed under side of a lathe bed. Paper packings are used between the fixtures and the work, for the double purpose of providing a perfectly firm foundation and of accurately leveling up the work for planing. Each casting is held down by straps which secure a hold in the space on the inside of the lathe bed, so that they are not shown in the illustration; and each piece of work is lined up for planing by making measurements from the edge of the planer table. To prevent sidewise motion, planer table stops are placed inside of the work at each corner; and at the end of each of the four rows of lathe bed castings, larger sized stops are provided to support the thrust of the tools and to prevent endwise motion of the work. Between adjacent castings in each row, there are spacing blocks and sheet-metal packings which transmit the retaining force of the end stops.

Sequence in which Operations are Performed

The following outlines the sequence in which planing

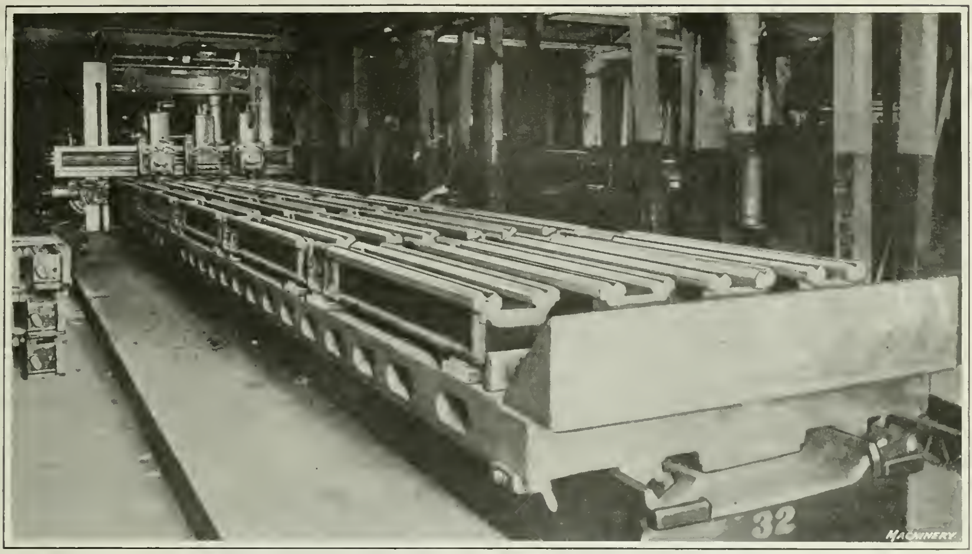


Fig. 1. Planer equipped for simultaneously planing Twenty-four 16-inch by 6-foot Lathe Beds

operations are performed on these lathe bed castings: A roughing cut is first taken on the tops of the V-bearings with multiple tool-holders in the rail-heads, carrying round-nosed cutter bits, as shown at *B* in Fig. 2, which provide for working simultaneously on three faces of the work. Next, a tool-holder carrying two round-nosed cutter bits is set up in each of the two outside rail-heads to provide for taking a roughing cut in the spaces between two V-bearings. With these tools, two rows of castings are first planed, and then the rail-heads are set over to plane the other two rows. Then the tops of the V-bearings are spotted ready for subsequent work which is to be performed on their angular sides, this cut being taken with square-nosed tools of 3/16-inch face width carried by the rail-heads.

For taking a roughing cut on the inclined sides of the V-bearings, use is made of round-nosed tools held in the rail-heads which are set at an angle, so that the feed movement of the heads can be utilized to run these tools down the sides of the work. Next, a roughing cut is taken on the vertical sides of the lathe bed adjacent to the V-bearings, using a tool-holder carrying twin round-nosed cutter bits in each of the rail-heads, and a single tool-holder in each of the side-heads. In this way, the twin tools carried by the rail-heads simultaneously plane the sides of adjacent castings, while the tools carried by the two side-heads plane the remaining outer sides of the castings in the outside rows.

For rough-planing the under-cut below the V-bearings, use is made of tool-holders of the form shown at *D*, which are carried by the rail-heads, each of these holders having its cutter bit extending out sidewise, so that it can reach under the shoulder below the V-bearing and plane this face of the work. In performing the present operation, a roughing cut is taken on the outside of the castings, while roughing and finishing cuts are taken on the inside. The tools used for this purpose have a spring relief for the cutter bit, which acts in a manner similar to the clapper-box of a planer, thus allowing the tools to relieve themselves during the return stroke of the planer table.

Next in the order of planing operations on these lathe bed castings comes the finish-planing of the tops of the V-bearings with square-nosed gooseneck tools in the rail-heads, and then the rough-planing of horizontal pads that are provided between the bearings at the head end of the lathe, two round-nosed tools being used in the rail-heads to plane the first two rows of castings and then the other two rows. The next step is to take a "straightening out" cut on the V-bearings, using shearing tools that extend across the face of the work and take a cut of from 0.002 to 0.004 inch in depth. One of these tools is shown at *I*, where it will be seen that it is of the so-called spring type, so that there is no danger of the cutting edge digging into the work. The forging is done in such a way that the cutting edge of the tool extends right across the surface of the work to be planed, and this edge is set at an angle to the line of travel of the work on which it is operating, so that a shearing action is obtained which leaves a good smooth finish. These tools are carried by the rail-heads.

There is a vertical slot to be planed in each casting, and this is done with square-nosed tools of the required width, which are carried by the rail-heads and fed straight down into the work. Then comes the planing of a clearance angle between the vees with square-nosed tools in the rail-heads; and after this has been accomplished the vees are finish-planed with gooseneck tool-holders having V-shaped cutter bits that simultaneously plane the entire surface of a vee and thus assure the accuracy of its form.

Following the performance of this operation comes the finish-planing of vertical surfaces on the inside and outside of the lathe beds, using shearing tools or so-called "side finishing" tools of the type which have a cutting edge of sufficient width to extend over the entire surface to be planed, so that they are able to take a light shearing cut which gives a very fine finish. These tools are carried by the rail-heads. The pads between the vees at the head end of each lathe bed are next finish-planed with square-nosed tools in the rail-heads, after which the under-cuts beneath the dovetail bearings are finish-planed with shearing tools carried by swivel tool-holders in the rail-heads, these tools being of the same kind that were used for performing the roughing operation. Finally, the tops of the vees are rounded with formed tools carried in the rail-heads.

Earlier in this discussion of the sequence of operations performed on these lathe bed castings, statements were made concerning the way in which either two or three of the rail-heads are used at the same time; also, it was learned that in certain cases, all three of the rail-heads and the two side-heads are operated simultaneously. In each case, it is the desire to have the greatest possible number of tools at work, the procedure always being governed by the number of surfaces to be planed on four rows of lathe bed castings and by the locations of these surfaces. For instance, in planing the vertical sides of the lathe bed castings adjacent to the vees, it was possible to operate all three rail-heads and the two side-heads simultaneously, because twin tools in the rail-heads were utilized to engage the three pairs of sides between adjacent rows of castings, while single-point tools carried by the two side-heads plane the outer sides of the two outside rows of castings. In this way, provision is made for simultaneously planing both sides of the castings in all four rows.

On the other hand, rough-planing of the pads located between the ways at the head end of the lathe beds, is done with single tools carried by two rail-heads, the procedure being to first plane the pads in two rows of castings and then to set the heads over on the rail to plane the pads on castings in the other two rows. Evidently, there would be no advantage in using three rail-heads on this job, as one head would subsequently have to be set over to plane the pads in the fourth row of castings. This general discussion of the procedure followed in performing two typical operations should enable the reader to understand how the tools are distributed for taking other cuts on these castings, without requiring further description of the set-up.

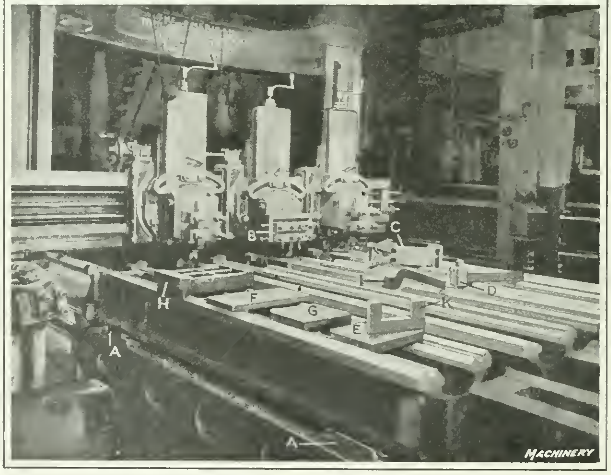


Fig. 2. Close-up View of Tools and Work on the Machine shown in Fig. 1. Attention is called to the Fact that Various Tools are shown set up for Purposes of Illustration; actually, these Tools are used in Sequence

Reference to Fig. 2 will convince any experienced planer-hand that the tools which have been developed for the performance of these planing operations have been carefully designed with a view to expediting production. Little thought need be given to this subject to realize that with multiple tool-holders of the types which are shown set up in the planer heads or lying on the work, and with provision for having as many as five tools operating simultaneously, very satisfactory rates of output can be realized. Doubtless there are many planer-hands who have not had occasion to use formed tools for such work as finish-planing dovetailed bearings. Such tools can be used with very satisfactory results for the planing of work that is required to have two or more surfaces finished in definite relationship to each other. The principle involved in the design of these tools is really nothing more than the reversal of one that is commonly used in dovetail finishing tools, which are fed into the work to plane the inclined side and bottom faces of the bearing. It will be apparent that the principle of the V-bearing finish-planing tool is identical, except that in the present case the tool embraces both sides of the work, instead of having the work encompass two sides of the tool.

Gages for Testing Accuracy of the Finish-planed Lathe Beds

In the preceding discussion, emphasis was laid on the fact that the tooling up of this planer has been worked out along lines which expedite rates of output. But it is also required to hold finish-planed faces within close limits of tolerance, and in Fig. 2 there are shown gages employed for testing the accuracy of the finished product. Gage *E* is furnished with two inclined parallel gaging faces which contact with corresponding sides of the V-bearings at opposite sides of a lathe bed, to provide for measuring the spacing between these bearings. This gage is used in conjunction with tissue paper feelers that are cut in strips measuring about 1/4 inch wide by 2 inches in length. Two of these strips are placed at the top and bottom of each V-bearing to be tested, and with the papers in these positions, the gage is required to hold all four of them in place. Thus it constitutes a test for both the alignment and inclination of the sides of the bearings, and if any of the four tissue papers is not firmly held in place under the gage, it indicates an error exceeding 0.001 inch, and such a lathe bed will have to be replaned until the test can be conducted with satisfactory results. Gage *E* is used for testing each side of the two inner V-bearings, and a gage *F* of identical design provides for conducting similar tests on the outer pair of V-bearings.

Two other gages *G* and *H* are used, respectively, for testing the bearing of the inner and outer pairs of vees on the work. For this purpose the bearings on the gages are rubbed with crayon or red lead, and the excess material is removed, after which gage *G* or *H* is put in place and rubbed along the work in order to ascertain whether a uniform contact is secured at all points. Gages *G* and *H* have on their under sides two gaging points which duplicate the contact of the bearings on the lathe headstock, carriage, or tailstock; that is to say, the fixed points on these gages which contact with the work correspond to the bearings which will subsequently rest on the vees. If the ways on the lathe bed contact uniformly with these gages, satisfactory results will be obtained when accurately planed headstocks, tailstocks, and carriages are assembled on these beds. A snap gage *K* is used for testing the width from the inner to the outer vertical face of each pair of V-bearings planed.

Setting up Large Lathe Beds on Planer

Bearing in mind the wide range of sizes in which lathes are built, it will be apparent that methods of planing the bed castings must be substantially modified to meet the requirements of different sizes of work. This fact is well brought out by a comparison of Figs. 1 and 3, the latter illustration showing the set-up of a planer built by the G. A. Gray Co., Cincinnati, Ohio, which is used in the plant of the Lodge & Shipley Machine Tool Co., in Cincinnati, for the performance of planing operations on the bed of a 48-inch engine lathe. In handling large heavy castings of this kind, it is not found practical to set up more than one at a time; and owing to the great length and weight of the work, care must be taken to support it in such a way that there will be no distortion to subsequently affect the accuracy of the results obtained in planing.

So far as the actual performance of successive operations in the planing of large lathe beds of this kind is concerned, there is no point that differs sufficiently from the methods covered by the previous description to call for further discussion. In the present case we are interested merely in the setting up of the casting for planing. As it is delivered from the foundry to the machine shop, each casting first has its under side planed, and this face is then available as a locating point in setting up the casting for subsequent planing operations that have to be performed. Three parallel blocks are first placed on the planer table, in such positions that two will come under the corners at one end of the casting and one will come under the center of the opposite end of the casting as it is lowered to the planer table. The casting is then lined up from the edge of the planer table. Next in the method of procedure in handling this job comes the laying off on the end of the work nearest to the planer cross-rail the various surfaces that have to be machined on the lathe bed casting, so that prior to the starting of any cuts, assurance is obtained that not only will all surfaces clean up properly, but that they will also be centrally located relative to the side walls of the casting.

After this point has been reached, the procedure in setting up becomes distinctly different for a long heavy lathe bed than it is for a short piece of work which is not of sufficient weight to cause a serious amount of sag at the center. Despite a somewhat general impression that large pieces of iron or other metal are quite rigid, a carefully conducted investigation of such a set-up as the lathe bed now under discussion would reveal the fact that there is a very appreciable amount of sag at the center. To overcome this distortion, a practice is made of slightly raising the casting and placing parallel blocks at each side of the work at the center, and then at various points along each side between these center blocks and those which were first placed under the end of the work.

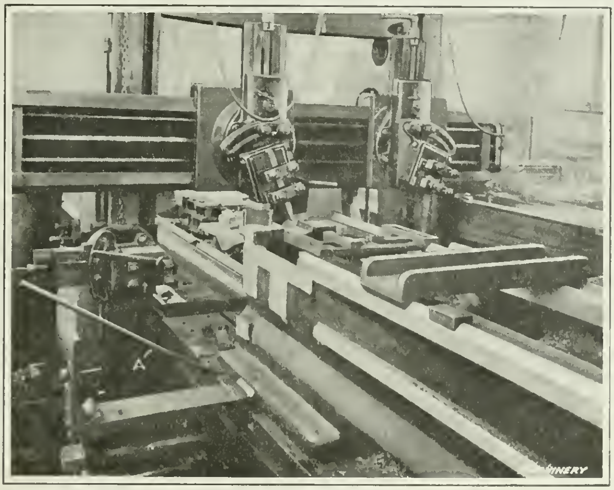


Fig. 3. Close-up View of a Large Lathe Bed that is being planed, showing Method of setting up and Gages for testing Finished Work

Next comes the placing of packing papers between the blocks and the work, their purpose being to assure a perfectly uniform and solid foundation. After an equal number of papers have been placed between each block and the work, the planer-hand proceeds to use what is known as a "pinch-bar," shown at *A* in Fig. 3, with which he is able to pry up the casting at a point adjacent to each block and test the degree of tension with which the packing papers are held between the block and work, for a given amount of pressure applied at the outer end of the pinch-bar. The planer-hand applies pressure on the end of the pinch-bar with his right hand and tests the packing papers with his left. Following this procedure he adds or removes packing papers from between the various blocks and the work until a condition has been reached where the papers are held with a uniform tension on each block. This assures that the casting is uniformly supported at all points and that there are no points where the casting has sagged down sufficiently to cause a serious amount of distortion, which will subsequently affect the accuracy of the work.

Planing Headstock Castings of Lodge & Shipley Lathes

In the title illustration of this article, there is shown a 54- by 54-inch widened pattern G. A. Gray planer with a 30-foot table, on which twenty-two headstock castings for 20-inch Lodge & Shipley lathes are set up for the performance of planing operations on these pieces; and lying beside the machine there is shown another lot of castings which have been delivered so that they are ready to be set up as soon as the machining of the previous load of pieces has been completed. A more definite idea of the way in which these castings are held for planing will be gathered from Fig. 4 which shows a close-up view of four of the castings and of one of the setting-up fixtures that are used in connection with this job. As all experienced planer-hands know, it is quite a general practice to set the work directly on a planer table or in very simple forms of holding fixtures that are of little or no assistance in locating the castings, and it is for this reason that a considerable amount of skill and judgment is often required of the planer-hand in setting up his work, before the actual machining operations are commenced.

Use of Fixtures to Facilitate Setting up the Work

A noteworthy feature of the present job, and of the equipment of this machine, consists of the provision of work-holding fixtures that relieve the operator of much of the responsibility ordinarily connected with the setting up of planer work. These fixtures also enable the work to be set up far more rapidly, thus expediting rates of output. The setting up of this job is more like the procedure followed in loading work on a milling machine, or on one of the other types of machine tools commonly used for the quantity production of duplicate parts. Only through the use of such means can the planer attain its maximum rate of output.

Fig. 4 illustrates the Lodge & Shipley headstocks held ready for performing the first planing operation, and the method of setting them up in the fixtures is as follows: The castings are lowered into place on the heads of three adjustable screws which engage the under side of the work. In addition to the work-holding fixtures that are shown in place on the planer table, one fixture *A* is illustrated lying unloaded at the end of the machine, in order to more clearly show its design; and at *B* there is illustrated one of a pair of locating arms that are employed in setting up the work. Reference to this illustration will make it apparent that cut in the right-hand vertical side of the work-holding fixture there is a T-slot which serves the double purpose of receiving a locating tongue carried by the bracket on arm *B* that rests on the side of the fixture, and also of holding the head of a bolt by means of which the locating arm is clamped in place on the fixture. The nut which fits over this bolt is in the form of a handwheel *C*, so that after the arm *B* has been slipped over the bolt with its tongue in the groove in the fixture, wheel *C* is screwed on the bolt to provide for clamping the arm in place.

At the top of arm *B* there is a bell D_1 which fits over one of the back-shaft bearing bosses D_2 on the work. It will be seen that two adjacent work-holding fixtures *A* support the opposite ends of a headstock casting, and the method of procedure in setting up the work is to secure two locating arms *B* to these two adjacent work-holding fixtures, so that the bells D_1 on these two arms can receive the two back-shaft bearing bosses D_2 on the casting and afford a temporary means of support. As the casting is hung in the bells on these arms, it swings downward until further movement is checked by having its side wall come into contact with stop *E* provided inside of the fixture for that purpose. Then two

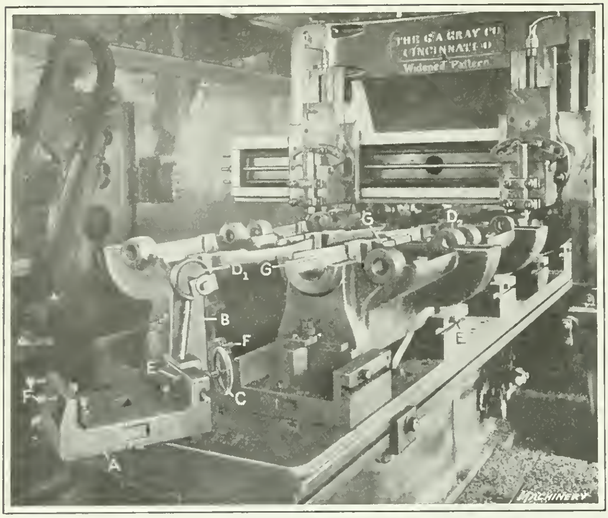


Fig. 4. Close-up View of Lathe Headstock Castings and Planer Tools. The Entire Set-up for this Job is shown in the Heading Illustration

screws *F* at the opposite side of the fixture are tightened in order to hold the work securely against sidewise movement, after which the three adjustable screws under the work are raised until they come into contact with the bottom of the casting.

With the work located and held in this manner, the two locating arms *B* can be removed and employed in setting up the next casting of the string, this method of procedure being continued until all of the twenty-two castings have been set up in two parallel rows. It will be evident from the illustration that two castings in the two rows are reversed end for end, so that the back-shaft bearing bosses are at the outside of the row in each case. After all of the castings have been located in this way, they are clamped down with the familiar form of straps held by bolts in the planer table T-slots, and then jacks are put between adjacent castings in each row to support the work against the end thrust of the tools. Finally, large jacks are placed at the end of each row of castings to support the entire thrust load.

Sequence of Planing Operations

Planing operations to be performed on these castings consist of finishing the two fits *G* for the spindle bearing caps and the fit for the joint between the headstock cover and the main part of the casting, which is the piece shown in process of planing in Fig. 4. On these operations three cuts are taken, namely, a roughing, a straightening out, and a finishing cut, the roughing cut being taken with a round-nosed tool, while square-nosed tools are used for straightening out and finishing. All three operations are performed at a cutting speed of 55 feet per minute, with a feed of 1/16 inch for roughing, and hand feed for straightening out and finishing, varying from ½ to 1 inch according to the position at which the tool is working.

In taking the roughing cut, about 0.020 inch of surplus metal is left, of which 0.015 inch is removed by the straightening out cut and 0.005 inch by the final finishing operation. A high degree of accuracy is not required, except on the seats for the spindle bearing caps, and after the finish-planing operation has been performed on these fits *G*, the work is tested with "Go" and "Not Go" gages that call for accuracy within 0.002 inch. The same equipment is used for planing various sizes of Lodge & Shipley lathe headstock castings, but it is necessary to have special locating arms *B* for each size of work. For the 20-inch lathe headstock castings which are shown, the production time for setting up and planing twenty-two castings is eight hours. On the smallest sizes, it is possible to set up twenty-six pieces of work, while only fourteen of the largest sized headstock castings can be set up on the planer table at a time.

Planing Base of Tops for Lathe Tailstocks

One type of tailstock used on Lodge & Shipley lathes has a lower member that is secured to the ways on the bed of the machine and a top member which is located on the lower portion of the tailstock by means of a tongue and groove joint. Fig. 5 shows a 36- by 36-inch extra heavy pattern G. A. Gray planer with a 24-foot bed, which is equipped for holding a string of eighteen of the upper tailstock members for 18-inch lathes while the base and tongue joint are being planed on these pieces. This set-up represents another example of the possibilities of tooling up a planer for performing repetition work, in such a way that the fixtures relieve the operator of a large part of the responsibility of obtaining accurate settings. In the present instance, the method of locating the work is as follows: Fig. 5 shows a fixture that provides for holding three castings, and six of these fixtures are set end to end along the planer table to hold eighteen pieces of work.

Each casting *A* is inverted and held in place in the fixture by the spindle bearing bosses that are dropped into V-blocks *B*, after which the casting is swung backward so that it rests against a bracket *C*; then a screw carried by the corresponding bracket in the next section of the fixture at the front of the casting is tightened up, to hold the work firmly in place against this locating point. Finally, two screws *D* are tightened on the top of the spindle bearing boss at each side of the fixture, to hold the work against any tendency toward lifting. In order to locate successive pieces of work in this manner, the method of procedure that is followed consists of setting up the casting nearest the cross-rail and

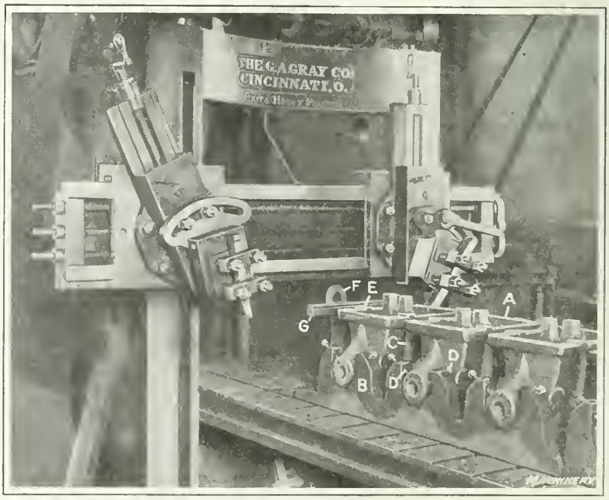


Fig. 5. Close-up View of Tools and Work on Machine used for planing Base of Top Castings for Lathe Tailstocks

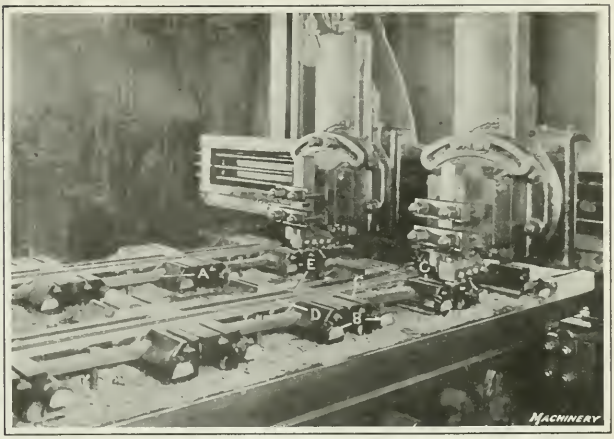


Fig. 6. Application of Multiple-cutter Tool-holders for performing Planing Operations on Lathe Carriages

working to the opposite end of the row of fixtures, in order that there may be plenty of room for tightening up the screws to locate the work securely in place against the brackets *C* on the string of fixtures.

Planing Operations to be Performed

So far as the actual planing is concerned, this is quite a simple operation, consisting of merely planing the flat lower face of the tailstock castings and the tongue which locates the upper casting on the base of the lathe tailstock, in which a corresponding groove has been machined. The usual sequence of round- and square-nosed tools is utilized for the performance of roughing, straightening out, and finishing operations on these castings, this work being done at a cutting speed of 55 feet per minute for all operations, with a feed of 1/16 inch for roughing, and hand feed for straightening out and finishing at the rate of from ½ to 1 inch according to the location. The straightening out cut removes about 0.015 inch of metal, leaving 0.005 inch for the final cut.

Prior to taking the straightening out and finishing cuts, a practice is made of loosening the four clamping screws *D* and the screw which holds each piece of work back against locating bracket *C*, so that the work may be reset to remove any strains which may have been produced by the pressure of these screws. In resetting for taking the two final cuts, the screws need not be tightened to the same extent that was necessary for holding the work for taking the heavy roughing cut. This is an important point in improving the accuracy that is obtained in the performance of planing operations of this general character. The only part of the work that has to be finished to a high degree of precision is the tongue *E* which must be finished within 0.001 inch of the specified size. For checking the accuracy of this part of the work, a snap gage *F* is used. A master form *G* is provided to facilitate the setting of the tools; and the work-holding fixtures are located by tongues on their under side that enter the T-slots in the planer table. On this job the time required to complete the planing operation on eighteen of the tailstock castings is from six to seven hours.

Planing Carriages for 14-inch American Engine Lathes

Fig. 6 shows the use of a 60- by 48-inch American planer with a 26-foot table, which is used in the American Tool Works Co.'s plant, for planing the carriages for 14-inch lathes of this firm's manufacture. Thirty castings are set up on the machine in two parallel rows, and the end casting of each row is carefully lined up and located in that position by means of stops, after which parallel packings are placed between adjacent castings in the row, thus obtaining their approximate location from the setting of the first piece in each row. Tests of the setting of each casting are then made, and paper packings are used to supplement the spacing blocks in order to have each piece of work accurately located. Also, it is necessary to test from the bottom of the casting to the top, using a surface gage to make this measurement from the planer table, in order to be sure that each casting will clean up properly. After the work has been set up and tested in this manner, straps *A* are used to hold the castings down.

The sequence of operations performed on these pieces of work consists of planing the ends *B* of the dovetail bearings, faces *C*, dovetail *D*, and clearance face *E*. On each surface, one roughing cut and one or more finishing cuts are taken, it being required to finish the work within a tolerance of 0.0005 inch. All roughing cuts are taken at a speed of 45 feet per minute, with a feed of ⅛ inch at the ends of bearings *B*, ½ inch on faces *C* and *E*, and 1/32 inch on dovetail *D*. For taking the finishing cuts, the same speed is employed with a feed of ½ inch at *B*, ¾ inch at *C*, ⅜ inch at *D*, and a shearing cut over the full width of face *E*. The production time for planing thirty of these castings is approximately thirty-two hours.

Fig. 6 shows the work of rough-planing surface *C* of the castings with a gang tool-holder made by the Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill. It will be seen that two rail-heads are in use, with one of these tool-holders in each head, thus providing for simultaneous operation on both rows of castings. Each of these tool-holders is furnished with four cutter bits which are staggered, so that they reach over a considerable width, the bits being set to take a progressively deeper cut from right to left. In this way they divide up the depth of chip, thus relieving the severity of the service required of the planer tool and removing from the work-holding clamps a substantial part of the load which they would otherwise be called upon to carry. The familiar types of round-nosed roughing tools, square-nosed finishing tools, and dovetail planing tools are used for the other operations on the castings.

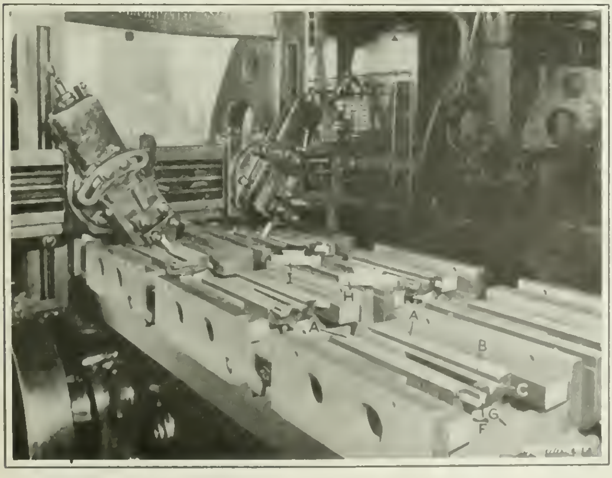


Fig. 7. Close-up View of Two-position Fixture used for holding Lathe Top Slides for planing the Dovetailed Bearing and the Under-cut Fit for the Tapered Gib

Planing Under Side of Top Slides for 18-inch American Engine Lathes

A planing operation is illustrated in Fig. 7 which is of interest for two reasons: First, because it constitutes a good example of the degree of accuracy that can be attained in the performance of planing operations, and second, because the design of the work-holding fixtures has been developed along lines which afford a convenient means of planing one surface at a specified taper angle to another face of the work. The machine is an American 36- by 36-inch by 18-foot planer, and it is shown in operation in the American Tool Works Co.'s plant, planing the top slides for 18-inch lathes of this firm's manufacture. With this general statement as an introduction, we are in a position to enter upon a detailed description of the way in which successive planing operations are performed.

As the castings come to this machine, they have been milled on what is normally their top side, although this milled surface constitutes the base on which these pieces are held in the planer fixtures; also, the edges of the castings have been finish-planed. Each of these castings is supported in its fixture on the previously milled under side, after which clamps engage the finished side faces of the work and secure it firmly in place. In order to assure uniform support, paper packings are used as explained in connection with set-ups previously described. As held in the present fixture, the operation consists of planing on each casting two horizontal faces *A*, the inclined side *B* of the dovetailed bearing which is parallel to the previously planed edges of the work, two faces (one of which is shown at *C*) at the bottom of the dovetailed bearing, and the edge *D* of the opening for the dovetailed bearing, which is inclined at a taper angle to the edges of the work that were previously planed.

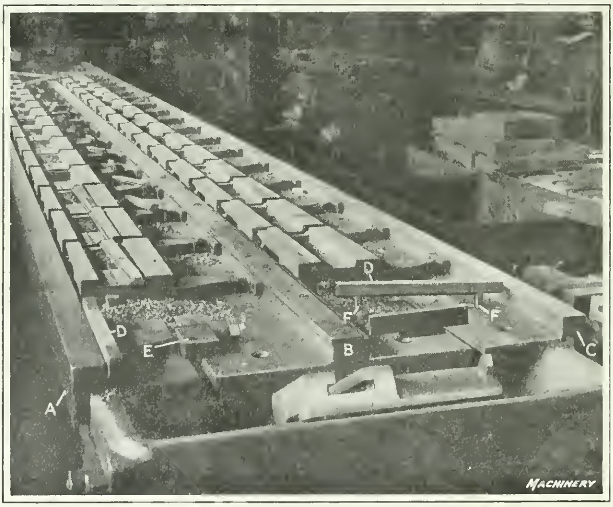


Fig. 8. Another Arrangement of a Planer for planing Lathe Top Slides and the Tapered Gibs that fit into these Slides

Planing an Under-cut to Receive a Tongue on the Gib

Next in the order of operations comes the planing of an under-cut *E* which is located at an angle to receive the tongue on gib *F*. It is the fit between the under-cut *E* and the tongue on gib *F* that constitutes an example of the accuracy that can be obtained in the performance of planing operations, provided the necessary care is taken in handling the work. The method of procedure in planing these top slide castings is to drive the previously planed tongue on the gib into the groove *E*, and then depend upon the fit between these two members to hold the gib in place, so that one side of a dovetailed bearing can be planed on it, parallel to the side *B* that has already been finished. The order in which these operations are performed is important. First, faces *A*, *B*, and *C* are planed; and then the clamping bolts are loosened and the fixture is swiveled on its pivotal support to a second position which inclines the work at an angle to its previous setting that is equal to the angle that it is required to finish on the work, after which the clamping bolts are tightened and edge *D* and under-cut *E* are rough- and finish-planed.

Driving the Gib Tongue into the Groove Planed in the Slide

As they are delivered to this planer, the gibs have had the tongue planed on them, so that they are ready to be driven into place in the top slide in the manner shown in Fig. 7. When this has been done, the work-holding fixtures are once more swiveled back to their normal positions, after which the top surface of gib *F* is rough-planed. Then scaling from the finish-planed edges of the work, the sides of the dovetailed bearing are accurately laid out and side *G* of the bearing is rough-planed, after which the top surface of gib *F* is finish-planed, and finally the sides *B* and *G* of the bearing are finish-planed. In this way the two inclined sides *B* and *G* of the dovetailed bearing are planed parallel, while the fit of the gib in the slide is tapered, so that longitudinal movement of the gib will result in affording the familiar adjustment of the fit of the slide.

Referring again to the design of the work-holding fixture, attention is called to the fact that each fixture is carried by a pivotal support and furnished with adjusting screws that provide for swinging each fixture about its pivot to engage either of two locating stops which set the fixture and work carried by it to provide for planing either of the two sets of surfaces on the castings that are to be finished at specified angles to each other. There are eighteen of these fixtures set up on the planer table in two rows containing nine fixtures each.

Finish-planing operations are performed on the two inclined sides of each dovetailed bearing until it fits the sheet metal templet *H*, and finally the form of the bearing is tested with a block gage *I* that is used with red lead. In performing the planing operations on these parts, dimensions must be held within a tolerance of 0.0005 inch in the dovetailed bearing, and the operations are performed in the following manner: Roughing cuts are taken at a speed of 60 feet per minute, with a feed of 1/16 inch on all faces except the inclined sides of the dovetail, where a feed of 0.006 inch is employed. For finishing, the same speed is used with a feed of ⅜ inch on all faces except the inclined sides of the dovetail, where hand feed is utilized. In taking the roughing cut, 0.030 inch of metal is allowed for subsequent finishing cuts that may be required, in order to bring the bearing to a fit on the gage *I*. The production time on this job is eighteen and three-quarter hours for planing eighteen castings.

Comparison of Practice in Planing the Under Side of Lathe Top Slides

It is always interesting to compare the methods used in different shops for the performance of the same machining operation, and an opportunity of so doing is presented by the jobs illustrated in Figs. 7 and 8. Of these, the former shows methods used by the American Tool Works Co., for planing the under side of top slides for engine lathes, and in Fig. 8 there is illustrated the equipment of a G. A. Gray planer used at the plant of the Lodge & Shipley Machine Tool Co. for performing the same operation. In so far as the method of planing the tapered fit for the gib is concerned, the procedure is the same in both cases.

Also both shops plane the dovetailed side of the gib after the tongue has been driven into the under-cut planed in the slide casting for that purpose. It is in the methods of setting up the work to obtain the required locations for performing successive operations that the methods of these two machine tool building plants are different; and this is where the interesting comparison comes in.

Equipment of a Single Planer for Handling Two Production Jobs

In the present case it will be seen that thirty-eight top slide castings for Lodge & Shipley lathes are set up in two parallel rows, but at the outset attention is called to the fact that the practice in equipping this planer differs from that of the case shown in Fig. 7, because the same machine is provided with means for planing both the top slide and the fit on the gib that enters the groove planed in the top slide for that purpose. At the time that the gibs are being planed, thirty-eight of these castings are set up on the machine in two parallel rows, the method of making this setting being shown at *D* in Fig. 8, where one gib has been put in place in order that the procedure which is followed may be readily understood.

Secured to the planer table, it will be seen that there are three parallel strips *A*, *B*, and *C*. Strips *A* and *B* are utilized as locating points against which either the gib castings or the top slide castings are located, while thrust members for holding the top slides against these strips are abutted against the left-hand sides of strips *B* and *C*, respectively. For holding the gib castings *D* in place, it will be seen that similar clamping members are provided, except that the pressure for holding the work is secured by means of stops *E* which are located in the table T-slots and furnished with thrust screws. The gibs are held edgewise, so that the fit and tongue for anchoring the gib in the top slide may be planed. One of the gib castings is shown standing crosswise on the planer table, where it will be seen that two legs *F* are cast on each gib, these legs being utilized as points against which the clamps grip the work. After the planing operation has been completed, these legs are broken off the gibs so that they may be assembled into the top slide ready for planing the dovetailed bearing on the side of the gib from which the legs were broken off.

Pivoted Work-holding Fixture versus Tapered Setting Strip

It will be recalled that according to the method of procedure followed in planing top slides for American lathes, each work-holding fixture was supported on a pivot and arranged with two limit stops that controlled the distance that it could be swung in either direction. In this way the work could be held in one position for planing the straight sides, after which the clamping screws were released and the fixture swung to its other extreme position, in order to locate the casting for planing the tapered fit for the gib. With the method of setting up this job in the Lodge & Shipley plant, a tapered bar is inserted between each piece of work and the parallel strips *A* and *B* to locate the work for taper planing. As these bars have the same angle as the tapered fit that it is required to plane in the top slide castings to receive the gibs, it will be apparent that the work will be planed to the required form.

As the top slide castings are delivered to this machine, they have been planed on what is normally the top, and the edges have also been planed. The order in which operations are performed is as follows: First, the castings are clamped against the tapered bars placed between the work and the locating strips *A* and *B* on the planer table, after which the fit is planed to receive the planed tongue on the gib. After this result has been accomplished, the gibs are driven into place and the work reset directly in contact with strips *A* and *B*. Then the dovetailed side of the gib is planed and also the dovetail on the opposite side. The other planing operations are performed at this setting. To obtain the required accuracy in setting the work, paper packings are used between the locating points on the planer table and the previously finished sides of the castings. For planing the fit on the gibs, it will be evident that only one setting of the work is required. After the description of planing operations performed on the job shown in Fig. 7, a detailed description of the sequence of cuts is unnecessary; but it may be mentioned that the dimensions are held within a tolerance of 0.0005 inch.

* * *

SAND-BLASTING WORK BEFORE GRINDING

Oxide scale produced on the surface of castings or forgings is considerably harder than the body of the metal; and where parts covered with such a scale have to be machined, the cutting tools are likely to become dull after only a short period of service. To overcome this difficulty it is quite a general practice to resort to the use of a sand-blasting machine for removing the scale; but it is probable that few mechanics have heard of using the same method of preparing work in which the inside of small openings has to be ground. This method has been adopted in the National Acme Co.'s plant in Cleveland, Ohio, for preparing raceways for ball and roller bearings that are to have the bore ground on internal grinding machines. After being machined, these pieces are subjected to a process of heat-treatment to give the desired physical properties to the steel, and the sand-blasting operation is next performed to remove the oxide scale produced on the work while in the furnace.

At the time when a decision was reached to sand-blast these pieces before grinding, the primary object was to effect an increase in the rate of production, and subsequent experience has shown that this increase amounts to fully 50 per cent, as compared with the time required for grinding raceways that have not been sand-blasted. Small grinding wheels used for precision internal grinding operations are more delicate and more likely to become "glazed" than larger sized wheels. If an attempt is made to grind work that is covered with a hard oxide scale, it is found that the grinding wheel requires dressing with a diamond at frequent intervals in order to remove the glazed surface which is no longer capable of cutting efficiently; and for that reason the removal of the scale from the work that is to be ground with such wheels becomes a matter of unusual importance.

It has already been stated that the rate of production has been increased 50 per cent by a preliminary sand-blasting operation. This saving is due to the fact that it is unnecessary to stop work as often in order to dress the wheel, and as a result the grinding machine is able to operate for longer periods without interruption. Another important saving resulting from the sand-blasting operation is that the working life of each wheel, that is, the amount of service obtained before the wheel is worn out, is substantially increased. Average results show that at least double the amount of service is obtained from each wheel where it starts work on the clean metal surface without being required to first remove a hard outer layer of iron oxide scale.

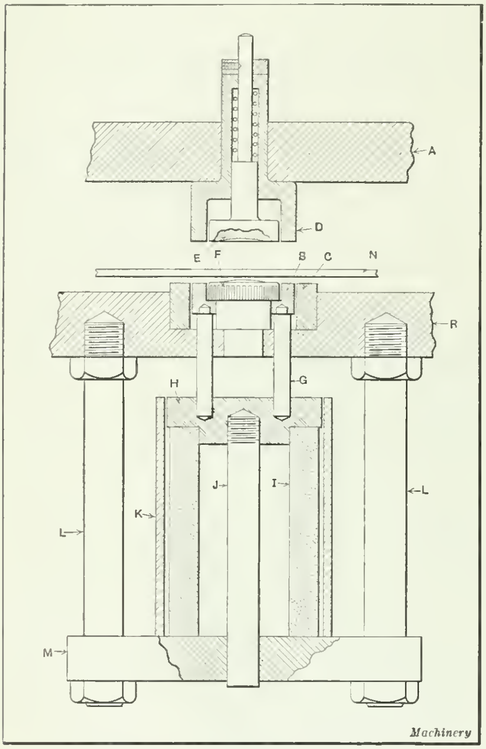
* * *

SWISS MACHINE TOOL REQUIREMENTS

The Swiss Government is planning to electrify a number of the Swiss federal railways, the sum appropriated for the first ten years being 125,000,000 francs annually. The intention is to make most of the electrical machinery and equipment required for this work in Switzerland, and it is stated that the Swiss firms that will build the electrical equipment will require machine tools in considerable quantities. It has been pointed out that the electrical development of the Swiss railroads will enable modern labor-saving machines to be sold in Switzerland even with the present adverse exchange.

PUNCH AND DIE FOR BLANKING AND FORMING METAL CAPS

The accompanying illustration shows a combination punch and die which was built to produce large quantities of metal caps for containers, such as bottles, cans, and jars. The operations of blanking, drawing, and forming the corrugations on the circumference of the cap are all performed with this die, which is of the four-post type, the upper and lower members being shown at *A* and *R*, respectively. The lower member holds the blanking die *C* and the forming punch *F*, while the upper member holds the blanking punch *D*, the inner surface of which performs the function of the female forming die. The lower end of plunger *E* also performs part of the forming operation. A drawing ring *B*, supported from beneath by four pins *G* which pass through the lower member and enter the ring *H*, exerts an even pressure on the work due to the provision of a rubber cushion *I*. The stud *J* serves as a guide, and is a sliding fit in a hole in tension plate *M*. Adjustment for tension is secured by tightening or loosening the nuts on rods *L*.



Blanking and Forming Die for making Metal Caps

In operation, the end of a roll of the steel from which the caps are made, is fed between the feed-rolls and under the stripper plate *N*. As the punch descends, plunger *E* forms the raised portion of the cap over punch *F*. Punch *D* next cuts the blank to the required size as it enters die *C*. The inner surface of *D* is fluted to correspond with the flutes on punch *F*. The size of these flutes is such that the metal fills them completely as die *D* passes down over punch *F*. The drawing ring *B* draws the blank as it is being formed, in order to insure an even flow of the metal. Experiments were made with several different forms of springs for exerting pressure on the drawing ring, but the rubber cushion *I* finally adopted was found to give better results than any of the springs that were tried.

The return stroke of the press allows the springs on the four posts of the sub-press to force the upper member back to the starting position. The spring surrounding plunger *E* exerts sufficient pressure to assist in extracting the cap from the female forming punch *D*, and the upper end of *E*, which comes in contact with the knock-out rod of the press, serves as a positive knock-out. A piece of steel tubing *K* is used to keep rubber cushion *I* from buckling, and it also serves to prevent oil from coming in contact with the rubber. An air hose, not shown in the illustration, is used for directing a jet of air on the caps as they fall from the upper die. The press is operated at a speed which gives a production of seventy caps per minute. B. S.

* * *

DIMENSIONS OF STRAIGHT FORMING TOOLS

The front face of flat and vertical forming tools is usually ground at an angle from the vertical so as to provide clearance for the tool and, on this account, a trigonometric calculation is involved in determining the depth to which the step on a tool must be ground in order that a step of the specified height will be formed on the work. This will be obvious from reference to the accompanying illustration, in which A represents the clearance angle, and X indicates the dimension usually desired in grinding the tool, this dimension being at right angles to the front face. The top surface of the forming tool is in the same plane as the horizontal center line of the work, and so dimension Y represents the actual distance between the radii of the two surfaces on the work being produced by means of the forming tool.

Dimension X for any case can be readily solved by employing the simple trigonometric formula $X = Y \cos A$. The accompanying tables are based upon this formula and upon clearance angles of 9 and 12 degrees, the 9-degree clearance angle being suitable for flat forming tools, and the 12-degree angle, for tools of the vertical type. These tables give the correct value of dimension X for any value of Y ranging in thousandths of an inch from 0.001 to 1.000 inch. They should prove advantageous to the draftsman when it is essential to specify dimension X on a drawing, or to the mechanic responsible for grinding the forming tool, as they eliminate the necessity of making the calculation mentioned, and thus reduce chance for error.

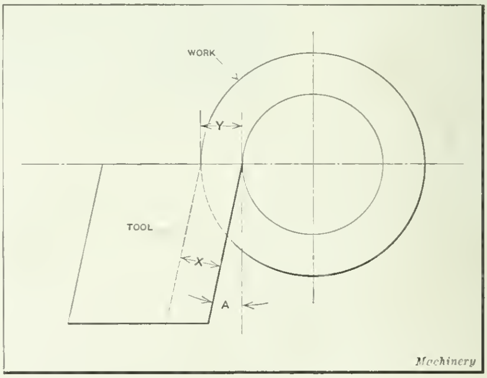


Diagram illustrating Application of Straight Forming Tools to Work

In order to illustrate in detail the use of the tables, assume that the difference Y between two radii on a piece of work is to be 0.500 inch and that the work is to be turned by means of a flat forming tool having a clearance angle of 9 degrees. Referring to the table, locate 0.500 inch in one of the Y columns, and in the corresponding X column for a clearance angle of 9 degrees, a value of 0.4939 inch will be found. If the clearance angle were 12 degrees, the value of X would be 0.4891 inch. F. C. S.

DEPTH OF STEPS ON STRAIGHT FORMING TOOLS MEASURED AT RIGHT ANGLES TO THE FRONT FACE, CORRESPONDING TO VARIOUS DIFFERENCES BETWEEN RADII ON THE WORK*

Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face	
	Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.
0.001	0.00099	0.00098	0.078	0.0770	0.0763	0.156	0.1541	0.1526	0.235	0.2321	0.2299
0.002	0.00197	0.00196	0.079	0.0780	0.0773	0.157	0.1551	0.1535	0.236	0.2331	0.2308
0.003	0.00296	0.00293	0.080	0.0790	0.0782	0.158	0.1560	0.1545	0.237	0.2341	0.2318
0.004	0.00395	0.00391	0.081	0.0800	0.0792	0.159	0.1570	0.1555	0.238	0.2351	0.2328
0.005	0.00494	0.00489	0.082	0.0810	0.0802	0.160	0.1580	0.1565	0.239	0.2361	0.2338
0.006	0.0059	0.0058	0.083	0.0820	0.0812	0.161	0.1590	0.1575	0.240	0.2370	0.2348
0.007	0.0069	0.0068	0.084	0.0830	0.0822	0.162	0.1600	0.1585	0.241	0.2380	0.2357
0.008	0.0079	0.0078	0.085	0.0839	0.0831	0.163	0.1610	0.1594	0.242	0.2390	0.2367
0.009	0.0089	0.0088	0.086	0.0849	0.0841	0.164	0.1620	0.1604	0.243	0.2400	0.2377
0.010	0.0099	0.0098	0.087	0.0859	0.0851	0.165	0.1630	0.1614	0.244	0.2410	0.2387
0.011	0.0109	0.0108	0.088	0.0869	0.0861	0.166	0.1640	0.1624	0.245	0.2420	0.2396
0.012	0.0118	0.0117	0.089	0.0879	0.0871	0.167	0.1649	0.1633	0.246	0.2430	0.2406
0.013	0.0128	0.0127	0.090	0.0889	0.0880	0.168	0.1659	0.1643	0.247	0.2440	0.2416
0.014	0.0138	0.0137	0.091	0.0899	0.0890	0.169	0.1669	0.1653	0.248	0.2449	0.2426
0.015	0.0148	0.0147	0.092	0.0909	0.0900	0.170	0.1679	0.1663	0.249	0.2459	0.2436
0.016	0.0158	0.0156	0.093	0.0918	0.0910	0.171	0.1689	0.1672	0.250	0.2469	0.2445
0.017	0.0168	0.0166	0.094	0.0928	0.0919	0.172	0.1699	0.1682	0.251	0.2479	0.2455
0.018	0.0177	0.0176	0.095	0.0938	0.0929	0.173	0.1709	0.1692	0.252	0.2489	0.2465
0.019	0.0187	0.0186	0.096	0.0948	0.0939	0.174	0.1719	0.1702	0.253	0.2499	0.2475
0.020	0.0197	0.0196	0.097	0.0958	0.0949	0.175	0.1728	0.1712	0.254	0.2509	0.2484
0.021	0.0207	0.0205	0.098	0.0968	0.0958	0.176	0.1738	0.1721	0.255	0.2519	0.2494
0.022	0.0217	0.0215	0.099	0.0978	0.0968	0.177	0.1748	0.1731	0.256	0.2528	0.2504
0.023	0.0227	0.0225	0.100	0.0988	0.0978	0.178	0.1758	0.1741	0.257	0.2538	0.2514
0.024	0.0237	0.0235	0.101	0.0997	0.0988	0.179	0.1768	0.1751	0.258	0.2548	0.2524
0.025	0.0247	0.0244	0.102	0.1007	0.0998	0.180	0.1778	0.1761	0.259	0.2558	0.2533
0.026	0.0257	0.0254	0.103	0.1017	0.1007	0.181	0.1788	0.1770	0.260	0.2568	0.2543
0.027	0.0267	0.0264	0.104	0.1027	0.1017	0.182	0.1798	0.1780	0.261	0.2578	0.2553
0.028	0.0276	0.0274	0.105	0.1037	0.1027	0.183	0.1807	0.1790	0.262	0.2588	0.2563
0.029	0.0286	0.0284	0.106	0.1047	0.1037	0.184	0.1817	0.1800	0.263	0.2598	0.2572
0.030	0.0296	0.0293	0.107	0.1057	0.1047	0.185	0.1827	0.1809	0.264	0.2607	0.2582
0.031	0.0306	0.0303	0.108	0.1067	0.1056	0.186	0.1837	0.1819	0.265	0.2617	0.2592
0.032	0.0316	0.0313	0.109	0.1076	0.1066	0.187	0.1847	0.1829	0.266	0.2627	0.2602
0.033	0.0326	0.0323	0.110	0.1086	0.1076	0.188	0.1857	0.1839	0.267	0.2637	0.2612
0.034	0.0336	0.0332	0.111	0.1096	0.1086	0.189	0.1867	0.1849	0.268	0.2647	0.2621
0.035	0.0346	0.0342	0.112	0.1106	0.1095	0.190	0.1877	0.1858	0.269	0.2657	0.2631
0.036	0.0356	0.0352	0.113	0.1116	0.1105	0.191	0.1886	0.1868	0.270	0.2667	0.2641
0.037	0.0365	0.0362	0.114	0.1126	0.1115	0.192	0.1896	0.1878	0.271	0.2677	0.2651
0.038	0.0375	0.0372	0.115	0.1136	0.1125	0.193	0.1906	0.1888	0.272	0.2686	0.2661
0.039	0.0385	0.0381	0.116	0.1145	0.1134	0.194	0.1916	0.1898	0.273	0.2696	0.2670
0.040	0.0395	0.0391	0.117	0.1155	0.1144	0.195	0.1926	0.1907	0.274	0.2706	0.2680
0.041	0.0405	0.0401	0.118	0.1165	0.1154	0.196	0.1936	0.1917	0.275	0.2716	0.2690
0.042	0.0415	0.0411	0.119	0.1175	0.1164	0.197	0.1946	0.1927	0.276	0.2726	0.2700
0.043	0.0425	0.0421	0.120	0.1185	0.1174	0.198	0.1956	0.1937	0.277	0.2736	0.2709
0.044	0.0435	0.0430	0.121	0.1195	0.1183	0.199	0.1965	0.1946	0.278	0.2746	0.2719
0.045	0.0444	0.0440	0.122	0.1205	0.1193	0.200	0.1975	0.1956	0.279	0.2756	0.2729
0.046	0.0454	0.0449	0.123	0.1215	0.1203	0.201	0.1985	0.1966	0.280	0.2765	0.2739
0.047	0.0464	0.0459	0.124	0.1225	0.1213	0.202	0.1995	0.1976	0.281	0.2775	0.2749
0.048	0.0474	0.0469	0.125	0.1234	0.1223	0.203	0.2005	0.1986	0.282	0.2785	0.2758
0.049	0.0484	0.0479	0.126	0.1244	0.1232	0.204	0.2015	0.1995	0.283	0.2795	0.2768
0.050	0.0494	0.0490	0.127	0.1254	0.1242	0.205	0.2025	0.2005	0.284	0.2805	0.2778
0.051	0.0504	0.0499	0.128	0.1264	0.1252	0.206	0.2035	0.2015	0.285	0.2815	0.2788
0.052	0.0513	0.0509	0.129	0.1274	0.1262	0.207	0.2044	0.2025	0.286	0.2825	0.2797
0.053	0.0523	0.0518	0.130	0.1284	0.1271	0.208	0.2054	0.2034	0.287	0.2835	0.2807
0.054	0.0533	0.0528	0.131	0.1294	0.1281	0.209	0.2064	0.2044	0.288	0.2844	0.2817
0.055	0.0543	0.0538	0.132	0.1304	0.1291	0.210	0.2074	0.2054	0.289	0.2854	0.2827
0.056	0.0553	0.0548	0.133	0.1313	0.1301	0.211	0.2084	0.2064	0.290	0.2864	0.2837
0.057	0.0563	0.0557	0.134	0.1323	0.1311	0.212	0.2094	0.2074	0.291	0.2874	0.2846
0.058	0.0573	0.0567	0.135	0.1333	0.1320	0.213	0.2104	0.2083	0.292	0.2884	0.2856
0.059	0.0583	0.0577	0.136	0.1343	0.1330	0.214	0.2114	0.2093	0.293	0.2894	0.2866
0.060	0.0593	0.0587	0.137	0.1353	0.1340	0.215	0.2123	0.2103	0.294	0.2904	0.2876
0.061	0.0602	0.0597	0.138	0.1363	0.1350	0.216	0.2133	0.2113	0.295	0.2914	0.2885
0.062	0.0612	0.0606	0.139	0.1373	0.1359	0.217	0.2143	0.2123	0.296	0.2924	0.2895
0.063	0.0622	0.0616	0.140	0.1383	0.1369	0.218	0.2153	0.2132	0.297	0.2933	0.2905
0.064	0.0632	0.0626	0.141	0.1392	0.1379	0.219	0.2163	0.2142	0.298	0.2943	0.2915
0.065	0.0642	0.0636	0.142	0.1402	0.1389	0.220	0.2173	0.2152	0.299	0.2953	0.2925
0.066	0.0652	0.0645	0.143	0.1412	0.1398	0.221	0.2183	0.2162	0.300	0.2963	0.2934
0.067	0.0662	0.0655	0.144	0.1422	0.1408	0.222	0.2193	0.2172	0.301	0.2973	0.2944
0.068	0.0672	0.0665	0.145	0.1432	0.1418	0.223	0.2202	0.2181	0.302	0.2983	0.2954
0.069	0.0681	0.0675	0.146	0.1442	0.1428	0.224	0.2212	0.2191	0.303	0.2993	0.2964
0.070	0.0691	0.0685	0.147	0.1452	0.1437	0.225	0.2222	0.2201	0.304	0.3003	0.2974
0.071	0.0701	0.0694	0.148	0.1462	0.1447	0.226	0.2232	0.2211	0.305	0.3012	0.2983
0.072	0.0711	0.0704	0.149	0.1471	0.1457	0.227	0.2242	0.2220	0.306	0.3022	0.2993
0.073	0.0721	0.0714	0.150	0.1481	0.1467	0.228	0.2252	0.2230	0.307	0.3032	0.3003
0.074	0.0731	0.0724	0.151	0.1491	0.1477	0.229	0.2262	0.2240	0.308	0.3042	0.3013
0.075	0.0741	0.0733	0.152	0.1501	0.1487	0.230	0.2272	0.2250	0.309	0.3052	0.3022
0.076	0.0751	0.0743	0.153	0.1511	0.1496	0.231	0.2282	0.2259	0.310	0.3062	0.3032
0.077	0.0760	0.0753	0.154	0.1521	0.1506	0.232	0.2291	0.2269	0.311	0.3072	0.3042
			0.155	0.1531	0.1516	0.233	0.2301	0.2279	0.312	0.3082	0.3052
						0.234	0.2311	0.2289	0.313	0.3094	0.3062

Machinery

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* Table continued on pages following

DEPTH OF STEPS ON STRAIGHT FORMING TOOLS MEASURED AT RIGHT ANGLES TO THE FRONT FACE, CORRESPONDING TO VARIOUS DIFFERENCES BETWEEN RADII ON THE WORK—(Continued)

Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face	
	Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.
0.314	0.3101	0.3071	0.393	0.3882	0.3844	0.472	0.4662	0.4617	0.551	0.5442	0.5390
0.315	0.3111	0.3081	0.394	0.3891	0.3854	0.473	0.4672	0.4627	0.552	0.5452	0.5399
0.316	0.3121	0.3091	0.395	0.3901	0.3864	0.474	0.4682	0.4638	0.553	0.5462	0.5409
0.317	0.3131	0.3101	0.396	0.3911	0.3873	0.475	0.4691	0.4646	0.554	0.5472	0.5419
0.318	0.3141	0.3110	0.397	0.3921	0.3883	0.476	0.4701	0.4656	0.555	0.5482	0.5429
0.319	0.3151	0.3120	0.398	0.3931	0.3893	0.477	0.4711	0.4666	0.556	0.5491	0.5439
0.320	0.3161	0.3130	0.399	0.3941	0.3903	0.478	0.4721	0.4675	0.557	0.5501	0.5448
0.321	0.3170	0.3140	0.400	0.3951	0.3913	0.479	0.4731	0.4685	0.558	0.5511	0.5458
0.322	0.3180	0.3149	0.401	0.3961	0.3922	0.480	0.4741	0.4695	0.559	0.5521	0.5468
0.323	0.3190	0.3159	0.402	0.3970	0.3932	0.481	0.4751	0.4705	0.560	0.5531	0.5478
0.324	0.3200	0.3169	0.403	0.3980	0.3942	0.482	0.4761	0.4715	0.561	0.5541	0.5487
0.325	0.3210	0.3179	0.404	0.3990	0.3952	0.483	0.4770	0.4724	0.562	0.5551	0.5497
0.326	0.3220	0.3189	0.405	0.4000	0.3961	0.484	0.4780	0.4734	0.563	0.5561	0.5507
0.327	0.3230	0.3198	0.406	0.4010	0.3971	0.485	0.4790	0.4744	0.564	0.5571	0.5517
0.328	0.3240	0.3208	0.407	0.4020	0.3981	0.486	0.4800	0.4754	0.565	0.5580	0.5527
0.329	0.3249	0.3218	0.408	0.4030	0.3991	0.487	0.4810	0.4764	0.566	0.5590	0.5536
0.330	0.3259	0.3228	0.409	0.4040	0.4001	0.488	0.4820	0.4773	0.567	0.5600	0.5546
0.331	0.3269	0.3238	0.410	0.4049	0.4010	0.489	0.4830	0.4783	0.568	0.5610	0.5556
0.332	0.3279	0.3247	0.411	0.4059	0.4020	0.490	0.4840	0.4793	0.569	0.5620	0.5566
0.333	0.3289	0.3257	0.412	0.4069	0.4030	0.491	0.4849	0.4803	0.570	0.5630	0.5575
0.334	0.3299	0.3267	0.413	0.4079	0.4040	0.492	0.4859	0.4812	0.571	0.5640	0.5585
0.335	0.3309	0.3277	0.414	0.4089	0.4049	0.493	0.4869	0.4822	0.572	0.5650	0.5595
0.336	0.3319	0.3287	0.415	0.4099	0.4059	0.494	0.4879	0.4832	0.573	0.5659	0.5605
0.337	0.3328	0.3296	0.416	0.4109	0.4069	0.495	0.4889	0.4842	0.574	0.5669	0.5615
0.338	0.3338	0.3306	0.417	0.4119	0.4079	0.496	0.4899	0.4852	0.575	0.5679	0.5624
0.339	0.3348	0.3316	0.418	0.4128	0.4089	0.497	0.4909	0.4861	0.576	0.5689	0.5634
0.340	0.3358	0.3326	0.419	0.4138	0.4098	0.498	0.4919	0.4871	0.577	0.5699	0.5644
0.341	0.3368	0.3335	0.420	0.4148	0.4108	0.499	0.4929	0.4881	0.578	0.5709	0.5654
0.342	0.3378	0.3345	0.421	0.4158	0.4118	0.500	0.4939	0.4891	0.579	0.5719	0.5663
0.343	0.3388	0.3355	0.422	0.4168	0.4128	0.501	0.4948	0.4900	0.580	0.5729	0.5673
0.344	0.3398	0.3365	0.423	0.4178	0.4138	0.502	0.4958	0.4910	0.581	0.5738	0.5683
0.345	0.3407	0.3375	0.424	0.4188	0.4147	0.503	0.4968	0.4920	0.582	0.5748	0.5693
0.346	0.3417	0.3384	0.425	0.4198	0.4157	0.504	0.4978	0.4930	0.583	0.5758	0.5703
0.347	0.3427	0.3394	0.426	0.4207	0.4167	0.505	0.4988	0.4940	0.584	0.5768	0.5712
0.348	0.3437	0.3404	0.427	0.4217	0.4177	0.506	0.4998	0.4949	0.585	0.5778	0.5722
0.349	0.3447	0.3414	0.428	0.4227	0.4186	0.507	0.5008	0.4959	0.586	0.5788	0.5732
0.350	0.3457	0.3423	0.429	0.4237	0.4196	0.508	0.5017	0.4969	0.587	0.5798	0.5742
0.351	0.3467	0.3433	0.430	0.4247	0.4206	0.509	0.5027	0.4979	0.588	0.5808	0.5751
0.352	0.3477	0.3443	0.431	0.4257	0.4216	0.510	0.5037	0.4989	0.589	0.5817	0.5761
0.353	0.3486	0.3453	0.432	0.4267	0.4226	0.511	0.5047	0.4998	0.590	0.5827	0.5771
0.354	0.3496	0.3463	0.433	0.4277	0.4235	0.512	0.5057	0.5008	0.591	0.5837	0.5781
0.355	0.3506	0.3472	0.434	0.4286	0.4245	0.513	0.5067	0.5018	0.592	0.5847	0.5791
0.356	0.3516	0.3482	0.435	0.4296	0.4255	0.514	0.5077	0.5028	0.593	0.5857	0.5800
0.357	0.3526	0.3492	0.436	0.4306	0.4265	0.515	0.5087	0.5037	0.594	0.5867	0.5810
0.358	0.3536	0.3502	0.437	0.4316	0.4274	0.516	0.5096	0.5047	0.595	0.5877	0.5820
0.359	0.3546	0.3511	0.438	0.4326	0.4284	0.517	0.5106	0.5057	0.596	0.5887	0.5830
0.360	0.3556	0.3521	0.439	0.4336	0.4294	0.518	0.5116	0.5067	0.597	0.5897	0.5839
0.361	0.3565	0.3531	0.440	0.4346	0.4304	0.519	0.5126	0.5077	0.598	0.5906	0.5849
0.362	0.3575	0.3541	0.441	0.4356	0.4314	0.520	0.5136	0.5086	0.599	0.5916	0.5859
0.363	0.3585	0.3551	0.442	0.4365	0.4323	0.521	0.5146	0.5096	0.600	0.5926	0.5869
0.364	0.3595	0.3560	0.443	0.4375	0.4333	0.522	0.5156	0.5106	0.601	0.5936	0.5878
0.365	0.3605	0.3570	0.444	0.4385	0.4343	0.523	0.5166	0.5116	0.602	0.5946	0.5888
0.366	0.3615	0.3580	0.445	0.4395	0.4353	0.524	0.5175	0.5125	0.603	0.5956	0.5898
0.367	0.3625	0.3590	0.446	0.4405	0.4362	0.525	0.5185	0.5135	0.604	0.5966	0.5908
0.368	0.3635	0.3600	0.447	0.4415	0.4372	0.526	0.5195	0.5145	0.605	0.5976	0.5918
0.369	0.3644	0.3609	0.448	0.4425	0.4382	0.527	0.5205	0.5155	0.606	0.5985	0.5927
0.370	0.3654	0.3619	0.449	0.4435	0.4392	0.528	0.5215	0.5165	0.607	0.5995	0.5937
0.371	0.3664	0.3629	0.450	0.4445	0.4402	0.529	0.5225	0.5174	0.608	0.6005	0.5947
0.372	0.3674	0.3639	0.451	0.4454	0.4411	0.530	0.5235	0.5184	0.609	0.6015	0.5957
0.373	0.3684	0.3648	0.452	0.4464	0.4421	0.531	0.5245	0.5194	0.610	0.6025	0.5967
0.374	0.3694	0.3658	0.453	0.4474	0.4431	0.532	0.5254	0.5204	0.611	0.6035	0.5976
0.375	0.3704	0.3668	0.454	0.4484	0.4441	0.533	0.5264	0.5213	0.612	0.6045	0.5986
0.376	0.3714	0.3678	0.455	0.4494	0.4451	0.534	0.5274	0.5223	0.613	0.6055	0.5996
0.377	0.3724	0.3688	0.456	0.4504	0.4460	0.535	0.5284	0.5233	0.614	0.6064	0.6006
0.378	0.3733	0.3697	0.457	0.4514	0.4470	0.536	0.5294	0.5243	0.615	0.6074	0.6016
0.379	0.3743	0.3707	0.458	0.4524	0.4480	0.537	0.5304	0.5253	0.616	0.6084	0.6025
0.380	0.3753	0.3717	0.459	0.4533	0.4490	0.538	0.5314	0.5262	0.617	0.6094	0.6035
0.381	0.3763	0.3727	0.460	0.4543	0.4499	0.539	0.5324	0.5272	0.618	0.6104	0.6045
0.382	0.3773	0.3736	0.461	0.4553	0.4509	0.540	0.5333	0.5282	0.619	0.6114	0.6055
0.383	0.3783	0.3746	0.462	0.4563	0.4519	0.541	0.5343	0.5292	0.620	0.6124	0.6064
0.384	0.3793	0.3756	0.463	0.4573	0.4529	0.542	0.5353	0.5302	0.621	0.6134	0.6074
0.385	0.3803	0.3766	0.464	0.4583	0.4539	0.543	0.5363	0.5311	0.622	0.6143	0.6084
0.386	0.3812	0.3776	0.465	0.4593	0.4548	0.544	0.5373	0.5321	0.623	0.6153	0.6094
0.387	0.3822	0.3785	0.466	0.4603	0.4558	0.545	0.5383	0.5331	0.624	0.6163	0.6104
0.388	0.3832	0.3795	0.467	0.4612	0.4568	0.546	0.5393	0.5341	0.625	0.6173	0.6113
0.389	0.3842	0.3805	0.468	0.4622	0.4578	0.547	0.5403	0.5350	0.626	0.6183	0.6123
0.390	0.3852	0.3815	0.469	0.4632	0.4587	0.548	0.5412	0.5360	0.627	0.6193	0.6133
0.391	0.3862	0.3824	0.470	0.4642	0.4597	0.549	0.5422	0.5370	0.628	0.6203	0.6143
0.392	0.3872	0.3834	0.471	0.4652	0.4607	0.550	0.5432	0.5380	0.629	0.6213	0.6152

Machinery

DEPTH OF STEPS ON STRAIGHT FORMING TOOLS MEASURED AT RIGHT ANGLES TO THE FRONT FACE, CORRESPONDING TO VARIOUS DIFFERENCES BETWEEN RADII ON THE WORK—(Continued)

Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face	
	Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.
0.630	0.6222	0.6162	0.709	0.7003	0.6935	0.788	0.7783	0.7708	0.867	0.8563	0.8481
0.631	0.6232	0.6172	0.710	0.7012	0.6945	0.789	0.7793	0.7718	0.868	0.8573	0.8490
0.632	0.6242	0.6182	0.711	0.7022	0.6955	0.790	0.7803	0.7727	0.869	0.8583	0.8500
0.633	0.6252	0.6192	0.712	0.7032	0.6964	0.791	0.7812	0.7737	0.870	0.8593	0.8510
0.634	0.6262	0.6201	0.713	0.7042	0.6974	0.792	0.7822	0.7747	0.871	0.8603	0.8520
0.635	0.6272	0.6211	0.714	0.7052	0.6984	0.793	0.7832	0.7757	0.872	0.8613	0.8529
0.636	0.6282	0.6221	0.715	0.7062	0.6994	0.794	0.7842	0.7766	0.873	0.8622	0.8539
0.637	0.6292	0.6231	0.716	0.7072	0.7003	0.795	0.7852	0.7776	0.874	0.8632	0.8549
0.638	0.6301	0.6241	0.717	0.7082	0.7013	0.796	0.7862	0.7786	0.875	0.8642	0.8559
0.639	0.6311	0.6250	0.718	0.7092	0.7023	0.797	0.7872	0.7796	0.876	0.8652	0.8569
0.640	0.6321	0.6260	0.719	0.7101	0.7033	0.798	0.7882	0.7805	0.877	0.8662	0.8578
0.641	0.6331	0.6270	0.720	0.7111	0.7043	0.799	0.7892	0.7815	0.878	0.8672	0.8588
0.642	0.6341	0.6280	0.721	0.7121	0.7052	0.800	0.7901	0.7825	0.879	0.8682	0.8598
0.643	0.6351	0.6289	0.722	0.7131	0.7062	0.801	0.7911	0.7835	0.880	0.8692	0.8608
0.644	0.6361	0.6299	0.723	0.7141	0.7072	0.802	0.7921	0.7845	0.881	0.8701	0.8617
0.645	0.6371	0.6309	0.724	0.7151	0.7082	0.803	0.7931	0.7854	0.882	0.8711	0.8627
0.646	0.6380	0.6319	0.725	0.7161	0.7092	0.804	0.7941	0.7864	0.883	0.8721	0.8637
0.647	0.6390	0.6329	0.726	0.7171	0.7101	0.805	0.7951	0.7874	0.884	0.8731	0.8647
0.648	0.6400	0.6338	0.727	0.7180	0.7111	0.806	0.7961	0.7884	0.885	0.8741	0.8657
0.649	0.6410	0.6348	0.728	0.7190	0.7121	0.807	0.7971	0.7894	0.886	0.8751	0.8666
0.650	0.6420	0.6358	0.729	0.7200	0.7131	0.808	0.7980	0.7903	0.887	0.8761	0.8676
0.651	0.6430	0.6368	0.730	0.7210	0.7140	0.809	0.7990	0.7913	0.888	0.8771	0.8686
0.652	0.6440	0.6378	0.731	0.7220	0.7150	0.810	0.8000	0.7923	0.889	0.8780	0.8696
0.653	0.6450	0.6387	0.732	0.7230	0.7160	0.811	0.8010	0.7933	0.890	0.8790	0.8705
0.654	0.6459	0.6397	0.733	0.7240	0.7170	0.812	0.8020	0.7943	0.891	0.8800	0.8715
0.655	0.6469	0.6407	0.734	0.7250	0.7180	0.813	0.8030	0.7952	0.892	0.8810	0.8725
0.656	0.6479	0.6417	0.735	0.7259	0.7189	0.814	0.8040	0.7962	0.893	0.8820	0.8735
0.657	0.6489	0.6426	0.736	0.7269	0.7199	0.815	0.8050	0.7972	0.894	0.8830	0.8745
0.658	0.6499	0.6436	0.737	0.7279	0.7209	0.816	0.8059	0.7982	0.895	0.8840	0.8754
0.659	0.6509	0.6446	0.738	0.7289	0.7219	0.817	0.8069	0.7992	0.896	0.8850	0.8764
0.660	0.6519	0.6456	0.739	0.7299	0.7228	0.818	0.8079	0.8001	0.897	0.8859	0.8774
0.661	0.6529	0.6465	0.740	0.7309	0.7238	0.819	0.8089	0.8011	0.898	0.8869	0.8784
0.662	0.6538	0.6475	0.741	0.7319	0.7248	0.820	0.8099	0.8021	0.899	0.8879	0.8793
0.663	0.6548	0.6485	0.742	0.7329	0.7258	0.821	0.8109	0.8031	0.900	0.8889	0.8803
0.664	0.6558	0.6495	0.743	0.7338	0.7268	0.822	0.8119	0.8040	0.901	0.8899	0.8813
0.665	0.6568	0.6505	0.744	0.7348	0.7277	0.823	0.8129	0.8050	0.902	0.8909	0.8823
0.666	0.6578	0.6514	0.745	0.7358	0.7287	0.824	0.8138	0.8060	0.903	0.8919	0.8833
0.667	0.6588	0.6524	0.746	0.7368	0.7297	0.825	0.8148	0.8070	0.904	0.8929	0.8842
0.668	0.6598	0.6534	0.747	0.7378	0.7307	0.826	0.8158	0.8080	0.905	0.8939	0.8852
0.669	0.6608	0.6544	0.748	0.7388	0.7316	0.827	0.8168	0.8089	0.906	0.8948	0.8862
0.670	0.6617	0.6554	0.749	0.7398	0.7326	0.828	0.8178	0.8099	0.907	0.8958	0.8872
0.671	0.6627	0.6563	0.750	0.7408	0.7336	0.829	0.8188	0.8109	0.908	0.8968	0.8882
0.672	0.6637	0.6573	0.751	0.7417	0.7346	0.830	0.8198	0.8119	0.909	0.8978	0.8891
0.673	0.6647	0.6583	0.752	0.7427	0.7356	0.831	0.8207	0.8128	0.910	0.8988	0.8901
0.674	0.6657	0.6593	0.753	0.7437	0.7365	0.832	0.8217	0.8138	0.911	0.8998	0.8911
0.675	0.6667	0.6602	0.754	0.7447	0.7375	0.833	0.8227	0.8148	0.912	0.9008	0.8921
0.676	0.6677	0.6612	0.755	0.7457	0.7385	0.834	0.8237	0.8158	0.913	0.9017	0.8930
0.677	0.6687	0.6622	0.756	0.7467	0.7395	0.835	0.8247	0.8168	0.914	0.9027	0.8940
0.678	0.6696	0.6632	0.757	0.7477	0.7405	0.836	0.8257	0.8177	0.915	0.9037	0.8950
0.679	0.6706	0.6642	0.758	0.7487	0.7414	0.837	0.8267	0.8187	0.916	0.9047	0.8960
0.680	0.6716	0.6651	0.759	0.7496	0.7424	0.838	0.8277	0.8197	0.917	0.9057	0.8970
0.681	0.6726	0.6661	0.760	0.7506	0.7434	0.839	0.8287	0.8207	0.918	0.9067	0.8979
0.682	0.6736	0.6671	0.761	0.7516	0.7444	0.840	0.8296	0.8216	0.919	0.9077	0.8989
0.683	0.6746	0.6681	0.762	0.7526	0.7453	0.841	0.8306	0.8226	0.920	0.9087	0.8999
0.684	0.6756	0.6690	0.763	0.7536	0.7463	0.842	0.8316	0.8236	0.921	0.9097	0.9009
0.685	0.6766	0.6700	0.764	0.7546	0.7473	0.843	0.8326	0.8246	0.922	0.9106	0.9018
0.686	0.6775	0.6710	0.765	0.7556	0.7483	0.844	0.8336	0.8256	0.923	0.9116	0.9028
0.687	0.6785	0.6720	0.766	0.7566	0.7493	0.845	0.8346	0.8265	0.924	0.9126	0.9038
0.688	0.6795	0.6730	0.767	0.7575	0.7502	0.846	0.8356	0.8275	0.925	0.9136	0.9048
0.689	0.6805	0.6739	0.768	0.7585	0.7512	0.847	0.8366	0.8285	0.926	0.9146	0.9058
0.690	0.6815	0.6749	0.769	0.7595	0.7522	0.848	0.8376	0.8295	0.927	0.9156	0.9067
0.691	0.6825	0.6759	0.770	0.7605	0.7532	0.849	0.8385	0.8304	0.928	0.9166	0.9077
0.692	0.6835	0.6769	0.771	0.7615	0.7542	0.850	0.8395	0.8314	0.929	0.9176	0.9087
0.693	0.6845	0.6779	0.772	0.7625	0.7551	0.851	0.8405	0.8324	0.930	0.9185	0.9097
0.694	0.6854	0.6788	0.773	0.7635	0.7561	0.852	0.8415	0.8334	0.931	0.9195	0.9106
0.695	0.6864	0.6798	0.774	0.7645	0.7571	0.853	0.8425	0.8344	0.932	0.9205	0.9116
0.696	0.6874	0.6808	0.775	0.7654	0.7581	0.854	0.8435	0.8353	0.933	0.9215	0.9126
0.697	0.6884	0.6818	0.776	0.7664	0.7590	0.855	0.8445	0.8363	0.934	0.9225	0.9136
0.698	0.6894	0.6827	0.777	0.7674	0.7600	0.856	0.8455	0.8373	0.935	0.9235	0.9146
0.699	0.6904	0.6837	0.778	0.7684	0.7610	0.857	0.8464	0.8383	0.936	0.9245	0.9155
0.700	0.6914	0.6847	0.779	0.7694	0.7620	0.858	0.8474	0.8392	0.937	0.9255	0.9165
0.701	0.6924	0.6857	0.780	0.7704	0.7629	0.859	0.8484	0.8402	0.938	0.9264	0.9175
0.702	0.6933	0.6867	0.781	0.7714	0.7639	0.860	0.8494	0.8412	0.939	0.9274	0.9185
0.703	0.6943	0.6876	0.782	0.7724	0.7649	0.861	0.8504	0.8422	0.940	0.9284	0.9195
0.704	0.6953	0.6886	0.783	0.7733	0.7659	0.862	0.8514	0.8432	0.941	0.9294	0.9204
0.705	0.6963	0.6896	0.784	0.7743	0.7669	0.863	0.8524	0.8441	0.942	0.9304	0.9214
0.706	0.6973	0.6906	0.785	0.7753	0.7678	0.864	0.8534	0.8451	0.943	0.9314	0.9224
0.707	0.6983	0.6915	0.786	0.7763	0.7688	0.865	0.8543	0.8461	0.914	0.9324	0.9234
0.708	0.6993	0.6925	0.787	0.7773	0.7698	0.866	0.8553	0.8471	0.915	0.9334	0.9243

Machinery

DEPTH OF STEPS ON STRAIGHT FORMING TOOLS MEASURED AT RIGHT ANGLES TO THE FRONT FACE, CORRESPONDING TO VARIOUS DIFFERENCES BETWEEN RADII ON THE WORK—(Continued)

Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face		Y (Difference between Radii on Work)	Dimension X on Tool, Measured at Right Angles to Front Face	
	Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.		Clearance Angle, 9 Deg.	Clearance Angle, 12 Deg.
0.946	0.9343	0.9253	0.960	0.9482	0.9390	0.974	0.9620	0.9527	0.988	0.9758	0.9664
0.947	0.9353	0.9263	0.961	0.9492	0.9400	0.975	0.9630	0.9537	0.989	0.9768	0.9674
0.948	0.9363	0.9273	0.962	0.9501	0.9410	0.976	0.9640	0.9547	0.990	0.9778	0.9684
0.949	0.9373	0.9283	0.963	0.9511	0.9419	0.977	0.9650	0.9556	0.991	0.9788	0.9693
0.950	0.9383	0.9292	0.964	0.9521	0.9429	0.978	0.9660	0.9566	0.992	0.9798	0.9703
0.951	0.9393	0.9302	0.965	0.9531	0.9439	0.979	0.9669	0.9576	0.993	0.9808	0.9713
0.952	0.9403	0.9312	0.966	0.9541	0.9449	0.980	0.9679	0.9586	0.994	0.9818	0.9723
0.953	0.9413	0.9322	0.967	0.9551	0.9459	0.981	0.9689	0.9596	0.995	0.9827	0.9732
0.954	0.9422	0.9331	0.968	0.9561	0.9468	0.982	0.9699	0.9605	0.996	0.9837	0.9742
0.955	0.9432	0.9341	0.969	0.9571	0.9478	0.983	0.9709	0.9615	0.997	0.9847	0.9752
0.956	0.9442	0.9351	0.970	0.9581	0.9488	0.984	0.9719	0.9625	0.998	0.9857	0.9762
0.957	0.9452	0.9361	0.971	0.9590	0.9498	0.985	0.9729	0.9635	0.999	0.9867	0.9772
0.958	0.9462	0.9371	0.972	0.9600	0.9507	0.986	0.9739	0.9644	1.000	0.9877	0.9781
0.959	0.9472	0.9380	0.973	0.9610	0.9517	0.987	0.9748	0.9654			

Machinery

ECONOMICAL SELECTION OF MATERIALS

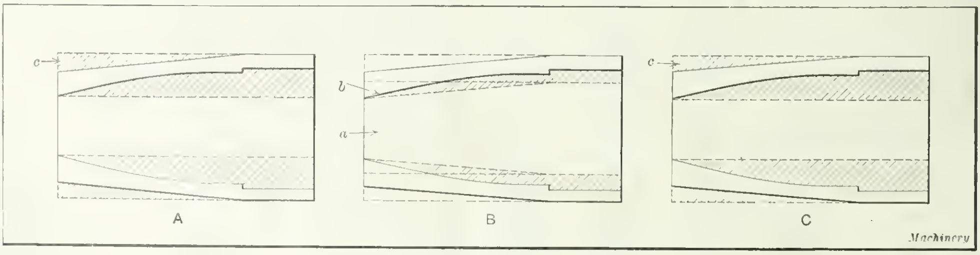
Shop managers could effect considerable saving in labor and waste stock by a more general use of materials that require a minimum of reworking after they come from the supply house. Many raw or semi-finished materials are on the market with which the manufacturer or consumer is acquainted in only a general way; and in numerous instances a closer study of the properties of such materials would lead to increased production and a product of better quality.

To illustrate, three drawings are shown at *A*, *B*, and *C* of a mechanical part which is essentially tubular. A mechanic unacquainted with the fact that seamless steel tubing 1⅞ inches in diameter can be obtained with walls 9/16 inch thick, would logically use solid stock for the purpose if small quantities were involved. This would necessitate a heavy drilling operation, an outside cut, a boring operation, and an inside forming operation; and aside from this essentially heavy machine work, there would be the undesirable factor of considerable waste stock, as indicated by the shaded area at *A* in the illustration. If, on the other hand, he were acquainted with the range of sizes and wall thicknesses in which seamless steel tubing is regularly or specially manufactured, he would secure tubular stock of the right size and proper kind of steel, and approach the matter in a way which would be more economical, whether the quantities involved were large or small. The same part, produced as shown at *A* would be more satisfactorily made by swaging tubing having a wall thickness equal to the greatest wall thickness of the finished product, or slightly less, if a portion were to be upset (see view *B*). The swaging operation would give at once the correct diameter of opening at *a*, sufficient thickness for the convex tapered bore *b* (with less stock to remove in this operation than would be necessary after drilling solid stock), and would also eliminate the heavy outside cut *c*. The boring and inside forming would be reduced to a minimum.

If facilities for swaging were not provided and the proposition was that of smaller quantity production, the part could still be made by using tubing having an internal diameter equal to the smallest internal diameter of the finished product and an outside diameter equal to the greatest outside diameter of the part. In this instance, as illustrated at *C*, the boring operation would be heavier than that required in the preceding case and an outside cut *c* would have to be taken, but the heavy drilling operation required when solid stock is used would be eliminated and waste stock correspondingly reduced.

By comparing either method *C* or *B* with that shown at *A*, the saving in time and labor will be apparent. The proportions of the part shown are based on actual dimensions of commercially procurable seamless steel tubing. Material of this kind is manufactured in diameters of from ¼ inch to 20 inches, and with wall thicknesses in a variable ratio to diameters of from No. 20 gage to 1½ inches. A few sizes taken at random include 1-inch tubing with walls ranging from No. 20 gage (0.035 inch) to ¼ inch thick; 4-inch tubing with walls of from No. 11 gage (0.120 inch) to 1 inch thick; and 9-inch tubing with walls ranging from ¼ inch to 1⅛ inches thick. All of these sizes are made by piercing solid billets. This material is made in a number of different kinds of steel, which are so annealed as to give practically any necessary quality for machining. For instance, where it is necessary to expand the tubing, sufficient ductility will be found, yet the strength will in no way be sacrificed if tubing is purchased after its requirements for some particular use have been passed upon by the dealer or the manufacturer of the tubing. Tubing, in the alloy steels, is so uniform that no unusual difficulties in machining should be experienced. Special heat-treatment is often given for specific purposes.

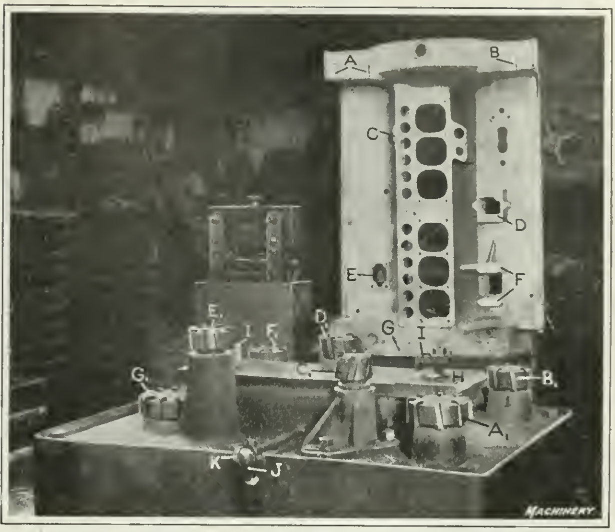
The manager who studies materials with the view of becoming acquainted with such information, can frequently effect economies, and raise the standard for quality.



Three Methods of producing a Tubular Part. The Metal removed in machining is indicated by Section Lines

Special Machines and Tools in the Chandler Plant

Equipment Used by the Chandler Motor Car Co., Cleveland, Ohio, for Milling Crankcases, Boring and Reaming Crankshaft and Camshaft Bearings, and Numerous other Operations



MEN who keep closely in touch with developments in machine tool design have come to regard the special single-purpose tool as an accepted institution in American manufacturing plants. A few years ago, many manufacturers were hostile to this type of equipment, chiefly on account of the fact that it was only adapted for the performance of a single class of work, and where the job would not keep the machine constantly employed a heavy item of overhead was inevitable. Also, in the event of a change in the design of the product, a special machine tool often became valueless. For those reasons, the machine shops of only a few years ago were equipped almost entirely with standard machine tools, but today there is a distinct trend toward specialization in the design of equipment that is to be used in machining duplicate parts. This statement must not be misconstrued. Doubtless the number of standard machine tools in the average plant will always far outnumber those of special construction, but as the economy in first cost and the high productivity of the special machine become better known, the planning departments of progressive industrial organizations are likely to give more and more time to the searching out of those operations which could be efficiently handled on special machines, and arrangements will then be made to have such equipment designed and built in the factory where it is to be used, or else to have the work done by experienced machine tool builders. Under favorable circumstances, the saving effected by a machine especially designed for the job would more than defray the cost of the machine, even though it was to be used in producing a part of the product which is likely to become obsolete after the special machine has been in operation for only a short period of time.

Special Machines Used by the Chandler Motor Car Co.

At the plant of the Chandler Motor Car Co., Cleveland, Ohio, a number of interesting special machine tools are utilized, and it is the purpose of this article to explain the merits of some of these special tools for the performance of their respective jobs. Briefly summarized, the advantages of a machine which has been developed to meet the peculiar requirements of a specified operation are likely to be as follows: (1) Lower first cost; (2) greater efficiency in production; (3) simplicity of design and suitability for operation by semi-skilled labor; (4) economy in the use of floor space. Naturally there will be other advantages in the numerous cases where special machines are used.

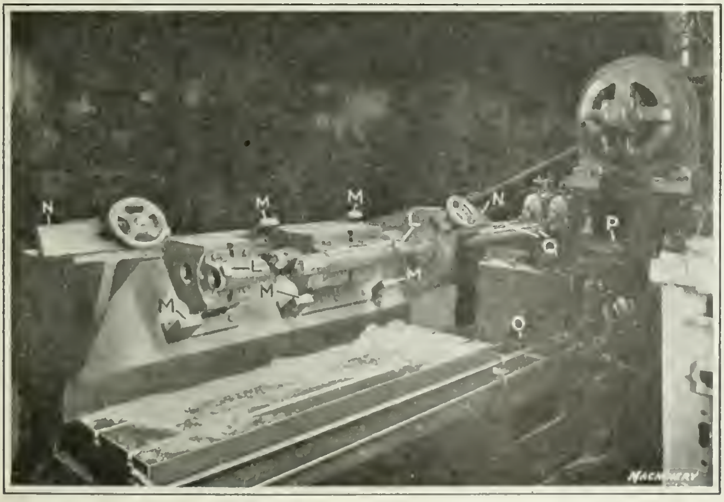


Fig. 1. Special-purpose Duplex Boring Machine for simultaneously rough-boring the Crankshaft and Camshaft Bearings of Chandler Crankcases

Special Milling Machine for Operation on Chandler Crankcases

The heading illustration shows a seven-spindle milling machine which operates simultaneously on faces *A*, *B*, *C*, *D*, *E*, *F*, and *G* of the crankcase shown standing on end by the machine. It will be noted that the milling cutters are lettered to correspond with the faces of the casting on which they operate. Before this special miller was developed, the work of handling these pieces was done on a large multiple-spindle machine and two knee-type millers. It was necessary to set up the castings three different times, which involved a serious

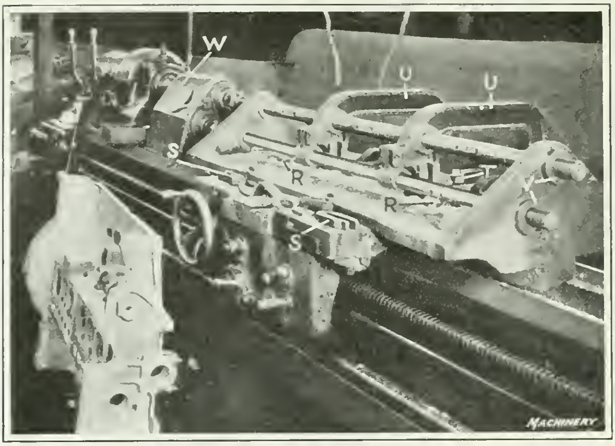


Fig. 2. Lathe equipped with Work-holding Fixture and Duplex Head for simultaneously reaming Crankshaft and Camshaft Bearings of Chandler Crankcases

loss in labor efficiency; also, the three machines occupied a great deal more floor space than is taken up by a single compact tool which provides for simultaneously finishing all seven surfaces on the castings. The crankcase casting is located on the machine by two pilots, one of which is shown at *H*, which enter the valve push-rod holes; and two straps *I* hold the casting down on a surface that has been previously milled.

This machine is arranged with individual motor drive from which power is transmitted through a main clutch to a train of gears contained in the bed of the machine, that provides for driving the various milling cutters at the correct peripheral speeds. After a casting has been set up ready for performing the machining operations, the clutch is engaged by manipulating lever *J*. With the machine in operation, it is then necessary to bring the feed into operation, which is accomplished by the manipulation of knob *K*. On this special machine, the rate of output obtained in milling seven surfaces on the castings is from 140 to 150 finished crankcases in a nine-hour day, and as many as 200 castings have been milled on the machine during this operating period.

Rough-boring and Line-reaming Operations on Crankshaft and Camshaft Bearings

From the milling machine shown in the heading illustration the crankcases are transferred to a machine illustrated in Fig. 1 on which the crankshaft and camshaft bearings are rough-bored. Following the same practice as in milling, location of the castings is accomplished by means of two pilots *L*, which enter the same valve push-rod holes that have been previously utilized. Five hardened blocks *M* engage the milled face of the casting, and clamping is accomplished by handwheels and straps *N*. It will be apparent that the work-holding fixture is mounted on a carriage which slides on the ways of the boring machine bed, this movement being accomplished by means of a lead-screw *O*. The machine is equipped with individual motor drive, and power is transmitted to the two spindles by means of a long helical pinion *P* that meshes with gears on the two spindles *Q*. It will be evident that bushings are provided on the work-holding fixture to maintain the boring-bars in accurate alignment. On this job the rate of production obtained is 150 crankcases that have been rough-bored in the crankshaft and camshaft bearings in a nine-hour working day.

After rough-boring the bearings on the machine illustrated in Fig. 1, the castings are taken to a machine which provides for simultaneously line-reaming the crankshaft and camshaft bearings. As in the two previous operations, location is accomplished by means of pilots which enter two of the valve push-rod holes, the work being clamped down on its previously milled surface. These pilots are shown at *R*, Fig. 2. Clamping down of the casting is accomplished by means of two U-shaped straps *S*, which are arranged to slide under the heads of two clamping bolts, one of which is shown at *T*. This arrangement saves time in setting up the work, as it is only necessary to loosen each nut one-half turn, after which the clamp can be withdrawn and the work lifted off the machine over the head of the bolt. This operation is performed with Kelly aligning bars and reamers made by the Kelly Reamer Co., of Cleveland, Ohio, the blades of which are loosened and turned into the bars to enable them to pass through the guide bushings on the fixture, this feature having been worked out by the Chandler tool designers in collaboration with the Kelly Reamer Co.

Accurate alignment of the two reamers is absolutely essential for the satisfactory performance of this operation, and as there is a wide span between their driving ends and outboard ends, supplementary support is afforded by means of two sets of intermediate bearings carried by arms *U*. These arms are pivoted so that they may be swung down into place to receive the reamers after the casting has been set up in the fixture on the machine. The reamers are next threaded

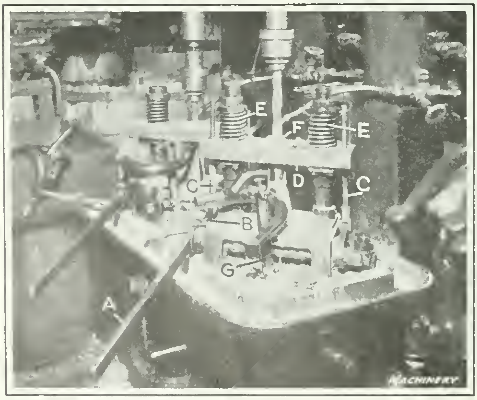


Fig. 3. Universal Drilling Jig used at the Chandler Plant for drilling and reaming Motor Car Steering Arms

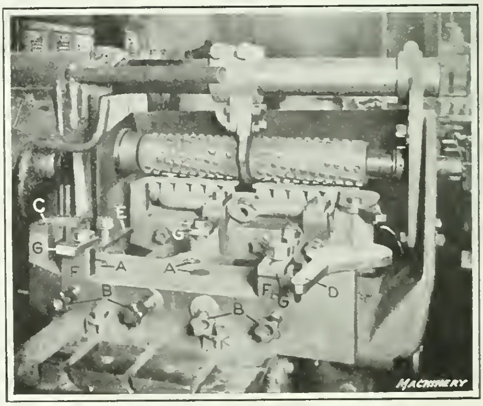


Fig. 4. Milling Machine equipped with Two Jigs for milling the Inlet and Exhaust Port Flanges on Manifolds

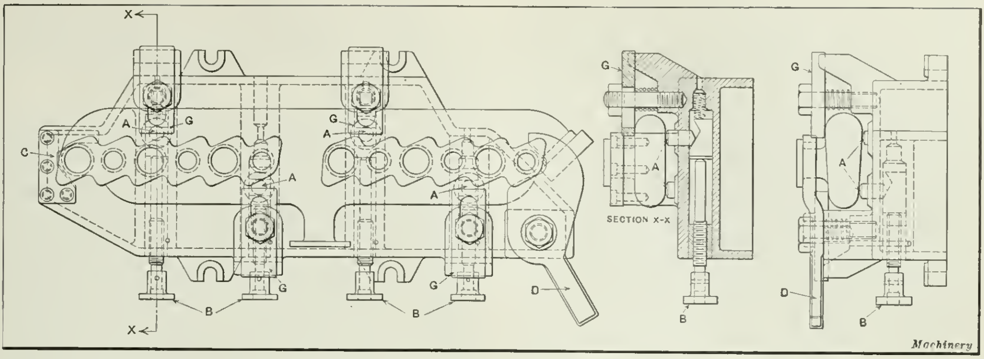


Fig. 5. Plan and Cross-sectional Views and End Elevation of One of the Milling Fixtures shown on the Machine illustrated in Fig. 4

through the work, and the guide bushings carried by arms *U* hold the cutters accurately in position to start their work. It will be seen that on the fixture of the machine there is a final outboard bearing *V* for holding each of the reamers. Arms *U* are clamped down to the fixture to secure them rigidly in place.

This machine was developed from a heavy-duty engine lathe built by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, which was used as a base. Connected to the spindle of the machine, it will be seen that there is a special duplex head *W* that provides for driving the two reamers through universal joints. The lathe carriage supports a special work-holding fixture, which is furnished with six hardened pads that hold the casting from its milled face, and it is traversed along the bed of the machine by means of the feed movement of the carriage. Hence, when the casting has been set up, the carriage provides for traversing the fixture so that the work is fed against the rotating reamers that occupy a fixed longitudinal position. For the performance of this job the average rate of output is 150 castings in twenty hours; it is necessary to employ two shifts of men for performing this line-reaming operation on the work, in order to obtain the required number of finished castings.

Application of Drilling Jigs of Standard Construction

In the motor car industry, cars of new models are brought out annually by many manufacturers, and these modifications of design of the product frequently involve the necessity of changing a large part of the manufacturing equipment in the plant. As a result, most motor car builders have enormous storage spaces in which obsolete tools are kept in storage because, although they are classed as "obsolete," they cannot be discarded due to the necessity of keeping the tools for use in machining replacement parts for delivery to service stations that are called upon to make repairs on cars that have not been manufactured as a regular product for several years.

In the case of drilling jigs, a satisfactory method of greatly reducing the loss resulting from the necessity of discarding special tools has been made possible through the introduction of what are known as standard jigs. They are sold by the National Sales Engineering Corporation, Kresge Bldg., Detroit, Mich., and only need to have special V-blocks added, or other means of holding a given piece of work in place in the jig. These jigs are made in a variety of different sizes to suit various classes of work. Fig. 3 illustrates a two-spindle drilling machine built by the Barnes Drill Co., Rock-

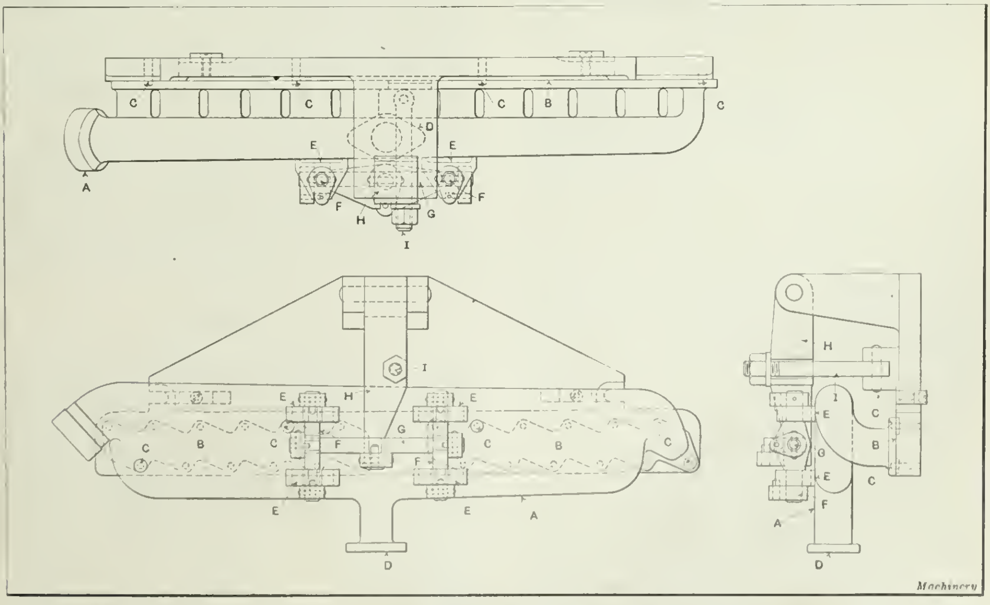


Fig. 6. Milling Machine Fixture with Equalizing Clamping Mechanism for holding Chandler Manifolds while milling the Carburetor Flange

ford, Ill., which is equipped with jigs of this type. It is used in the Chandler plant for drilling motor car steering arms. Both of the jigs used on this machine are of essentially the same design, except that they are arranged for drilling holes in opposite ends of the work, so that a description of one jig and the way in which it is used will suffice.

It will be seen that the jig is of the so-called "pump-handle" type. When handle *A* is depressed, it swings the outer ends of links *B* upward and through connections *C* provides for raising bar *D* against the tension of springs *E*. Connections *C* are threaded and furnished with lock-nuts above and below bar *D*, so that the position of this bar may be adjusted to suit the requirements of the work. With standard jigs of this type, the provision made for holding the work varies according to its form and the conditions under which the operation is performed. In the present instance, a hole is to be drilled in a cylindrical shaped boss at the end of the steering arm, and so the cup bushing principle can be satisfactorily utilized. Drill bushing *F* has a locating cup at its lower end beneath bar *D*, and there is a flat end bushing placed in the bed of the jig in line with the upper bushing *F*. When pump-handle *A* is pushed down, these two bushings are parted sufficiently so that the drilled work can be removed and the cylindrical boss at the end of the next forging can be put into place above the lower bushing, so that when handle *A* is released springs *E* will force bar *D* and bushing *F* down on the work, thus serving the double purpose of locating and clamping the work and of providing a guide bushing through which the drill operates.

With such a method of clamping, it is necessary to furnish a means for preventing the work from rotating while the drilling operation is in progress, and such means are provided by having the outer end of the forging engage a stud *G* set in the drilling machine table for that purpose. As previously mentioned, the hole in the opposite end of the steering arm forging is drilled in the other jig, the arrangement of which is essentially identical with the one that has just been described. The large hole is 51/64 inch in diameter by 1¼ inches deep, and the small hole is ⅝ inch in diameter by 1 inch deep. It will be seen that both spindles of the drilling machine are equipped with quick-change chucks, so that after the holes have been drilled tools may be changed to provide for the performance of reaming operations, the large hole being reamed to a diameter of 13/16 inch and the small hole being reamed to a taper. On this job the rate of production obtained is 225 steering arms in a nine-hour day.

Milling Inlet and Exhaust Port Flanges on Manifolds

On the cast-iron combination type of manifold used on the Chandler motor, the faces of the inlet and exhaust port flanges are finished by milling. This job constitutes a good example of the benefits that may result through making a desirable change in the method of setting up the work on a machine. A practice was formerly made of using fixtures that provided for holding two of the castings in a lengthwise position on the milling machine table, and when the work was milled in this way a feed movement of approximately 30 inches was required to complete the job. The planning department, in looking over this operation, saw that by reversing the position of the work and placing it transversely across the table of the milling machine, provision could be made for handling a casting with a feed movement of approximately 3½ inches.

A new fixture was made for handling the job with two castings set up to be milled simultaneously; and as a little space is required between the fixtures the actual feed movement is somewhat in excess of the 7 inches that would theoretically be required. The job is handled on a Brown & Sharpe plain miller shown in Fig. 4, and the method of procedure is to set up a casting in the fixture nearest to the cutters and then engage the feed movement. Before it is time for the cutter to start working on the second casting, the operator has had ample time to load it into the fixture, and following this procedure the idle time of both the machine and its operator is substantially reduced. It will be seen that the two inserted-tooth cutters have sufficient face width to reach across the two sets of flanges on each manifold, thus enabling the entire milling operation to be performed at one setting.

For locating these pieces for milling, the method of procedure is as follows: There are four plugs *A*, (see Figs. 4 and 5) that are raised or lowered by means of hand-screws *B* to provide for uniformly supporting the work from its rough cast surface. Before tightening up plugs *A*, the casting is dropped into place in the fixture, and one end is pushed into a V-block *C*, after which lever *D* is swung about its pivotal support to bring the V-block that is located at the opposite end of this lever from the handle into engagement with the end of the work. Next, two pivoted eccentric clamps, one of which is shown at *E* in Fig. 4 are brought into engagement with the back of the work to force it forward against the two plugs *F* at the front of the fixture, that support the thrust of the milling cutters; and, finally the casting is clamped down by tightening three straps *G*. In the performance of this operation the rate of production is 150 to 160 milled castings in a nine-hour day.

Milling Carburetor Flange on Manifolds

At *A* in Fig. 6 there is illustrated the manifold on which the intake and exhaust port flanges were milled while the work was set up in the fixture shown in Figs. 4 and 5; and the fixture illustrated in Fig. 6 is used for milling the carburetor flange on the same pieces. Bearing in mind that the operation just described is the first work done on these cast-iron castings, it will be obvious that the milled surfaces of the intake and exhaust port flanges will be utilized for locating the work. The finished faces of these flanges are secured against surface *B* on the fixture, and final location is accomplished by means of four pins *C* that enter holes drilled in the intake and exhaust port flanges. Held in this way the carburetor flange *D* is properly located for milling on a plain knee-type machine.

The interesting feature of this fixture is the arrangement of equalizing clamps that provides for obtaining a uniform grip on the rough cast surface of the back side of the manifold, to secure it in place ready for performing the milling operation. For this purpose there are four pivoted equalizers *E*, each of which is provided with two feet to grip the work. It will be evident that these equalizers are carried by crossbars *F*, which, in turn, are supported on a rod *G* carried by the pivoted arm *H*. After the manifold casting has been set up in the fixture, arm *H* is swung down so that the four equalizing clamps *E* come into contact with it; then the clamping bolt *I* is swung into position in a slot in the arm *H*, so that a slight amount of turning of the nut on this bolt provides the desired clamping effect. With the present system of supporting the clamping members *E*, adjustment is provided in three directions by means of pivotally supported connections between the arm *H* and the clamps *E*, so that ample compensation is provided for any irregularities in the castings.

* * *

PRINTING COSTS

The American Society of Mechanical Engineers has been investigating the increased cost of printing since 1914, and in November *Mechanical Engineering* are published some figures showing increases in costs in the publishing and printing business which have been greater than in practically any other industry. The figures that are quoted below from *Mechanical Engineering* show the percentages of increase since 1914 in the production of that journal, and of course are equally applicable to the production costs of a journal like MACHINERY:

Machine Composition	105	Paper	300
Hand Composition	218	Engravings (inch rate)	110
Presswork	170	Engravings (minimum sizes)	275
Binding	118		

Chart for Selecting Spiral Gears

By C. W. MAPES

THE selection of a pair of spiral gears to satisfy certain established requirements is not easily accomplished, mainly because an adequate grasp of the relation between the several factors involved cannot be easily acquired. The accompanying chart was developed to aid in selecting and calculating spiral gears with shafts at right angles to each other. It gives a graphical presentation of the conditions involved, and readily shows the influence that a change in one factor has on the others, thus making it possible to select the most suitable combination of gears with little labor and, in many cases, eliminate several trial calculations. The results read from the chart are necessarily approximate and should be checked by using formulas given in MACHINERY'S HANDBOOK in the section pertaining to spiral gears.

Description of Chart Construction

The chart is only suitable for gear combinations in which the tooth angle of the large gear is not greater than 45 degrees. However, as the ratio between the two gears of a combination increases above 1 to 1, the angle of the teeth in the large gear has an increasingly strong tendency to fall below 45 degrees, and so the range of the chart will satisfy nearly all cases. The center distance between two gears, the normal diametral pitch of their teeth, and the number of teeth in the small gear are not limited to the numbers and dimensions shown on the chart. The manner in which the scope of the chart is enlarged in this respect will be explained later. The horizontal lines represent the center distance in inches between the two gears of various sets. The plain vertical lines represent the angle of the teeth of the large gears, the width of each space representing ½ degree. The dotted vertical lines represent the number of teeth in the small gear. The vertical lines crossed by short oblique dashes, represent the normal diametral pitch of the gear teeth. The upper numbers at the top of the chart refer to the dashed lines while the lower ones refer to the dotted ones. The curves represent the ratio of gear sets and, as they are equally spaced vertically, odd ratios are proportional between the curves when measured in that direction.

Selecting Gear Combination by Use of Chart

In order to illustrate the use of the chart, assume that it is required to calculate a pair of spiral gears having a ratio of 3 to 1, of 10 normal diametral pitch, with an exact center distance of 1.875 inches, and with their shafts placed at right angles to each other. In addition, the conditions are such that the large gear must pass through a hole 2.25 inches in diameter and must fit on a 1-inch diameter shaft. These conditions necessitate that the pitch diameter be about 1.75 or 2 inches. In solving this problem, the first step is to locate the horizontal line on the chart representing a center distance of 1.875 inches, and follow it to its intersection with the dashed vertical line corresponding to 10 normal diametral pitch. From this intersection, lay a straightedge in the direction followed by the nearest diagonal line, intersecting the dotted vertical lines representing the number of teeth in the small gear.

At this point of the procedure, several trials must be made in order to decide what is the proper number of teeth to assume for the small gear. Trying six teeth, next follow the nearest horizontal line from the intersection of the straightedge with the six-tooth line, to the 3 to 1 ratio curve. From this point of intersection follow the nearest plain vertical line to the bottom of the chart, where the angle of the teeth of the large gear will be found to be about 19 degrees. As six teeth were selected for the small gear and as the ratio between the two gears of the combination is 3 to 1, the large gear will have 18 teeth. The pitch diameter of a gear having this number of teeth must now be determined, and this can be done by means of the following formula taken from MACHINERY'S HANDBOOK:

$$D = \frac{N}{P_n} \sec \alpha$$

in which

D = pitch diameter of large gear;

N = number of teeth in large gear;

P_n = normal diametral pitch; and

α = exact spiral angle of teeth of large gear.

Substituting the known values in this formula,

$$D = \frac{18}{10} \times 1.0576 = 1.904 \text{ inches approx. pitch diameter}$$

This value for the pitch diameter is satisfactory according to the approximations previously made. Trying five teeth for the small gear and proceeding in the same manner, the large gear will be found too small, and with seven teeth, it will be found that the horizontal line from the intersection of the diagonal line with the vertical line representing seven teeth for the small gear falls below the 3 to 1 ratio curve. This fact shows that a combination of seven and twenty-one teeth would require either a greater center distance between the two gears or a finer pitch. These trials show that six teeth in the small gear and eighteen in the large one is the only combination which will fill the requirements.

The angle of the teeth in the large gear obtained by means of the chart should now be checked by the following equation given on page 674 in MACHINERY'S HANDBOOK:

$$R \sec \alpha + \operatorname{cosec} \alpha = \frac{2\,CP_n}{n} \qquad (1)$$

in which

R = ratio of number of teeth in large gear to number of teeth in small gear;

C = exact center distance between gears;

n = number of teeth in small gear;

and the remaining symbols represent the same elements as in the previous formula.

Substituting the values in this equation,

$$3 \times 1.0576 + 3.0715 = \frac{2 \times 1.875 \times 10}{6}$$

$$6.2443 = 6.25$$

This shows that the angle of the teeth in the large gear is slightly less than 19 degrees. Taking angle α as equal to 18 degrees 58 minutes gives a value of 6.2489 for the left side of the equation; and an angle of 18 degrees 57 minutes, gives the value of 6.2512. These calculations indicate that the exact angle of the teeth lies between 18 degrees 57 minutes and 18 degrees 58 minutes. Substituting this angle in the formula for exact pitch diameter,

$$D = \frac{18}{10} \times 1.05735 = 1.903 \text{ inches}$$

Cases when Chart Gives Two Different Angles for Teeth of Large Gear

In instances where the horizontal reference line from the intersection of the diagonal line with the tooth line crosses the required ratio curve at two points, either of these points may be used in determining the angle of the teeth of the

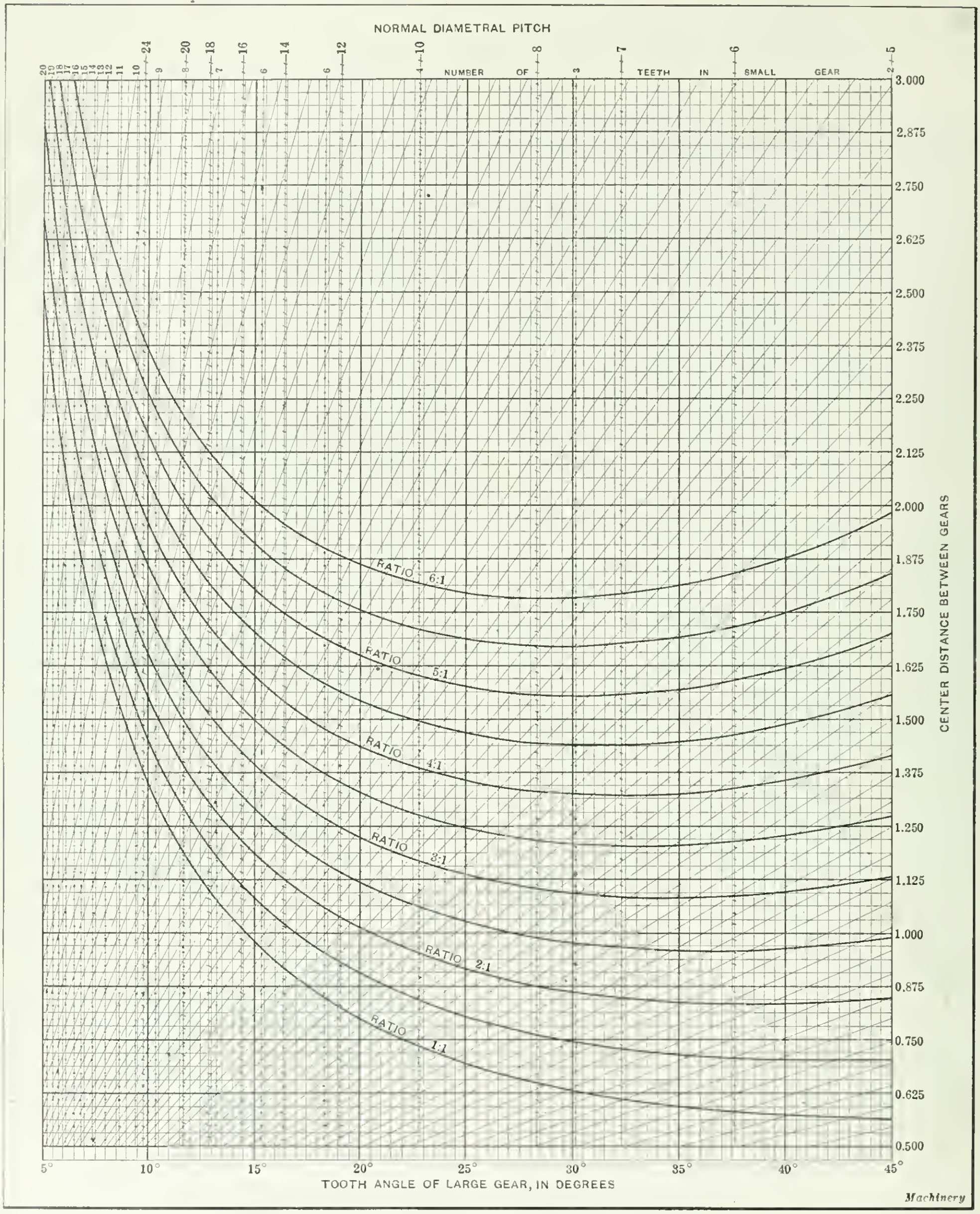


Chart for Selecting Spiral Gears having Shafts at Right Angles to Each Other

large gear. For instance, in a case where the center distance between two gears is 1.875 inches, the normal diametral pitch 10, the ratio 6 to 1, and the number of teeth of the small gear 4, it will be found that the horizontal line referred to crosses the 6 to 1 ratio at two points. The nearest vertical line to one point shows the tooth angle of the large gear to be about 19 degrees 22 minutes, while the nearest vertical line to the other point shows it to be about 39 degrees 50 minutes. The values obtained by substituting these angles in Equation (1) are almost identical, thus proving that either angle is suitable for the requirements given. It must be borne in mind, however, that the pitch diameter of the gear varies with the angle of the teeth, and so the proper angle to be selected depends upon this factor to some extent.

Enlarging Scope of Chart

Only a knowledge of the fundamental principles of spur gears is required to extend the use of the chart beyond the limits indicated by the figures for center distances and the numbers for normal diametral pitches and numbers of teeth of the small gear. The following rules hold good in this connection, provided the other factors remain unchanged:

Rule 1—The center distance between two gears varies inversely as the normal diametral pitch.

Rule 2—The number of teeth in the small gear varies directly as the center distance between two gears.

Rule 3—The number of teeth in the small gear varies directly as the normal diametral pitch.

As an example of the application of the first rule, for a set of 4 normal diametral pitch gears with a center distance of 4 inches, use the chart the same as for a center distance of 2 inches and for gears of 8 normal diametral pitch. As an example of the second rule, for a set of 10 normal diametral pitch gears having a center distance of 4 inches, use the chart the same as for a center distance of 2 inches but read double the number of teeth for the small gear indicated by the figures on the chart. As an example of the third rule, for a set of 32 normal diametral pitch gears having a center distance of 2 inches, use the chart the same as for a center distance of 2 inches and a normal diametral pitch of 16, but make the number of teeth 32/16 times, or double, that indicated by the figures.

* * *

FIXTURE FOR CASTELLATING NUTS ON A VERTICAL MILLING MACHINE

By WILLIAM OWEN

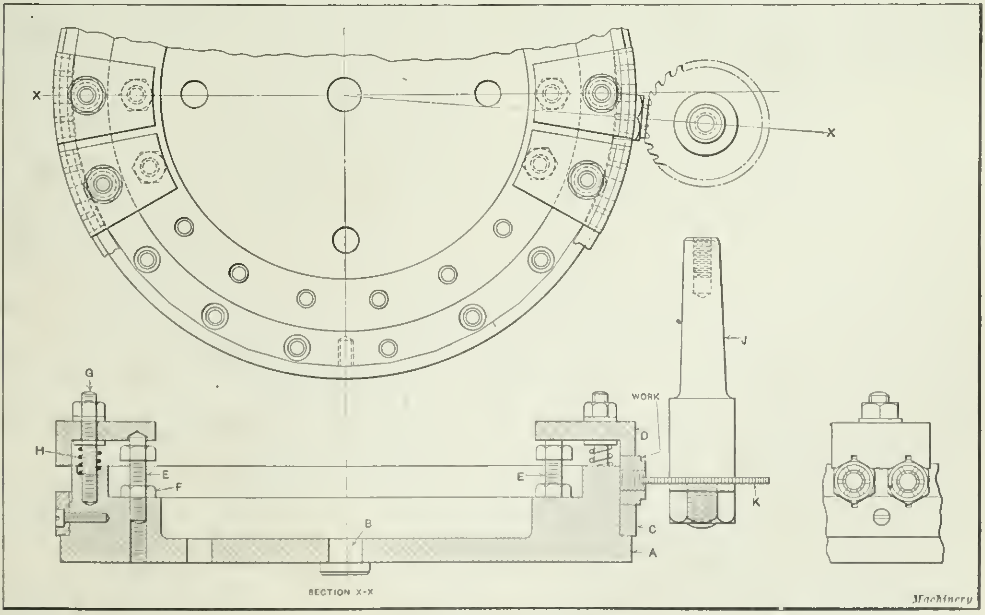
The grooving or castellating of nut faces without the aid of a special machine can be readily accomplished on a vertical milling machine equipped with a circular table, by employing the fixture shown in the illustration. This fixture was designed for handling nuts of a hexagonal shape, but by slight modifications it can be adapted for nuts of other shape or other parts on which it is desired to mill grooves in their faces. The fixture holds thirty-six nuts at one time, provision having been made for handling nuts of various sizes ranging from 5/8 to 1 3/8 inches.

The cast-iron body *A* is located on the table of the milling machine by means of plug *B*, and is secured to it by four T-bolts inserted through the holes in the base. The body is turned down around its periphery for the hardened V-ring *C*, which is pressed in place and attached to the body by four fillister-head machine screws. This ring is provided with thirty-six vees placed 10 degrees apart along its top surface for supporting the lower portions of the nuts to be machined, as shown in the partial end view. These vees have included angles to suit those between the flats of the work. Just above the top of ring *C*, thirty-six flats, also 10 degrees apart, are milled around the periphery of the body, their centers being in line with the centers of the vees in the ring. These flats support the backs of the nuts placed in the fixture, during the performance of the operation.

The upper portions of the nuts are held in vees provided in eighteen hardened clamps *D* which are placed equidistantly around the top of the fixture, there being two vees in each clamp. These clamps are held to various heights above ring *C*, by means of studs *E*, the height to which they are held depending upon the size of nuts being machined. Each of studs *E* can be raised or lowered by turning its hexagonal head, and after a clamp has been adjusted to the desired height, the stud is locked in place by means of nut *F*. The clamps are forced down on the work by tightening the nuts on studs *G*. A spring *H* is provided on each of these studs to force its corresponding clamp upward when the clamping nut is loosened.

After the clamps on the fixture have been set for handling a certain size of nut, arbor *J*, with cutter *K* attached, is placed in the spindle of the milling machine and secured there. The cutter is then set to the proper height in relation to the fixture so that it will cut grooves directly through the center of the nuts when the fixture is rotated. In order that these grooves will be cut to the correct depth, the fixture must also be set the proper distance away from the cutter.

The work of the operator consists of inserting and removing the nuts as the fixture revolves, and clamping and unclamping them by tightening and loosening the nuts on studs *G*, as previously described. When two grooves are milled across the nut in one direction, the position of the nut in the vees of ring *C* is shifted so that two more grooves are milled at an angle of 60 degrees to the first. The nut is then again replaced so that the final two grooves will be milled midway between those machined previously. A large production has been obtained by the use of the fixture described in the foregoing.



Fixture for grooving or castellating Nuts on a Vertical Milling Machine

SUGGESTION SYSTEM

A system that encourages employes to suggest improvements which they believe would increase production, promote safety, better working conditions, or lower production costs, is a paying proposition. The suggestion system here described has been used with excellent results by a well-known machine tool manufacturing company, and should prove a good type for almost any shop employing from one hundred to a thousand men. An organization of more than a thousand employes might well afford to adopt a more elaborate system.

Methods of Encouraging Suggestions

It may be said that the best method of encouraging suggestions is through an employe's shop magazine. In this magazine can be given a list of subjects upon which suggestions are desired. Another method of stimulating the desire to send in suggestions is to send letters by mail to the employe's home. When an employe gets an idea, either through the letter or some other source, he can go to one of the many suggestion boxes provided through the shop, and there obtain envelopes addressed to the president of the company and printed forms on which suggestions are to be written. These forms may be filled out at home or in the plant, as preferred. The employe signs his name, clock number, and department number at the bottom of the form, and mails the suggestion direct to the president.

Method of Handling Suggestions

These envelopes are never opened by anyone except the president. He reads the suggestion, and acknowledges its receipt in a friendly way, stating that the suggestion will be carefully considered and that decision as to its availability will be made as soon as possible. The president then writes the names of three department heads or executives on the back of the suggestion form, and turns the suggestion over to a stenographer who makes three copies, omitting the signature. The suggestion with the acknowledgment is then numbered and indexed, after which it is filed to await the replies from the three executives. As soon as the replies are received, they are attached to the original suggestion and turned over to the works manager. He reviews the answers, makes any required investigations, writes down his personal opinion of the suggestion, and then turns it over to the employment department to record. The suggestion then goes back to the president.

Reward for Suggestions

In most cases, the president will base his answer and the amount of the reward upon the three replies and the report of the works manager. Occasionally a suggestion is received which is referred to every department head. Again, a meeting may be called before a decision is made. The suggestion, when placed on the president's desk, is accompanied by a memorandum showing how many suggestions have been previously made by the employe. If it is the first suggestion, it receives special attention and the reward is usually more liberal than for later suggestions of the same value. In the plant in which this system was employed, it was found that only 40 per cent of the employes sent in suggestions during the first two and one-half years in which the system was in use. The employes composing the 40 per cent, however, did very well, having submitted 900 suggestions which averages a little better than one suggestion a day. A suggestion system, like many other systems or plans, is much easier to start than to keep up, and it requires some work to maintain the employes' interest. Almost any system will get results for the first two or three months, but if it is to become of permanent value, it must be carefully worked out. Care must be exercised in the handling of the suggestions, as one poorly handled suggestion may cause several employes to stop sending in suggestions. Almost every suggestion can be made of value. Probably only a small percentage of the suggestions will be found to be really good, while perhaps 75 per cent will be classed as ordinary. Of course, many suggestions that are actually foolish and a few of a peculiar nature that require diplomatic handling will be received.

Suggestion System Promotes Cooperation

The writer has in mind an instance of the tactful handling of an unacceptable suggestion. A suggestion was sent in, in which it was requested that the president arrange a new working schedule for the plant. The existing schedule was criticized, and an outline was given of a new working schedule which was claimed to be more favorable to the employes. After investigating the proposed plan, it was found that only about 15 per cent of the employes favored the idea. In replying to this suggestion, it was pointed out that the existing plans were made for the benefit of as large a percentage of the employes as possible, and that 85 per cent of the workers were better suited with the existing arrangement than they would be with the proposed schedule. With this explanation the employe could readily see why his proposed plan should not be adopted, and his sense of fairness would prompt him to tell others who had advocated the plan, why it was undesirable to make any change in the schedule.

A suggestion system is of great assistance to the employment department. It often enables the department to make promotions that will greatly benefit the company. Altogether, it serves as a means by which the employer can get into closer touch with his employes and thereby develop a spirit of cooperation throughout the plant. A. J. S.

* * *

SCIENTIFIC ENGLAND AND THE METRIC SYSTEM

According to a statement received from the American Institute of Weights and Measures, 115 Broadway, New York City, there was prepared in the early part of 1920, but only recently made public, a very interesting and important report on the compulsory adoption of the metric system in the United Kingdom. This report was submitted by the metric committee appointed by the Joint Board of Scientific Societies, this board representing about fifty societies covering every field of science, art, and engineering. As stated in the preface note of the report, the committee was appointed to consider and report upon the advisability of compulsory adoption of the metric system of weights and measures by the United Kingdom. The report covers with appendices seventy printed pages. The first and basic recommendation made by the committee reads as follows:

1. That the British system of units of weights and measures be retained in general use in the United Kingdom; that no proposals for modification of these units with the object of improving their inter-relation be entertained; and that no new fundamental unit be established. In preference to any such alteration, the committee would recommend the whole-hearted adoption of the metric system.

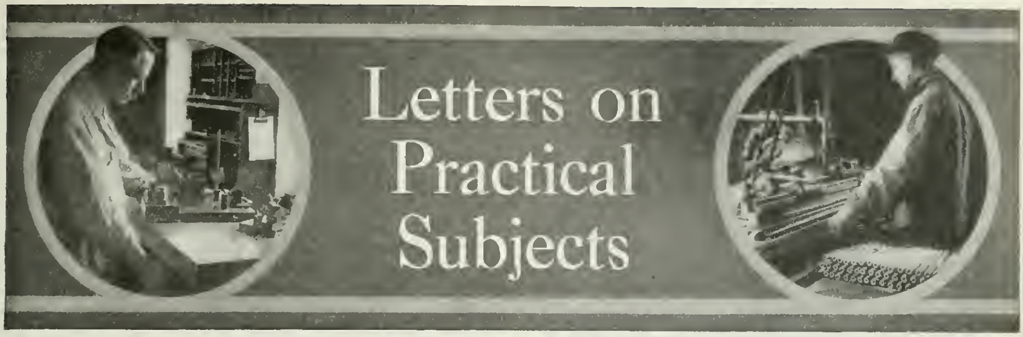
In the matter of simplification of the British system, the committee recommends the following:

Measure of Length—The abolition of the pole, furlong, and league; the limitation of the link and chain to use in the determination of area.

Measures of Weight—The abolition of the grain, dram, stone, quarter, and hundredweight of 112 pounds, and the complete abolition of apothecaries' weight.

Measures of Capacity—The use of the gallon as the general standard, with the customary subdivision into quarts and pints for retail use, but not otherwise; the abolition of the peck, bushel, quarter, chaldron, and barrel, and the substitution of measure by weight.

Measures of Areas—The abolition of the square rod or perch and the rood, all areas of land being in acres and decimals, or in square feet for small plots, and all other superficial measures being in square feet.



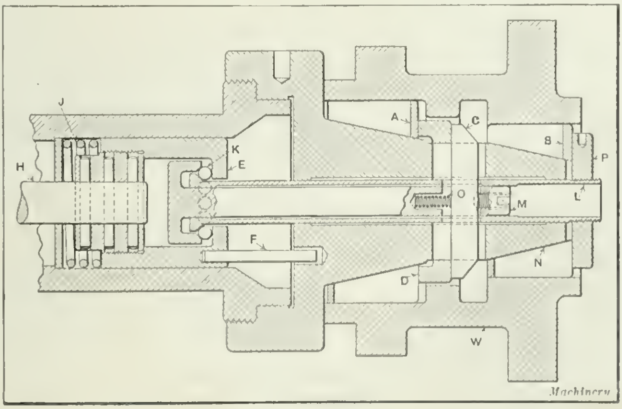
Letters on Practical Subjects

ADAPTER FOR LONG WORK

The adapter or expansion chuck here illustrated is shown applied to a Foster universal turret lathe, but may be used in connection with any screw machine or turret lathe that is furnished with an automatic chucking mechanism. The adapter in the present case is of the draw-back type, but with slight modifications in design it may be used in connection with the push-out type of chucking mechanism. It will be seen that this adapter employs the familiar expanding bushing idea and that the design provides especially for handling long work, which has been previously bored and on which there is a faced end that may be used as a locating surface when drawing the work against the arbor *N*.

The construction and operation of the adapter is as follows: The draw-rod *H*, which extends through the machine spindle and is operated by the automatic chucking mechanism, is pinned to a head which screws into one end of plunger *E*. The opposite end of plunger *E* and the angular surfaces of sleeve *L* and rod *M* form a housing for balls *K*, so that when the plunger is drawn back, the pressure will be equally distributed on these surfaces of the rod and sleeve, through the medium of the ball bearings. Rod *M* extends through sleeve *L* in which it is free to operate, and both these members are slotted to accommodate the bar *C*. The tapered arbor *N*, which is screwed to the nose of the spindle, contains an elongated slot in which this bar *C* operates.

There are two split bushings *A* and *B* which are expanded on the two tapers of the arbor when the adapter is in use, by rod *H* being moved axially to the left. It will be seen that there is a washer *D* which is forced against the end of bushing *A* when bar *C* is brought in contact with it, and on the threaded end of sleeve *L* there is another washer *P* which acts on bushing *B*, so that by drawing rod *H* to the rear, the two washers force the split bushings on the tapered arbor and thus expand them. The adapter is shown expanded, holding the work *W* against the face of the tapered arbor. Spring *J*, enclosed in the spindle, releases the work by returning the expanded bushings to their inoperative positions as soon as the chucking mechanism has functioned. Simultaneously with the release of the work, the spring *O* in the end of rod *M* expands, keeping the bar *C* in contact with the set-screw against which it bears.



Sectional View of Adapter applied to Turret Lathe Spindle

By suitable modification in the size of the bushings to suit the requirements of the particular piece of work for which the adapter is to be used, this device is applicable to a wide range of work. Pin *F* is provided to prevent the plunger from turning while the draw-rod is being turned.

Elkhart, Ind. I. F. Yeoman

TRAINING TOOLMAKERS FOR TOOL DESIGNERS

It is a source of annoyance to many toolmakers to receive some of the drawings that they are compelled to follow in making tools, because in many instances the men in the shop know more about the tool to be made than the man who made the drawing. The usual way to obtain a tool designer is to advertise for him, and frequently the best kind of man is not obtained in that manner. There is some very good material available in almost every large plant in the mechanical line from which first-class tool designers could be made. This material in many cases is not used and, instead, great effort is put forth to secure ready-made tool designers from the outside.

Every toolmaker will not make a good tool designer, but it is certain that the more shop experience a good tool designer has, the better designer he is. It does not take long to make a good tool designer out of a toolmaker with ideas and ability, provided he is of the type that is willing to learn. When a man is found in the shop who is quick to learn and is a good all-around mechanic, it is a good plan to try him out in the drafting-room. He is likely to make a good tool designer. If he has made good in the shop, there is at least an even chance that he will make good in the drafting-room. With a shop full of good toolmakers that could be tested out and from which selections may be made for designers, why should unknown outside men be brought in for trial? It is believed that it will pay the employer to put some of his toolmakers into the drafting-room and train them even if they have to stay at the board learning for the first six months. It has been suggested that in order to protect himself, the employer might have some kind of contract drawn up for a given period of time. The selection should be based upon the man's experience, his willingness to learn, his loyalty and his ability to see things mentally. Generally speaking, a good toolmaker who has had an opportunity to spend a period in the production department, so as to get a good idea of the necessary essentials of jigs and fixtures, will in a short time make a good and dependable tool designer. If the large plants in the country would use this method of training tool designers, it would be possible to eliminate a great many men who are now engaged in this work but who are not fitted for it by experience and training, and more efficient designers would thus be obtained.

JACK HOMEWOOD
Ontario, Cal.

CAM MILLING ATTACHMENT

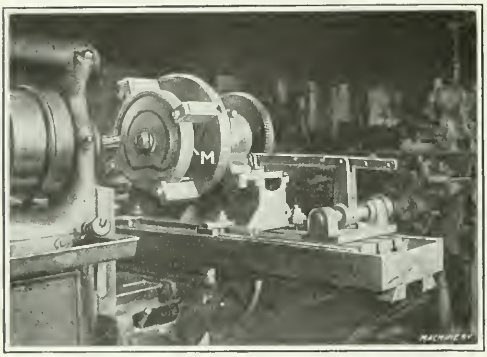


Fig. 1. Cam Milling Attachment mounted on Milling Machine

The attachment shown in the accompanying illustrations has been used successfully for a number of years on a horizontal milling machine for milling cams such as the one shown at *M*, Fig. 1. In this illustration the attachment is shown in position on the milling machine table as it appears when in operation. The method of imparting motion to the work in such a way that the required contour will be given the cam, is shown in Fig. 2.

Referring to Fig. 2, *A* is the bearing or headstock casting, which is mounted on slide *B*. The chuck *C* has four jaws and is mounted on one end of the work-spindle, which is rotated by means of worm *E* and worm-wheel *D* through shaft *N*. Shaft *N* is driven from the feed-box, and is provided with a universal joint *P* as shown. The former, or master cam *F*, corresponds in outline to the cam groove required in the plate cam which is to be milled. The weight *I*, acting on head *A* through bellcrank lever *J* and link *K*, keeps former *F* in contact with roller *G*, which is mounted on a fixed bracket *H*. When the machine is in operation, the cam being cut is rotated against the cutter *R*, which is held in the milling machine spindle. In addition to the rotary motion, it is evident that the work-spindle moves back and forth over slide *B* in accordance with the sliding motion transmitted by former *F*. The contour of the groove milled in the cam face is thus made to conform to the contour of the former cam *F*.

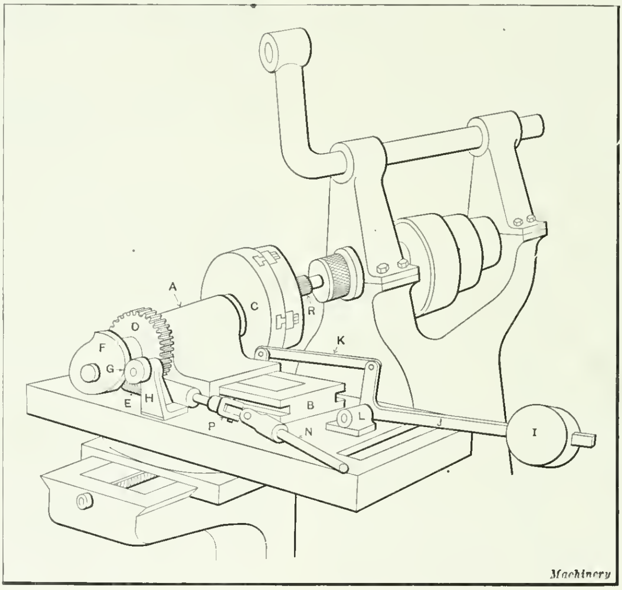


Fig. 2. Illustration showing Principle on which the Cam Milling Attachment operates

Fig. 3 is a sectional view of the milling attachment, which shows the work-holding spindle and the important structural details of the attachment. The plate cam shown in Fig. 1 has cam grooves on both of its faces. In order to mill these grooves, it was, of course, necessary to make suitable provision for reversing the piece in the chuck. This necessitated designing the spindle in such a way that it could be adjusted longitudinally so that it would extend through the full length of the cam hub when the cam was reversed or placed in the chuck in the position indicated by the dotted lines at *N*. It will be noticed that the chuck jaws consist of two pieces *A* and *B* and that the parts *A* are formed to fit the work. The jaws are employed to clamp the work against the face of the chuck, and are not intended for use in centering the work, as that is accomplished by the spindle, which is made a close fit for the hole in the hub of the cam. Former or master cams which are interchangeable on the spindle are provided for use in milling cams that have different contours.

W. C. STEUART
Baltimore, Md.

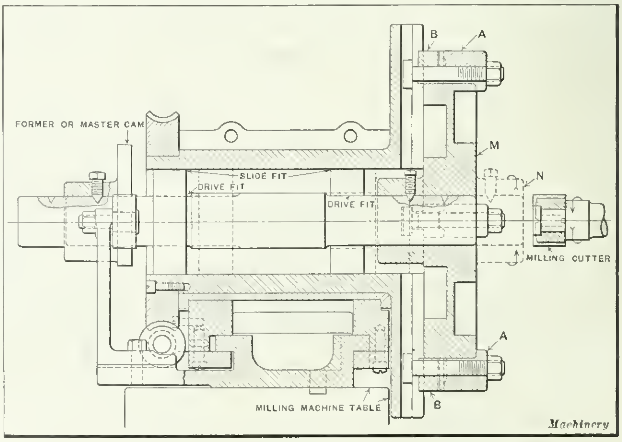


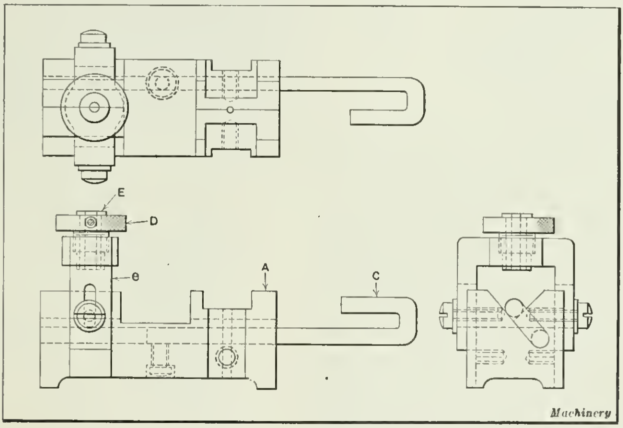
Fig. 3. Sectional View through Work-holding Spindle showing Important Details of Construction

ADJUSTABLE DRILL JIG FOR SMALL ROUND STOCK

The drilling of cross-holes in small studs, pins, shafts, tubes, etc., presents a problem in shops where the quantity of work does not warrant the outlay of much money for drill jigs. When the tolerances specified are taken into consideration, it is obvious that this work demands some adequate method of tooling that will permit operations to be performed accurately and economically. The accompanying illustration shows a jig which has been designed to meet such conditions on work ranging from 1/8 to 5/8 inch in diameter and of various lengths.

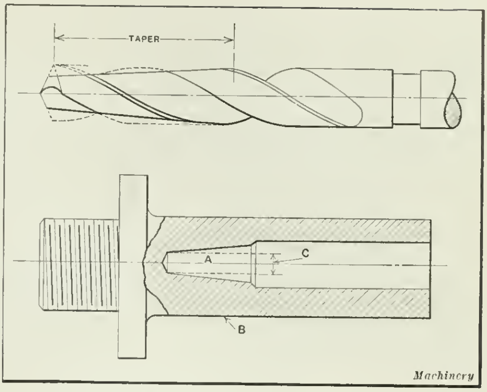
It will be seen that base *A* is provided with a raised section at the top of each end, which has a V-groove running in a longitudinal direction in which the work is placed. On each side of the ends of the base there is a slot of a sufficient width to accommodate yoke *B*. The latter is attached to base *A* by means of two fillister-head machine screws which fit in tapped holes in the slots of the base. In the slot at the left end of the base, the tapped holes are near the top, and when the yoke is placed at this end, the jig is adapted for the larger sizes of work. The tapped holes in the right-end slots are near the bottom of the base, and when the yoke is fastened in these slots, the jig is arranged for handling the smaller sizes.

The work is located longitudinally in the jig by means of stop *C* which can be secured in various positions to suit the distance a hole is to be drilled from the end of a part, by means of the fillister-head machine screw contained in the bottom of the base. The work is clamped in the jig by the knurled and threaded sleeve *D*, which is screwed down on it. This sleeve contains the drill bushing *E* and has a ground cylindrical surface at its lower end to guide it accurately while it is being screwed into the yoke. Drill bushing *E* is removable and made for various drill sizes.



Jig for drilling Holes in Different Sizes of Small Round Stock of Various Lengths

Brooklyn, N. Y. William J. Gourley

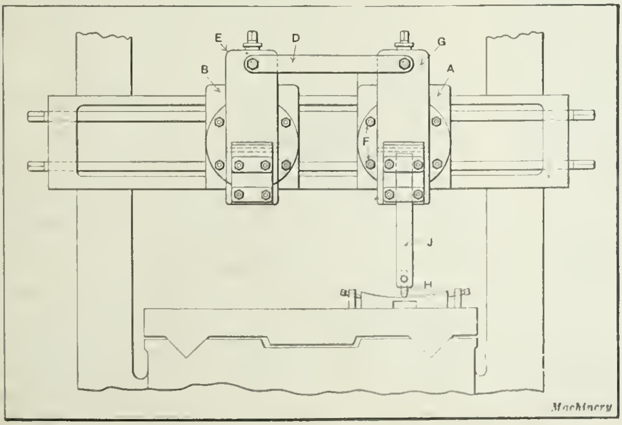


Reamer made from Twist Drill for reaming Hole A

TAPER REAMER MADE FROM TWIST DRILL

The accompanying illustration shows how a standard 5/16-inch diameter high-speed steel twist drill was ground down to a taper of 3/8 inch per foot, and properly relieved for the purpose of reaming out hole *A* in the hard cast-iron step bearing *B*. It was found that a twist drill with the taper ground as shown would cut faster than the best standard reamer obtainable, and that it would produce a good finish and stand up well in the hands of unskilled workmen. A straight drill was, of course, employed to drill out the hole to the size indicated by the dotted lines at *C* in the illustration before using the tapered drill to produce the desired tapered form.

Honesdale, Pa. W. Burr Bennett



Equipment provided on Double-head Planer to adapt it for machining Circular Surfaces

MACHINING CIRCULAR SURFACES ON THE PLANER

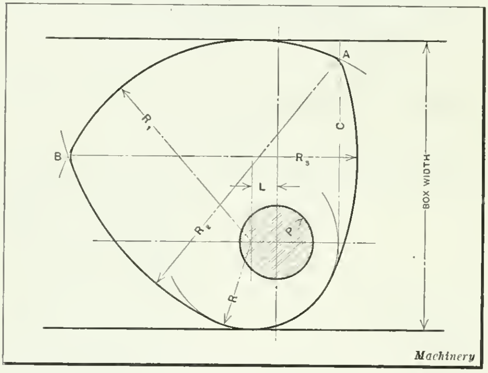
A simple arrangement permitting circular surfaces to be planed, which can be applied to any double-head planer, is shown diagrammatically in the accompanying illustration. Saddle *A* is clamped stationary on the cross-rail, while saddle *B* can be fed along the cross-rail in the customary manner. Slide *E* is clamped in a vertical position on saddle *B* and is connected to slide *G* by means of rod *D*, the latter being attached to the slides by machine screws. The slide clamp-nuts *F* are loosened just sufficiently to permit slide *G* to swivel when a slight pressure or pull is applied at its upper end. It will be seen that tool *H* is held in a special holder *J*, which should be rugged enough to permit operations to be performed without chattering.

In planing a circular surface, when saddle *B* is fed along the cross-rail, rod *D* causes slide *G*, holder *J* and tool *H* to swivel, so that the cutting edge of tool *H* travels in the desired arc. The radius to which the circular surface is planed depends upon the distance from the cutting edge of the tool to the center about which slide *G* swivels. The writer has seen surfaces having a radius of 3 feet planed successfully with this equipment. The length of rod *D* is governed by the width of the planer and the width of the work.

Ilion, N. Y. D. R. Gallagher

LAYING OUT A BOX CAM

In the following, a description is given of an accurate method of laying out a box cam of the type used extensively in jig and fixture constructions, so that the cam will be in contact with both sides of the box during the complete revolution of the pin on which the cam is mounted. Although this cam is a standard type, the writer has never seen any instructions that would enable a draftsman to lay one out to suit various conditions which may arise. The following method applies to a cam of any size and lead, and the layout can be accomplished within a few minutes.



Method of laying out a Box Cam Quickly and Accurately

First establish the horizontal and vertical center lines about which the cam is to rotate, and then determine the horizontal distance *L* that the contact points of the cam are to be ahead of the center about which the cam rotates. Next lay out the pin outline of which *P* is the radius, after which draw an arc of radius *R* and one of radius R_1, to suit the width of the opening in which the cam is to fit. Next, erect vertical line *C* tangent to the arc of radius *R* until it intersects the arc of radius R_1 at *A*. From this point of intersection draw an arc of radius R_2 tangent to the arc of radius *R*, intersecting the arc of radius R_1 at *B*. Finally, from intersection *B*, strike an arc of radius R_3 tangent to the arc of radius *R*. The last arc will also meet intersection *A*.

It is evident that radii R_2 and R_3 are limited by radii *R* and R_1. With a cam of this construction, there will be no play between the box and the cam at any time, and the fixture clamp may be operated either by the box, using a stationary cam pin, or by the cam pin, using a stationary box.

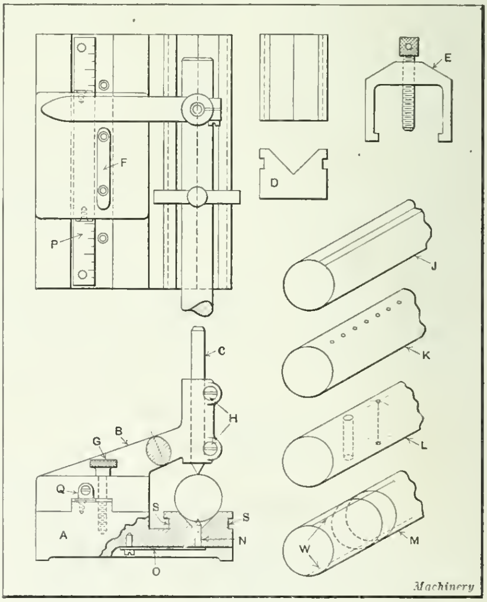
Bound Brook, N. J. Oscar J. Nollet

A PUNCH-MARKING AND SCRIBING FIXTURE

The accompanying illustration shows a useful fixture for the toolmaker or anyone who has considerable laying out to do on round stock. It consists of a cast-iron base *A*, having a vee for holding the work, and a cast-iron bracket *B* for holding the punch or scriber *C*, also an auxiliary V-block *D* for supporting the end of a long piece of work. At each side of the vee are grooves *S* for the hold-down clamps *E*, which may be forged to shape or cut from a solid steel plate. The bracket slides on the base, being guided by the raised portion or tongue on the latter. It has a long slot *F* through which a clamp screw *G* enters any one of a series of tapped holes in the base, for such work as requires clamping the bracket to the base. The hole for the punch or scriber is accurately drilled and reamed vertically on a line with the bottom of the vee in the base. A split boss and two clamp-screws *H* take up any play between the punch and its guide.

For the purpose of marking round stock diametrically opposite for drilling as indicated at *L*, a small hardened and pointed stud *N* is set into the bottom of the vee as shown, and held in place by a flat spring *O* working in a planed or milled groove in the bottom of the base. In doing work of this kind the bracket is first clamped so that the points of the punch and stud are in line; then the work is inserted and a mark made with the punch. The work is then reversed and placed so that the lower point enters the punch mark; then the upper side is punched, thus locating the two marks opposite each other. Another way would be to drill the work in place in the fixture after marking the upper side. When using this method the work would be left clamped in place and the bracket removed. The base and work would then be placed on the drilling machine table and the hole drilled through. The lower aligning point would not, of course, be used, but a clearance hole for the drill would be drilled through base *A* at any convenient place in the bottom of the vee.

It is sometimes necessary to mark off a series of equally spaced points as indicated at *K*, for slot drilling. To facilitate such work the fixture is provided with a thin flat steel rule *P* attached to the top of the slide and a steel spacing plate *Q* at each end of the bracket casting, so that the bracket may be moved along the work a known distance after a prick-mark is made.



Marking and Scribing Fixture, and Examples of Work for which the Device is adapted

Locating lines for keyways as shown at *J*, may also be scribed by clamping the work and sliding the bracket and scriber over it, or in the case of a long bar, the auxiliary V-block would be clamped to the bar, which would then be pushed under the bracket, the bracket in this case being clamped to the base. Circumferential lines as indicated at

M may be scribed by rotating the work against a stop. Lines *W* can be scribed diametrically opposite by making use of the lower point and the auxiliary V-block.

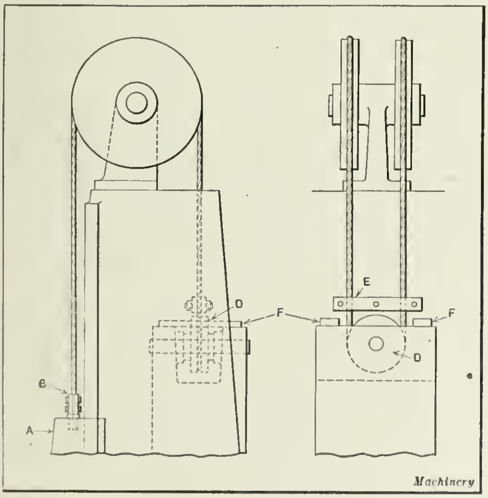
The bracket, when removed bodily from the base, makes a very convenient fixture for use in marking a surface plate or flat work, as it holds the punch perpendicular to the surface. It can also be used for scribing lines by sliding the bracket along against a straightedge.

Oakland, Cal. H. H. Parker

SAFETY ARRANGEMENTS FOR MACHINE TOOL COUNTERWEIGHTS

In the article describing various applications of counterweights to machine tools, which appeared in the October number of Machinery, mention was made of the damage which might be caused by breakage of the chain attaching the counterweight to the spindle slide of the machine, and an illustration was presented of an arrangement for automatically locking the spindle slide in the event of such an occurrence. The writer knows of several other safety devices which may be of interest. In attaching a counterweight to the tool-slides of vertical planers and long-stroke slotting machines, it has been the practice of some manufacturers to employ two parallel chains for the purpose, each of the chains being sufficiently strong to support the counterweight and the tool-slide if the other chain should become broken. In other designs, wire ropes are substituted for the chains, the ropes being spliced at each end and provided with eyes that are attached to the tool-slide and counterweight in much the same way as the chains.

A method of attaching the counterweight to the tool-slide by means of a single wire rope is shown in the illustration. In this case, both ends of the rope are attached to the tool-slide *A* by means of clamps *B* which are screwed to the slide. The rope is held by vees cut in these clamps and gripped securely by four bolts. It passes over the two pulleys at the top of the column and around pulley *D* which is mounted at the top of the counterweight. Just above pulley *D*, two bars *E* are clamped tightly on the rope. Each half of the rope supports one-half the load, but the rope must be of sufficient strength so that the entire load can be supported by either section in case one breaks. If this should happen, bars *E* would come in contact with either of bars *F*, preventing the rope from slipping around pulley *D* and so causing the weight to be supported by the unbroken half of the rope.

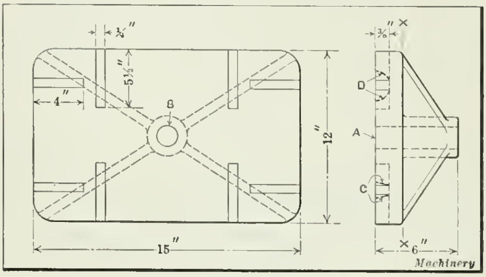


Safety Method of attaching Counterweight to Tool-slide

Provision against such an occurrence may seem a needless precaution in view of the fact that wire rope is not subject to sudden fracture without warning, but the cost of the application is little, and is a small enough insurance to pay against even the remote chance of rope breakage. H. T. M.

HOW SMALL CHANGES IN DESIGN FACILITATE MOLDING

Proper consideration of the purpose for which a casting is intended and of molding methods should always be given by the draftsman and patternmaker when making the drawing and pattern. A little forethought often reveals cases in which slight alterations in the design of a part will make the construction of the pattern and the molding operation much simpler. A concrete example of such an instance will be given. The illustration shows the drawing of an iron side-plate casting for a block used in winding electric generator and motor fields. This drawing was produced from a rough sketch furnished by an electrician, who specified that surface *A* and hole *B* were to be finished, and that the slots in surface *A* were to be cast clean so that no machine or hand work on them would be necessary.



Drawing of Side Plate for Block used in winding Electric Generator and Motor Fields

The pattern made from this drawing was split along the line *X–X*, it being the idea of the patternmaker that the hub and rib section should be molded in the cope of the flask, and the plate section in the drag. Slots were cut on the pattern so that green sand could be used to form the projections in the mold required for obtaining the slots in the casting. As a matter of fact, the slots were too narrow for molding in green sand, so the molder placed the entire pattern in the drag and made the parting line of the mold along face *A*. In order to produce the slots, cores of proper size were cut from a stock slab core and fitted into the slots on the pattern. When the sand in the cope had been rammed and the cope was lifted from the drag for the purpose of removing the pattern from the mold, it was found that the cores adhered firmly to the cope. Thus, when the cope was replaced on the drag, a satisfactory mold was obtained.

The purpose for which the casting was employed did not require the sides of the slots to be parallel, and they could just as well have been tapered as indicated by the heavy dotted line at *C*, or rounded as shown at *D*. By making the slots either way, cores for their production would have been unnecessary, as the green sand of the cope could have been rammed into the slots on the pattern and the projections thus formed would not have been destroyed when the cope was lifted in order to remove the pattern from the drag. The construction of the pattern also would have been much simpler, as it could have been of the solid type. Making the slots as shown at *D* would mean even less work for the patternmaker than making them as shown at *C*, because in the former case the slots could be made by the use of gouges. From the foregoing it will be apparent that the more knowledge a draftsman or a patternmaker has of the molding trade, the more efficient he will be in his line of work.

Kenosha, Wis. M. E. Duggan

FORMULA FOR FINDING ROOT WIDTH OF SPLINEWAYS

For milling splineways in shafting and similar work, a milling cutter of the form shown in the partial section view of the accompanying illustration may be used. The accuracy of the finished work as regards width of cut depends upon the width W of the cutting edge of the cutter. This dimension may be computed by using the following formula:

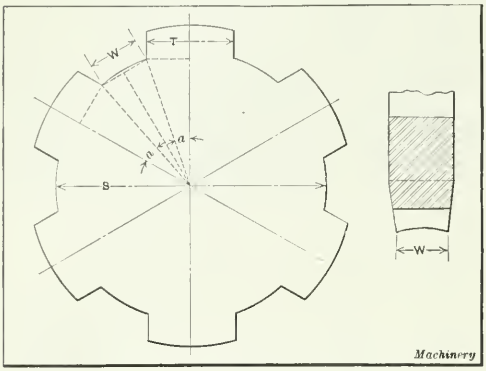


Diagram used in calculating Width of Cutting Edge of Spline Groove Milling Cutters; also Partial Section View showing Type of Cutter

$$\text{Sin}\left(\frac{\dfrac{360\text{ deg.}}{N} - 2a}{2}\right) \times B = W$$

in which N = number of splines;
B = diameter of body or of the shafting at the root of the splineway.

Angle a must, of course, first be computed, as follows:

$$\text{Sin } a = \frac{T}{2} \div \frac{B}{2} \text{ or}$$

$$\text{Sin } a = \frac{T}{B}$$

where T = width of spline;
B = diameter at the root of splineway.

This formula has been used frequently by the writer in connection with broach design, but it is capable of a more general application, and for that reason may be of considerable value to other readers of MACHINERY. If the splines are to be ground on the sides, suitable deduction must be made from dimension W to leave sufficient stock for grinding.

New London, Conn. C. H. BRIGGS

CHART FOR DETERMINING PRESSURE FOR FORCED FITS

The accompanying chart was developed to facilitate the determination of the approximate pressure in tons required to assemble parts having a forced fit. It is based upon data given in MACHINERY'S HANDBOOK on pages 883 to 885, inclusive. The formula given on page 885 for finding the pressure is comparatively simple; however, when a considerable number of calculations of this nature must be made, much time can be saved by using the chart, and the values will be found to be sufficiently close for ordinary practice. Referring to the chart, scale D represents the diameter of the work in inches; scale L, the length of the work in inches; scale P, the pressure in tons; and scale A, the fit allowance in decimals of an inch. Scale F is based upon the table of pressure factors given on page 884 in the HANDBOOK, but instead of the actual factors being denoted on the scale, the corresponding diameters are given in inches. This makes the use of the chart more convenient, as otherwise it would be necessary to refer to the HANDBOOK in order to find the proper factors to be used with a given diameter. These pressure factors are based upon the assumption that the diameter of the hub is twice that of the bore, that the shaft is machine steel, and that the hub is cast iron.

In order to illustrate the use of the chart, assume that it is desired to find the pressure required for assembling a flywheel having a bore 5 inches in diameter and a hub 5 inches long, on a shaft, and that the fit allowance is 0.002 inch. The dotted lines on the chart show the manner in which this example is solved: A straightedge is first laid across the chart connecting the graduation marked 5 on scale D with a similar graduation on scale F. Then from the intersection of this line with the reference line X, the straightedge is laid to the graduation marked 5 on scale L. From the intersection of this line with the reference scale Y, the straightedge is next laid to the graduation on scale A that denotes the fit allowance given in the example, or 0.002 inch. The required pressure will then be found by observing the point of intersection of the straightedge with scale P. This is shown on the chart to be about 8 tons; actual calculation by means of the formula on which the chart is based, gives this value as 7.14 tons. If the pressure is known and it is desired to find the amount of allowance that could safely be employed on the parts to be assembled by the given pressure, the same procedure would be followed with the exception that in the last step, the straightedge would be placed on the graduation on scale P rather than scale A, and the result read on scale A.

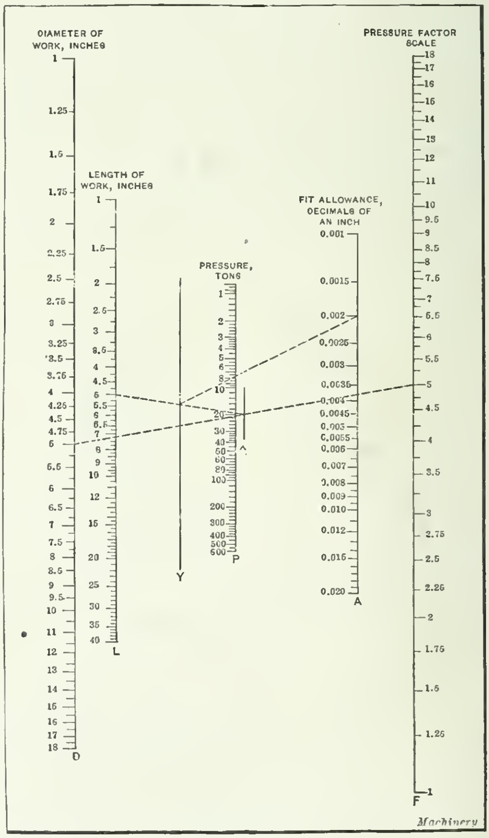


Chart for determining Pressure required to assemble Parts having a Forced Fit

North Plainfield, N. J. J. B. CONWAY

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

CALCULATING DISTANCES TO CENTER OF RADIUS

H. W. K.—Will you please show me how to find distances x and y in the illustration, from the dimensions given?

A.—In the right-angled triangle AOB it is obvious that

$$x^2 = (8-2)^2 - (8-y)^2 = (14-y)\,(y-2) = 16y - y^2 - 28$$

and,

$$x = \sqrt{16y - y^2 - 28} \qquad (1)$$

Now, in the right-angled triangle OFG,

$$2^2 = (4-x)^2 + (y-2)^2, \text{ or } y^2 - 4y + 16 = 8x - x^2 \qquad (2)$$

Substituting the value of x from Equation (1) in Equation (2),

$$12y - 12 = 8\sqrt{16y - y^2 - 28}$$

Squaring both sides of this equation and arranging terms,

$$208y^2 - 1312y + 1936 = 0$$

By removing the factor 16, the following expression is obtained

$$13y^2 - 82y + 121 = 0$$

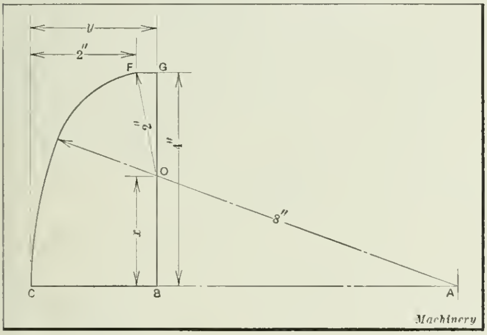


Diagram illustrating Conditions of Problem to find Center from which Arc is struck

Solving this quadratic equation,

$$y = \frac{41 \pm 6\sqrt{3}}{13}$$

By using this equation with the minus sign before the radical, it will be found that $y = 2.3544$ inches.

In developing Equation (1) it was shown that

$$x = \sqrt{(14-y)\,(y-2)}$$

Now, substituting the value found for y in this equation,

$$x = \sqrt{(14-2.3544)\,(2.3544-2)} = \sqrt{11.6456 \times 0.3544}$$

and

$$x = 2.0315 \text{ inches}$$

W. W. J.

CALCULATION FOR BLANKING DIE

D. C. A.—Fig. 1 shows a stamping to be produced on a punch press; from the dimensions given, please explain how to find radius x which is required in making the blanking die.

A.—At A in Fig. 2, letters are substituted for the known dimensions of the stamping involved in calculating radius x, and at B the conditions of the problem are illustrated diagrammatically. In both cases $R = 2$ inches, $r = 1$ inch, $b = \frac{1}{2}$ inch and $h = \frac{1}{8}$ inch. The two following relations are obtained from trigonometry:

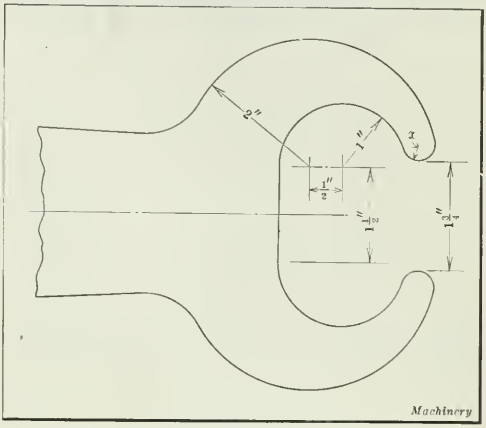


Fig. 1. Stamping for which Blanking Die is to be built, Radius x being unknown

$$(R-x)^2 = (y+b)^2 + (x+h)^2 \qquad (1)$$

$$(r+x)^2 = y^2 + (x+h)^2 \qquad (2)$$

Subtracting Equation (2) from Equation (1),

$$(R-x)^2 - (r+x)^2 = (y+b)^2 - y^2$$

Then

$$y = \frac{R^2 - r^2 - 2x\,(R+r) - b^2}{2b} \qquad (3)$$

Substituting the value of y obtained in Equation (3) in Equation (2),

$$(r+x)^2 = \left[\frac{R^2 - r^2 - 2x\,(R+r) - b^2}{2b}\right]^2 + (x+h)^2$$

Through expanding and combining, the following quadratic equation is secured:

$$4\,(R+r)^2 x^2 - 4\,[(R^2 - r^2 - b^2)\,(R+r) + 2b^2\,(r-h)] \times x + (R^2 - r^2 - b^2)^2 - 4b^2\,(r-h)^2 = 0$$

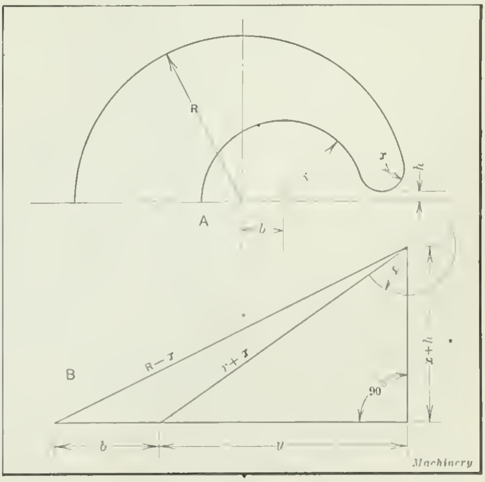


Fig. 2. Diagrams used in solving Diemaker's Problem

Solving this equation,

$$x = \frac{(R + r)^2 (R - r) - b^2 (R - r + 2h)}{2 (R + r)^2} \pm \frac{2b\sqrt{(R + h)(r - h)(R + r + b)(R + r - b)}}{2 (R + r)^2}$$

In calculating radius x in Fig. 1 use this equation with the minus sign before the radical since b is positive and measures to the right of the point from which radius R is struck. Therefore,

$$x = \tfrac{1}{2} (R - r) - \frac{1}{2(R + r)^2} \times \left[2b\sqrt{(R + h)(r - h)(R + r + b)(R + r - b)} + b^2 \times (R - r + 2h)\right]$$

Substituting the numerical values given and then solving,

$$x = 0.2585 \text{ inch}$$

W. W. J.

FORMULA FOR FINDING FORMING TOOL ANGLE

H. R. B.—I wish to make forming tools for different sizes of poppet valve heads and would like a general formula for finding angle X from dimensions such as given in Fig. 1.

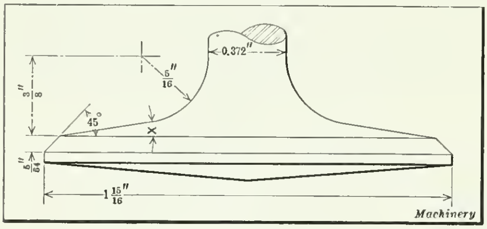


Fig. 1. Dimensions of Head of Poppet Valve

A.—By comparison with Fig. 1, the values for b, h, and r. Fig. 2, can be easily determined. Angle X can then be found in the following manner: Referring to Fig. 2,

$$\operatorname{Tan} A = \frac{h}{b} \quad (1) \qquad c = \frac{h}{\sin A} \quad (2)$$

Also,

$$c = \frac{r}{\sin B} = \frac{r}{\sin (A - X)} \quad (3)$$

From Equations (2) and (3) by comparison,

$$\frac{r}{\sin (A - X)} = \frac{h}{\sin A}$$

$$\operatorname{Sin} (A - X) = \frac{r \sin A}{h} \quad (4)$$

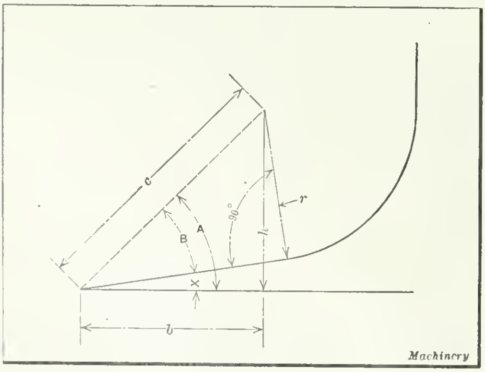


Fig. 2. Diagram used for solving for Angle X, Fig. 1

From the dimensions given in Fig. 1, it is obvious that $b = 0.392125$ inch, $h = 0.375$ inch, and $r = 0.3125$ inch. Substituting these values in Equations (1) and (4) and solving, angle A will be found to be 43 degrees 43 minutes 16 seconds, and angle $(A - X)$, to be 35 degrees, 10 minutes. By subtracting these two values, angle X will be found to equal 8 degrees 33 minutes 16 seconds. The easiest way of solving such problems is by the use of logarithms.

W. W. J.

DETERMINING THE LENGTHS OF TWO SIDES OF AN OBLIQUE TRIANGLE

H. W. P.—The accompanying illustration shows an oblique triangle in which the difference between the lengths of sides b and $c = 1$ inch; the length of side $a = 13$ inches; and angle $A = 120$ degrees. How can the lengths of sides b and c be found?

A.—According to the law of sines,

$$\frac{b}{a} = \frac{\sin B}{\sin A}, \quad \text{and } \frac{c}{a} = \frac{\sin C}{\sin A}$$

Therefore,

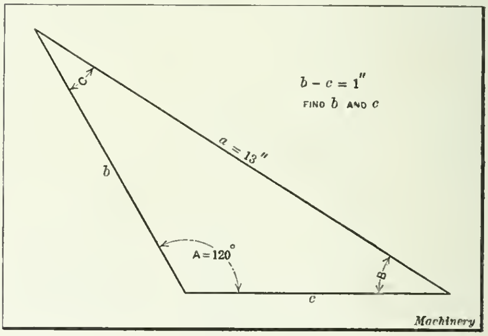
$$\frac{b - c}{a} = \frac{\sin B - \sin C}{\sin A} = \frac{2 \cos \frac{1}{2}(B + C) \sin \frac{1}{2}(B - C)}{2 \sin \frac{1}{2} A \cos \frac{1}{2} A}$$

But, since $\frac{1}{2}(B + C)$ is the complement of $\frac{1}{2} A$,

$$\operatorname{Cos} \tfrac{1}{2}(B + C) = \sin \tfrac{1}{2} A$$

and

$$\frac{b - c}{a} = \frac{\sin \frac{1}{2}(B - C)}{\cos \frac{1}{2} A}.$$



Oblique Triangle in which the Difference between Sides b and c, and Angle A are known

From this equation,

$$\operatorname{Sin} \tfrac{1}{2}(B - C) = \frac{(b - c) \cos \frac{1}{2} A}{a} = \frac{1 \times 0.5}{13} = \frac{1}{26}$$

By the law of tangents,

$$b + c : b - c = \tan \tfrac{1}{2}(B + C) : \tan \tfrac{1}{2}(B - C)$$

As $A + B + C = 180$ degrees, and $B + C = 180$ degrees $-$ A, then $\frac{1}{2}(B + C) = 90$ degrees $- \frac{1}{2} A$. Thus, $\tan \frac{1}{2}(B + C) = \cot \frac{1}{2} A$. Since $\sin \frac{1}{2}(B - C) = \frac{1}{26}$, then, by the following relation, $\tan \phi = \frac{\sin \phi}{\sqrt{1 - \sin^2 \phi}}$, it will be found that $\tan \frac{1}{2}(B - C) = \frac{1}{15\sqrt{3}}$.

Therefore,

$$b + c = \frac{(b - c) \cot \frac{1}{2} A}{\tan \frac{1}{2}(B - C)} = \frac{\frac{\sqrt{3}}{3}}{\frac{1}{15\sqrt{3}}} = 15 \text{ inches}$$

Now, if $b + c = 15$ inches and $b - c = 1$ inch, $b = 8$ inches and $c = 7$ inches.

W. W. J.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Newark No. 5 Gear-hobbing Machine. Newark Gear Cutting Machine Co., Newark, N. J. 581
Heim Centerless Roll Grinder. Ball & Roller Bearing Co., Crosby St. and Maple Ave., Danbury, Conn. 583
Monarch Gap Bed Lathe. Monarch Machine Tool Co., 109 Oak St., Sidney, Ohio 584
Frontier Air-operated Chucks. Frontier Chuck & Tool Co., Buffalo, N. Y. 585
Geiras Indexing Head. Geiras Mfg. Co., Inc., 417-419 E. 156th St., New York City 585
Heald Cylinder Grinding Machine. Heald Machine Co., 16 New Bond St., Worcester, Mass. 586
Consolidated Breast Drill with Three-jaw Chuck. Consolidated Tool Works, Inc., 261 Broadway, New York City 587
Victor Self-opening Die-head. Victor Tool Co., Waynesboro, Pa. 587
Taylor-Shantz Bench Tapping Machine. Taylor-Shantz Co., 478-486 St. Paul St., Rochester, N. Y. 588
Woodall-Basch Self-centering Drill and Reamer Holder. Woodall-Basch Tool Co., 450 Weiting Block, Syracuse, N.Y. 588
Ready Threading Tool. Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn. 589
Haskins Swivel Base and Flexible Shaft Drive for Portable Motor. R. G. Haskins Co., 27 S. Desplaines St., Chicago, Ill. 589
St. Louis Rotary Piston Pump. St. Louis Pump & Equipment Co., 321 International Life Bldg., St. Louis, Mo. 589
Coulter Shaping Planer. Automatic Machine Co., Bridgeport, Conn. 590
Van Keuren Gage-blocks. Van Keuren Co., 362 Cambridge St., Allston Station, Boston, Mass. 590
"Junior" Surfacing Machine. Peerless Surfacing Machine Co., Inc., Troy, N. Y. 591
"Martian" Drill Protector. F-S Machine Specialties, Inc., 171 Washington St., Newark, N. J. 591
Arter Automatic Piston-ring Grinder. Persons-Arter Machine Co., 72 Commercial St., Worcester, Mass. 592
Newton Drum Type Continuous Milling Machines. Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. 593
Dreis & Krump Steel Slitting Shear. Dreis & Krump Mfg. Co., 2909-2923 S. Halsted St., Chicago, Ill. 594
Combination Grinder and Buffer. Cincinnati Electrical Tool Co., 1501-1505 Freeman Ave., Cincinnati, Ohio 594
Cedar Rapids Valve-facing Machine. Cedar Rapids Engineering Co., 902 N. 17th St., Cedar Rapids, Iowa 594
Diamond Crowned-pulley Grinding Fixture. Diamond Machine Co., Providence, R. I. 595
Marquette Pressure Locking Device. Marquette Tool & Mfg. Co., 319-331 W. Ohio St., Chicago, Ill. 596
Motor Drive for Cleveland Milling Machines. Clark-Mesker Co., 18511-18517 Euclid Ave., Cleveland, Ohio 597
Straight-sided Trimming Presses. Williams, White & Co., Moline, Ill. 598
Rockford Automatic Lathe. Rockford Machine Tool Co., Rockford, Ill. 598
Elmes Hydraulic Presses and Pump. Charles F. Elmes Engineering Works, 222 N. Morgan St., Chicago, Ill. 599
Cruban Threading Tools. Cruban Machine & Steel Corporation, 63 Duane St., New York City 600
Cleveland Adjustable Reamers and Inserted-tooth Cutters. Cleveland Cutter & Reamer Co., Cleveland, Ohio 600
Rockwell Direct-reading Hardness Testing Machine. Wilson-Maeulen Co., Inc., 736 E. 143rd St., New York City 601
No. 2 Standard Milling Machine. Standard Engineering Works, Pawtucket, R. I. 601
Southwark Planer. Southwark Foundry & Machine Co., Philadelphia, Pa. 602
Curtis & Curtis Pipe Threading Machine. Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn. 603
Forbes & Myers Hand Grinder. Forbes & Myers, 178 Union St., Worcester, Mass. 603
American Metal Products Shaft Cleaners. American Metal Products Co., 72 W. Adams St., Chicago, Ill. 604
Rearwin No. 6 Die-filing Machine. W. D. Rearwin, 716 Monroe Ave., Grand Rapids, Mich. 604
Langelier Multiple Tapping Machine. Langelier Mfg. Co., Arlington, Cranston, R. I. 604
Pennsylvania Air Compressor and Vacuum Pump. Pennsylvania Pump & Compressor Co., Easton, Pa. 605
R. G. Smith Cutting-off Tool. R. G. Smith Tool & Mfg. Co., 317 Market St., Newark, N. J. 605
Hisey-Wolf Radial Drill Stand. Hisey-Wolf Machine Co., Cincinnati, Ohio 606
Reed Rim Drilling Machine. Francis Reed Co., 43 Hammond St., Worcester, Mass. 606
Fosdick Radial Drilling Machines with Standardized Motor on Arm. Fosdick Machine Tool Co., Cincinnati, Ohio 607

Newark No. 5 Gear-hobbing Machine

The Newark Gear Cutting Machine Co., Newark, N. J., has added a new No. 5 automatic hobbing machine to its line of gear-cutting machinery. This machine is a special simplified type, designed primarily for the rapid production of helical and herringbone gears for use on street railway cars, electric locomotives, mill drives, and numerous other applications in the industrial field. Of course, the same machine can also be employed for hobbing worm-wheels and spur gears.

A noteworthy feature of the machine is its ability to hob helical gears of comparatively small helix angles just as readily as gears having relatively large helix angles. Fig. 1 shows the machine cutting a cast-iron helical gear of 1¾ normal diametral pitch, and having such a small helix angle (7 degrees relative to the axis) that it bears a rather close resemblance to a spur gear. Heretofore it has been a simple matter to hob helical gears having angles ranging from 15 to about 45 degrees, but it has been difficult on most designs of hobbing machines to cut helical gears of such large leads that the teeth appear to be almost parallel with the axis. With this No. 5 machine the mechanical and mathematical difficulties have been overcome, so that helical gears with angles of only 3, 4, or 5 degrees with the axis may be hobbed as well as gears with large helix angles.

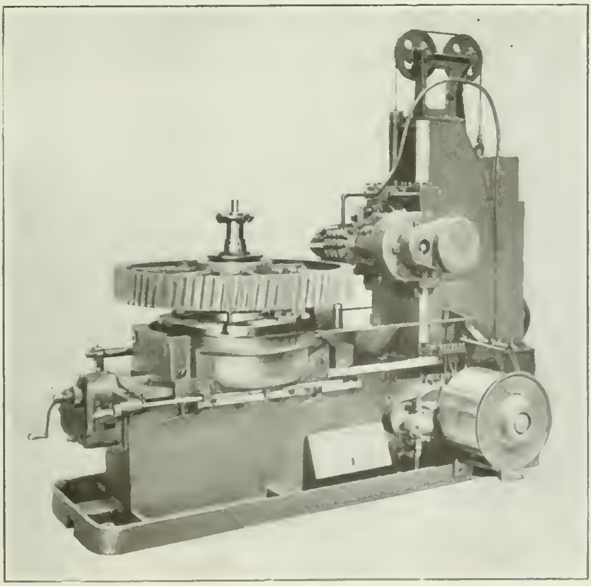


Fig. 1. Newark No. 5 Gear-hobbing Machine cutting a Cast-iron Helical Gear

In order to obtain a true bearing between helical gears designed to run on parallel shafts this machine employs an improved method of helical control through the use of differential gearing placed in the ratio or dividing train of gears ahead of the indexing change-gears. Thus the modification of the motion for the "one-tooth lead" in the ratio train is multiplied in absolute proportion to the number of teeth desired in the finished gears. The term "one tooth lead" is literally the lead distance from one tooth to another measured along the axis. Mathematically, it is the full helix lead divided by the number of teeth. The machine, therefore, does its own multiplying for all numbers of teeth, and obtains the full helix lead in absolutely correct proportion for all ratios, regardless of any possible slight error in the lead gears. For example, a gear of 100 teeth, having a 100-inch full helix lead has a "one tooth lead" of 1 inch. The machine then automatically multiplies this lead to 100 inches for 100 teeth, or to 79 inches for 79 teeth, etc.

If three gears having, say, 18, 37, and 16 teeth, respectively, are to be cut to run together on parallel shafts, the machine is geared up for the "one tooth lead" of this train, and this lead gearing remains constant during the cutting of the whole train, thereby automatically producing the same angle and consequently a true bearing along the teeth of all the gears in the train. A chart is furnished with this machine which gives the "one tooth lead" change-gearing for most of the commonly used angles and normal diametral pitches. The angles are given to each 5 minutes of arc. With this chart, the choosing of lead gears is just as simple as choosing the indexing gears, and no calculation is required on the part of the operator. The "one tooth leads" can also be obtained by the following formulas, the proper one depending on the pitch used for sizing the helical gear. (The helix angles in these formulas are from the axis of the gear).

For helical gears calculated to normal diametral pitch,

$$\text{"One tooth lead"} = \frac{3.1416 \times \text{cosecant of helix angle}}{\text{Normal diametral pitch}}$$

For normal circular pitch,

$$\text{"One tooth lead"} = \text{Normal circular pitch} \times \text{cosecant of helix angle}$$

For diametral pitch (not normal),

$$\text{"One tooth lead"} = \frac{3.1416 \times \text{cotangent of helix angle}}{\text{Diametral pitch}}$$

For circular pitch (not normal),

$$\text{"One tooth lead"} = \text{Circular pitch} \times \text{cotangent of helix angle}$$

A chart is also furnished in which the "one tooth lead" change-gearing is arranged numerically. This enables gearing to be readily chosen to duplicate or match gears cut on older types of machines. Excellent bearing surfaces between gears cut on this machine and those cut on metric machines have been obtained.

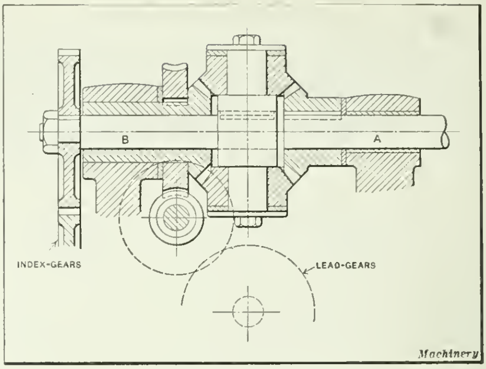


Fig. 3. Arrangement of Gearing on No. 5 Gear-bobbing Machine

Fig. 3 shows how the helical control mechanism and the indexing or ratio mechanism are combined by means of differential gearing. The driving shaft *A* revolves at twice the speed of the driven shaft *B* upon which the index gear is placed, thus increasing the power and smoothness of action of the indexing worm train. The machine, when belt driven, receives power through constant-speed tight and loose pulleys mounted on the machine, no countershaft being required. A flywheel is mounted on the cutter-spindle pinion-shaft, instead of on the cutter-spindle. This permits a light flywheel at the right place to be more efficient than a heavy one in the wrong place.

Ten changes of cutter speed are provided. Feed motion is controlled by one lever, which connects with the indexing train for feeds governed by the revolutions of the work, or with the constant-speed driving train for feeds per minute. The latter feeds are used with ordinary disk cutters for cutting helical gears for which no hob may be available. This is a semi-automatic operation, the indexing being done by hand with a special attachment. Fifty-five changes of feed are provided. The feed can be changed at any time, no extra calculation being required. If, after beginning to cut a blank, the material is found to be softer or harder than estimated at the start, an increased or decreased feed can be obtained without refiguring the lead gears.

The cutter carriage has a quick-return motion whereby hobs can be returned to the top of the gear blank for a second or finishing cut, if found desirable, and again passed through the cut without any special resetting of hair lines or zero marks; that is, the machine automatically holds the hob in the work, in the proper helical path. The clutch lever controlling the vertical feed-screw is locked in the operative position when set for cutting helical gears, so that accidental disconnecting of the helical train of motion by the operator is avoided. The work-table is arranged to take solid pinions, where the teeth are cut integral with a shaft. Such pinion-shaft shanks up to 10 inches diameter can be accommodated. Regular taper-shank work-arbors are held in a rigid flange bearing or adapter in the work-table.

For the rapid cutting of pinions and wide-face gears up to 28 inches in diameter, a massive outside support bearing is provided for the outer end of the work-arbor as shown in Fig. 2. This support is of box section, and has an arm mounted on it that grips the work-arbor through an adjustable sleeve. The unique feature of this support consists in the ease with which gear blanks can be mounted or re-

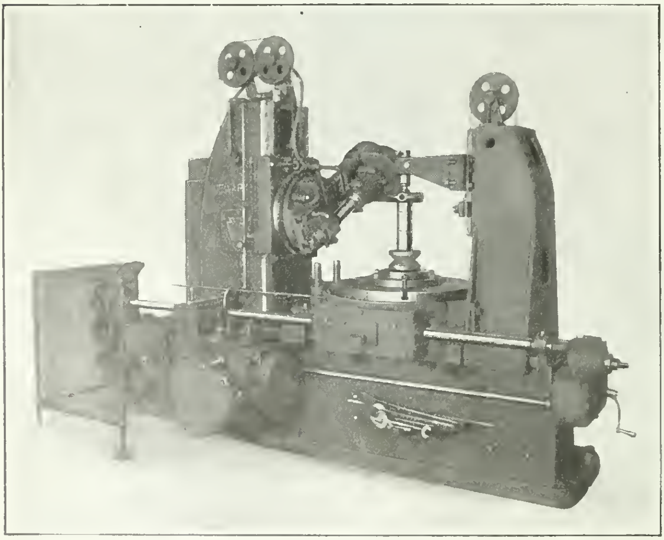


Fig. 2. No. 5 Gear-hobbing Machine equipped with Rigid Support for Work-arbor

moved without disturbing any of the vertical adjustments of the support as set for the job at hand. The support arm is simply unclamped and swung to one side where it is out of the way. After mounting a new blank, the arm is swung back in place and again tightened. Larger gears up to 60 inches diameter are supported by height blocks and jacks.

The machine is provided with automatic trips to the vertical cutter movement and the horizontal work movement. The vertical trip always operates to stop the entire machine. The machine is rated for cutting 2½ diametral pitch in steel or 2 diametral pitch in cast iron at a rapid production rate, and with a minimum grinding of hobs.

Additional specifications are as follows: Face capacity, 18 inches; minimum centers between work- and cutter-arbors, 2½ inches; hob capacity, 7¾ inches diameter by 9 inches long; diameters of cutter-arbors, 1¼ and 1½ inches; work-arbor diameter, 2¼ inches; motor drive, when furnished, requires constant-speed 7½- to 10-horsepower motor with a speed of 1100 to 1200 revolutions per minute. The machine weighs 14,000 pounds.

HEIM CENTERLESS ROLL GRINDER

A grinding machine for automatically grinding cylindrical work without placing such work on centers, is now being manufactured by the Ball & Roller Bearing Co., Crosby St. and Maple Ave., Danbury, Conn. This machine is known as the Heim centerless cylindrical roll grinder, and is the invention of L. R. Heim, general manager of the company. The machine is adapted for grinding work such as rolls for roller bearings, wrist-pins, camshafts, valve lifters, valve-lifter roll-pins, pistons, shackle bolts, spring bolts, roller chain studs, or in fact any cylindrical part that requires grinding on only one diameter. A large battery of these grinders is in use in the Ball & Roller Bearing Co.'s plant in connection with the manufacture of journal roller bearings, radial roller bearings, and various small cylindrical parts manufactured for the trade by this company.

General Features of Construction

Figs. 1 and 2 show front views of the latest design of this machine. In Fig. 1 the machine is shown with the doors or covers removed from the wheel housing so that the position of the regulating wheel and the grinding wheel may be seen. This illustration also shows the roll-supporting fixture, and the chute in which the rolls are placed and from which they pass into the roll support, and thence between the grinding and regulating wheels. It will be noticed that there is a platform or shelf at the front of the machine on which the rolls or supply of work can be placed in a convenient position for the operator. In feeding, the operator places the pieces to be ground in the chute, which is supported by a rod clamped to the shelf, as shown. Underneath the work-holding shelf is a water tank provided with a tray into which the work is automatically dropped after being ground. The tray into which the work falls is hung from the top of the water tank, and can be easily removed and dumped when it is full.

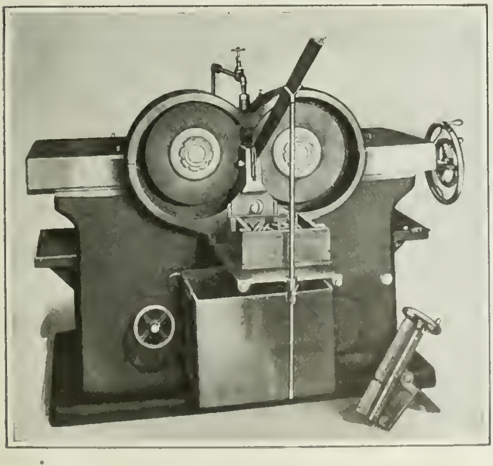


Fig. 1. Heim Centerless Roll Grinder with Wheel Housing Cover removed

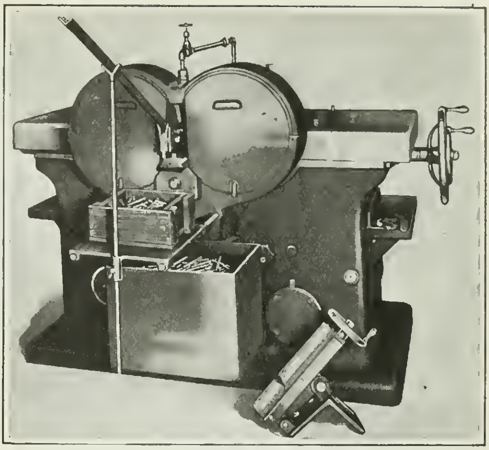


Fig. 2. Heim Centerless Roll Grinder made by Ball & Roller Bearing Co.

The roll-regulating wheel and the grinding wheel are adjusted in respect to each other and the roll-supporting fixture, by means of the two handwheels shown at the right-hand end of the machine. The grinding wheel and regulating wheel are each mounted on a slide, which, in turn, is mounted on the top of the main bed of the machine. These slides, the housings for the wheels, and the regulating spindles are of heavy construction, as will be readily apparent by referring to Fig. 3. On each side of the machine base, there is a large opening. The openings at the ends of the base and the one at the rear are provided with metal doors. Over the doors of the openings at the ends of the machine are hung trays for holding tools. The opening at the rear of the machine gives easy access to the mechanism inside the frame.

The water tank, fastened to the front of the bed, serves as a cover for the front opening in the base. Attached to the water tank is a centrifugal pump, driven from the main drive shaft of the machine. This pump supplies the grinding and regulating wheels with a constant flow of coolant.

Design of Driving Mechanism

The drive shaft for driving the grinding spindle and also for conveying power to the regulating wheel spindle and coolant pump is hung in the main bed of the machine, and is mounted on radial roller bearings, which are enclosed in a substantial housing and rotate in oil. From this drive shaft, power is conveyed to another shaft on which is mounted a speed reduction gear. This gearing and the shaft to which it is attached are enclosed in a housing and run in oil. By the use of this gearing, four speeds can be transmitted to the regulating wheel spindle. The design of the machine is such that the driving belts of the regulating wheel spindle and the grinding wheel spindle pull from underneath, and therefore have a tendency to hold the wheel-slides down in contact with the bed of the machine, thus adding to the rigidity of the slides in which the wheel-spindles are mounted. The slack in these driving belts is taken up by idlers mounted on anti-friction bearings.

The wheel-spindles are made from a special alloy steel, hardened, tempered, and ground, and they run in large phosphor-bronze bearings. These bearings provide automatic

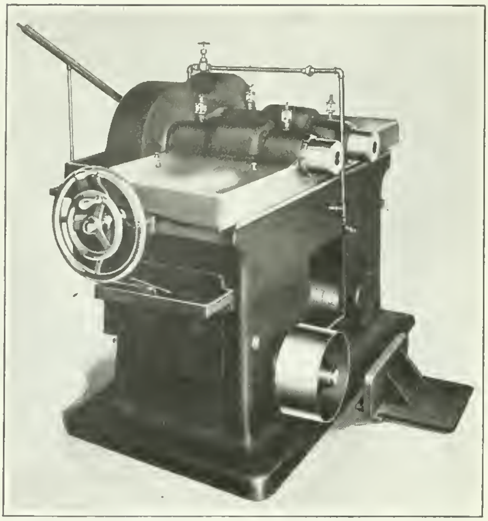


Fig. 3. Rear View of Heim Centerless Grinder

lubrication for the spindles, and the design is such that grit and dirt are absolutely excluded. The lateral thrust on the spindles is taken by ball bearings.

Operation of Machine

One operator can take care of a machine; that is, under normal conditions, he can keep the chute full of work and attend to the gaging and adjusting of the wheels. In some instances, it would be possible for one operator to attend to more than one machine, depending upon the nature of the work to be ground. When very long runs of any one size of work are to be ground, automatic feeders can be provided, so that one operator can run several machines, it merely being necessary for him to adjust the wheels, gage the work, and fill the magazines at regular intervals. The machine can be provided with tight and loose pulleys to be driven from a countershaft, or it can be driven by a motor either hung to the ceiling, set on the floor, or mounted on the machine at the end of the bed.

A diamond wheel-dresser shown in the lower right-hand corner of Figs. 1 and 2 is furnished with the machine. This device is placed between the two wheels and fastened to the machine, after first removing the roll-supporting fixture. The truing diamonds are passed back and forth across the faces of the wheels by operating the handwheel at the end of the truing fixture. In this way the faces of both wheels are dressed parallel with each other.

The changing of the speed of the regulating wheel is accomplished by the use of a handwheel shown on the left side of the main bed of the machine near the coolant tank. By turning this handwheel in one direction, the speed of the regulating wheel can be changed from that employed for grinding to that employed for dressing the wheel. By a slight turn of this wheel, the power drive can be disconnected from the regulating wheel.

It is claimed by the manufacturers that exceptionally high production rates can be obtained by the use of this machine, the increase in some instances ranging as high as from 100 to 500 per cent over the ordinary method of grinding, and at the same time a high degree of accuracy can be maintained. The grinding and regulating wheels employed on this machine are of the regular type such as are used on external grinders, and the life of the grinding wheel is approximately the same as that of an external grinding wheel, while the life of the regulating wheel is much greater. This machine occupies a floor space of 4 by 6 feet, and when equipped for belt drive it weighs approximately 4500 pounds.

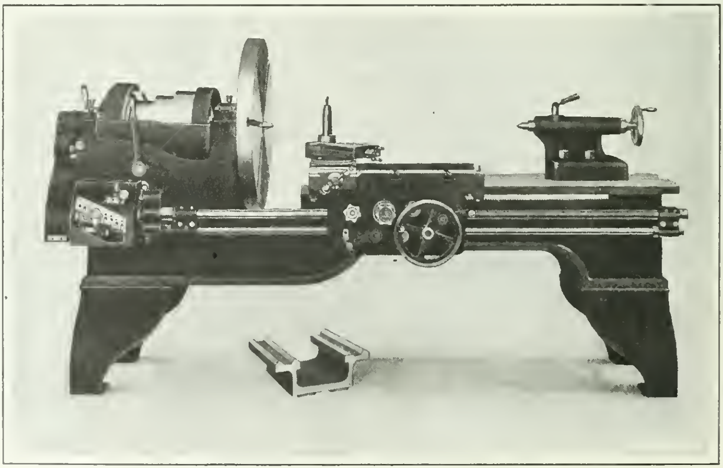
MONARCH GAP BED LATHE

The gap bed lathe shown in the accompanying illustration is one of five sizes now being manufactured by the Monarch Machine Tool Co., 109 Oak St., Sidney, Ohio. The carriage is of unusually heavy construction, and the rear carriage wings are extended at the tailstock end in order to form a long bearing that will withstand heavy service. The carriage is gibbed, both at the front and the rear, and the cross-bridge and power cross-feed slide are extended to permit taking facing cuts the full swing of the gap without undue stress or chatter. The carriage is also built so that it will overhang the gap, thus permitting the tool to be used close to the faceplate, if necessary.

The gears contained in the apron are of drop-forged steel. The apron is double-walled, permitting bearings at both ends for the studs and shafts. It is provided with a feed reverse. and interlocking device which prevents the feed-rod and lead-screw from being engaged at the same time. The rack and pinion disengages when screw-cutting.

The headstock is of the solid bowl-shaped box housing construction. The quick-change gear-box is of simple design, and the thread and feed range is sufficient to cover all ordinary requirements. The change-gears are made of steel, and are of coarse pitch; they are wide-faced, bushed with bronze, and run on vanadium-steel shafts. The spindle is made of 50-point carbon crucible steel; it is accurately ground and runs in a phosphor-bronze bearing.

The back-gears are locked in and out of position by a spring plunger. The double back-gears are of the positive geared type. The compound rest is gibbed throughout, and has liberal bearing surfaces. The usual swivel and cross-feed graduations are provided. Drilled and tapped holes are provided on the back of the carriage for receiving a taper



Gap Bed Lathe built by the Monarch Machine Tool Co.

attachment which can be furnished when desired. The five sizes in which this machine is regularly made are as follows: 14–23 inches by 6 feet; 16–25 inches by 6 feet; 16–27 inches by 8 feet; 18–28 inches by 8 feet; 20–30 inches by 8 feet. The lathe can also be furnished with beds of greater lengths.

FRONTIER AIR-OPERATED CHUCKS

Two new designs of air-operated chucks sold under the trade name of "Lavoie" have been produced by the Frontier Chuck & Tool Co., Inc., 30 Letchworth St., Buffalo, N. Y. One of these chucks—a pilot-bar type—which was especially developed for work that requires piloted tools is illustrated in Fig. 1. By reference to this illustration, it will be seen that the air cylinder and the chuck are one complete unit and that the air source is at the back of the outer tube, the air being piped through the spindle of the machines on which the chuck is mounted. A revolving air box at the rear end of the spindle makes connection to the air valve. A tube is screwed into the piston which allows a pilot-bar of any desired length to enter without interfering with any other part of the chuck. This tube also prevents dust and chips from entering the mechanism of the chuck.

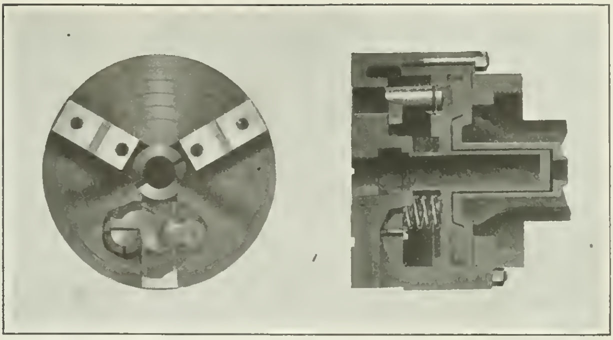


Fig. 1. "Lavoie" Air-operated Pilot-bar Chuck made by the Frontier Chuck & Tool Co., Inc.

The chuck-operating mechanism consists of wedge spindles of the circular type having flat inclined surfaces. Each spindle rests against one end of a lever and is held in place but is free to revolve on the face of the piston. The wedges, one for each jaw, rest against a similarly tapered surface on the end of the lever that is pivoted at the opposite end and pinned to a jaw at the center. Thus when the air is admitted to the cylinder, the piston and the wedge spindles are forced forward, causing the levers to swivel on their fulcrums and bringing the jaws toward the center of the chuck. When the air is turned off, springs force the piston and jaws back to their original positions. It will be noted that the pilot-bar is guided by the pilot bushing which is screwed into the face of this chuck and that the outer pilot tube has no movement whatsoever.

The second chuck, which was developed for application on drilling machines, is illustrated in Fig. 2. This chuck is provided with holes so that it can be bolted to the machine table. Its operation is similar to the chuck previously described, but in this case the air is admitted at one side instead of the back. As the opening runs clear through the center, danger of chips working into the center is eliminated. The base is raised on four legs about 1 inch high, which allows the operator to rake out any chips that might accumulate by falling through the opening in the center. Both chucks are made with either two or three jaws, and in manufacturing or adjustable types, and the sizes are 10, 12, 15, and 18 inches.

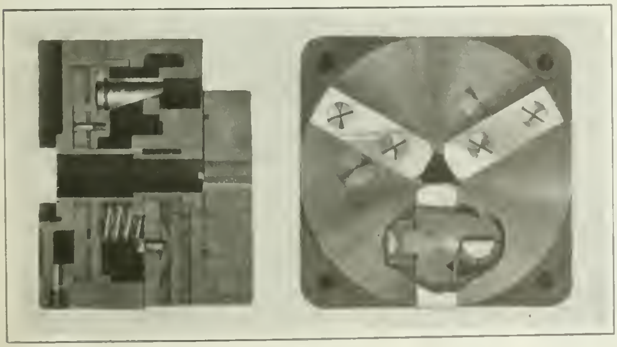


Fig. 2. Design of Pneumatic Chuck for Application on Drilling Machines

GEIRAS INDEXING HEAD

An indexing head known as "Lightning," which differs considerably in design from styles made by other concerns has been developed by the Geiras Mfg. Co., Inc., 417-419 E. 156th St., New York City, for application in small shops or on machines engaged continuously on a class of work requiring the use of such an appliance. The outstanding feature of this head is that after certain adjustments have been made, prior to taking the first cut on a piece of work, the latter can be rapidly indexed for each successive cut by simply operating a handle back and forth; it is unnecessary to give further attention to the setting of the indexing mechanism because accurate indexing is assured through an automatic arrangement. Reference to the accompanying illustrations will show that the index-plate *A* is provided with teeth around its periphery and that a plunger *B* is held in a housing attached to the base. The positive indexing of work is obtained by causing this plunger to spring into engagement with the teeth of the index-plate when the work has been revolved the required amount.

Setting the Indexing Mechanism

In setting the head to suit the specifications of any job, the two locking screws *C* are first loosened. These screws furnish means of securing plates *D* and *E* together after a setting has been made, so that the relation between stop *F* on plate *D* and trip *G* on plate *E* will remain the same until the setting is altered. After screws *C* have been loosened, the index-plate is revolved until a certain tooth space, above which a line is scribed, is placed directly above the plunger. Plate *E* is then rotated until trip *G* comes in contact with trigger *H*, which is also mounted in the plunger housing and keeps the plunger depressed. However, as trip *G* strikes trigger *H*, the plunger is released and is forced into the tooth space by means of a coil spring placed beneath the plunger, thus preventing further movement of the index-plate.

The next step is to locate the tooth space diametrically opposite the one above which the scribed line is placed, and then, in a clockwise direction, count the number of tooth spaces which, when divided into the total number of teeth on the index-plate, will give a result equal to the number of divisions desired on the work. For instance, if the index-plate has sixty teeth and it is desired to index the work in order to mill four equally spaced slots, fifteen tooth spaces should be counted.

The plate *D* is then swiveled until the screw *I*, which is held in a bracket attached to plate *D*, is placed directly above the last space counted. Screw *I* is then turned, forcing a tapered pin into the tooth space above which it is placed, and locking the index-plate and plate *D* together. It will be seen that in this way the distance between stop *F* and trip *G* is regulated to suit the conditions of the job. Screws *C* are next retightened, after which the pin operated by screw *I* is withdrawn from engagement with the teeth, and after the index-pin contained in handle *J* has been placed in any one of the holes of the index-plate, the head is ready for the work. Handle *J* is keyed to the hollow spindle of the head, thus causing the spindle to rotate with the index-plate. The use of the pin operated by screw *I* eliminates the danger of inaccurate settings which would occur if plate *D* should move slightly in relation to the index-plate while screws *C* are being tightened.

Procedure Followed in Indexing Work

In operation, when viewing the head from the index end, the work is indexed by simply pushing handle *L* toward the right, plates *D* and *E* and the index-plate moving as one unit after plunger *B* has been withdrawn from engagement with the teeth of the index-plate by means of a second trigger *K* on plate *D*. The three plates are then rotated until trip *G* strikes trigger *H*, permitting plunger *B* to be forced into the proper tooth space on the index-plate and preventing further rotation of the parts in that direction. The handle is then pushed toward the left until stop *F* strikes the plunger housing, only plates *D* and *E* being returned, as the index-plate is held stationary by the plunger.

The movement of the plates independently of the index-plate is made possible by a ratchet mechanism that is engaged when the handle is pushed toward the right but disengaged when pushed toward the left. The various parts are thus placed in position for again depressing the plunger and revolving the index-plate and work after an operation has been performed on the work. An important feature of this arrangement is that even though handle *L* may be turned only part way toward the right and then returned to its original position before the plunger is operated, the relation between the moving members will remain the same and the setting will not be altered.

The various sets of holes in the index-plate are used for indexing in connection with the teeth when the desired number of divisions on the work cannot be obtained with the teeth alone. For instance, suppose it is required to cut one hundred slots around a piece, and there are only sixty teeth on the plate. In this case, the plunger is made to spring into every third tooth space when handle *L* is operated as previously described, so that twenty equally spaced slots can be milled on the work. During this step, the index-pin in handle *J* is put in the hole farthest to the left in row *M*, as shown in Fig. 2. After twenty slots have been milled, this pin is advanced to the second of these holes, the result being that the relation between the spindle and the index-plate has been changed such an amount that twenty more slots can be milled around the work, each slot being the desired distance from those machined the first time. By placing the pin successively in each of the holes in row *M* and indexing completely each time, one hundred equal divisions can be obtained. Handle *J* is adjustable in its bearing to suit the various sets of holes in the plate.

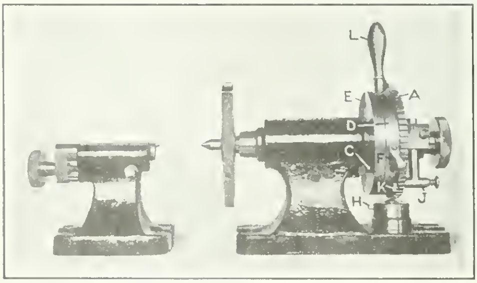


Fig. 1. New Type of Indexing Head and Footstock made by the Geiras Mfg. Co., Inc.

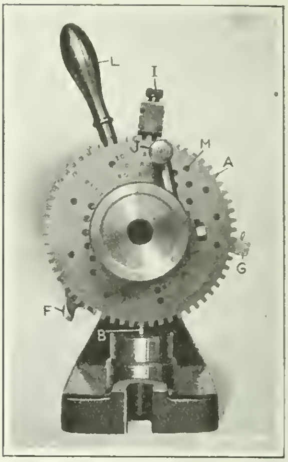


Fig. 2. Indexing End of Head

Equipment Furnished with Indexing Head

Nine index-plates are made for permitting any number of divisions up to 100, except the prime numbers above 40 and, in addition, special plates can be supplied to suit the needs of a customer. The head is provided with a driving plate of standard design for holding work between centers, and there is a draw-bar extending through the hollow spindle for the operation of draw-in collets having a capacity for holding work up to 9/16 inch in diameter. When a chuck is mounted on the front end of the spindle, work up to 13/16 inch in diameter may be passed through the spindle.

The footstock furnished with the indexing head is also shown in Fig. 1. A pin located at the rear and about 2 inches below the point of the center insures that the latter will always be central within a very small error. The center is adjustable axially by means of a knurled-head screw at the rear of the footstock, and is clamped at the front. A cam-operated footstock can also be furnished when an exceptionally quick-operating center is desired. The various steel parts on the head and footstock are hardened and ground, while some of the more important are lapped. This equipment has been employed for several years in the manufacture of milling cutters, and its use has given such satisfactory results that it was decided to place it on the market.

HEALD CYLINDER GRINDING MACHINE

The Heald Style No. 55 cylinder grinding machine shown in the accompanying illustrations has been brought out by the Heald Machine Co., 16 New Bond St., Worcester, Mass., in response to the demand for a machine of simple, substantial design, adapted for regrinding automobile cylinders and general repair work. This machine is designed along the same general lines as the No. 60 cylindrical grinding machine of this company's manufacture, and will handle a large variety of cylinders, as well as a miscellaneous class of awkward shaped castings that cannot be revolved while performing the grinding operation. The expensive speed-change boxes and other units incorporated in the design of the No. 60 machine, which are so necessary in a manufacturing machine of that type have been eliminated from the No. 55 machine, the speed-change box being replaced with a drive from a single shaft at the back of the machine. The new machine is also self-contained; that is, no countershaft is required, it being only necessary to belt from the main lineshaft to the rear drive shaft. While these changes enable the No. 55 machine to be sold at a lower price than the No. 60, the No. 55 machine will nevertheless handle all cylinder grinding, and the general class of work met with in jobbing shops.

In addition to simplifying the machine as described, other changes have been made which better adapt the machine for the particular purposes for which it is designed. These

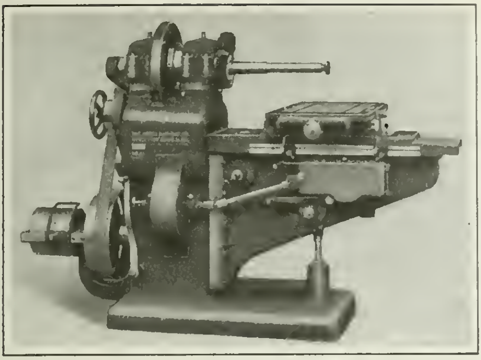


Fig. 1. Front View of No. 55 Cylinder Grinding Machine built by the Heald Machine Co.

changes include an increase in the width of the knee and main table, so that when grinding large work, such as six-cylinder castings of the en bloc type, there is no undue overhang on either side when grinding the holes at the extreme ends of the casting. The distance between the center line of the grinding spindle and the top of the cross-slide table has also been increased over that of the No. 60 machine. On the No. 60 machine, this distance ranges from 4¼ to 7½ inches, and in the new style No. 55 machine from 7 inches minimum to 9½ inches maximum. This is of considerable importance where a great variety of work is done, and will be especially appreciated in jobbing shops where large castings are frequently ground.

The main casting is a column on the top of which is a grinding spindle carried in a cylindrical rotating head or sleeve. This rotating head is made up of two eccentrics, one inside the other, giving the grinding spindle a sort of planetary adjustment for accurately feeding the wheel to the work. It has two speeds, being driven by a belt from a two-step cone on the main drive bracket. On the front of the column, and having an extra long bearing, is mounted the massive knee. This knee has a vertical adjustment of 2½ inches, and carries the main sliding table which travels forward and back in a line parallel to the grinding spindle.

The main table is made heavy with ample wearing surfaces and of sufficient length to fully protect the ways on which it slides from grit and dust. Oil-pockets with rolls provide continuous lubrication. The travel of the main table is automatic, reversing automatically at any desired point. Two speeds are instantly obtained by a simple movement of a knob on the front of the machine. A cross-slide table mounted on the main table gives crosswise adjustment to the work. The feed-screw of this cross-slide is graduated to read to thousandths of an inch. Adjustable dogs are provided to facilitate setting the table in different positions, as required when grinding the bores of en bloc cylinder castings. The exact distance between the centers of the cylinders can be obtained by means of a micrometer dial attached to the cross-feed screw; the dial is set at zero from the first hole, and the position of the dial noted for the other holes.

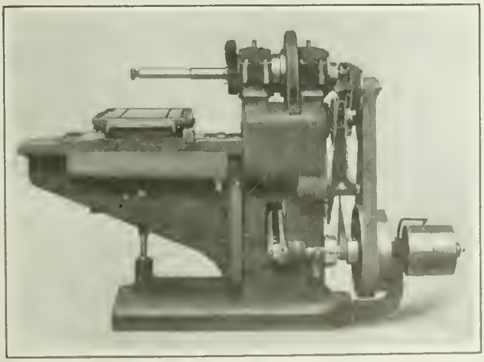
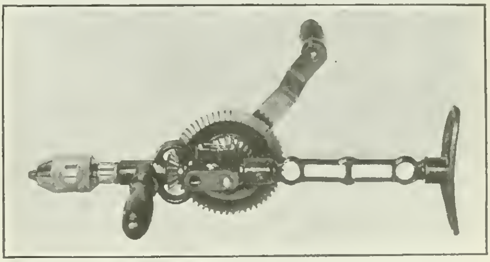


Fig. 2. Rear View of Heald Cylinder Grinding Machine, showing the Main Drive Shaft

The wheel-spindle is hardened, ground, and runs in a solid taper bronze bearing at the wheel end, with a self-aligning ball bearing at the pulley end. It is fitted with interchangeable pulleys to give different speeds to the grinding wheels, so the operator always obtains exactly the right speed, whether using large or small wheels for the work in hand. The depth of cut is obtained by the feed mechanism on the right-hand end of the rotating head, which is operated either by a knob when small adjustment is desired, or by a small crank on the shaft below when large adjustments are to be made, as in going from one size of hole to another.

Interchangeable wheel-spindle and arm units can be furnished, which give the machine a range for grinding holes from 1⅛ inches in diameter by 7½ inches long up to 5 inches in diameter by 16½ inches long. The wheel-spindle regularly furnished with the machine grinds holes 2⅜ inches in diameter and larger, by 11 inches long; also holes 3 inches in diameter and larger, by 18 inches long. The standard grinding wheels for the regular 11- and 18-inch spindles are 2½ and 3½ inches in diameter, and their speed is 4950 to 5650 surface feet per minute. The machine occupies a floor space of 72 by 110 inches, is equipped with tight and loose pulleys, 10 inches in diameter by 4½ inches face width, which should be driven at 700 revolutions per minute. A 5-horsepower motor, running at 1000 to 1200 revolutions per minute, is recommended. The net weight of the machine is approximately 2900 pounds.



Breast Drill with Three-jaw Chuck made by the Consolidated Tool Works, Inc.

CONSOLIDATED BREAST DRILL WITH THREE-JAW CHUCK

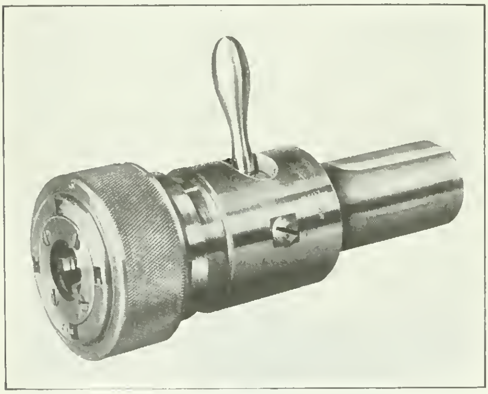
The Consolidated Tool Works, Inc., 261 Broadway, New York City, manufacture the breast drill shown in the accompanying illustration which is equipped with a three-jaw chuck that is without springs or other devices liable to get out of working order. The breast-plate is adjustable to various angular positions, and the speed change is controlled by a push-pin. The over-all length is 18 inches. The drill may be furnished with a level attachment if desired.

VICTOR SELF-OPENING DIE-HEAD

The new Style E Victor self-opening die-head shown in the accompanying illustration, which has recently been brought out by the Victor Tool Co., Waynesboro, Pa., is a development of the Style D self-opening die-head of this company's manufacture. The new die-head has been considerably simplified in its construction, and is said to be even more positive in its operation than the previous style. Instead of using separate plungers for holding and actuating the chasers as in the Style D die-head a ring is now used for this purpose which controls and actuates the chasers by means of slots and tongues which fit corresponding slots and tongues in the chasers. The same style chasers with tapered edges used in Victor collapsible taps have been employed in the new die.

The accompanying illustration shows the die closed in the cutting position. It will be noted that when in this position the chasers are fully supported for their entire length back of the cutting point, thus preventing any possibility of tipping or tilting which would result in cutting a tapered thread. The size adjustment for cutting tight or loose threads is obtained by simply turning a large knurled collar, which is accurately graduated. A range of approximately 1/16 inch either over or under size can be obtained by adjusting this collar. A small locking screw is provided for holding the adjusting collar securely in place when the desired set has been made.

For cutting threads close to a shoulder, provision is made for extending the chasers through the cap. Standard shanks are made hollow to permit the threading of long rods. Special shanks can be made, however, to meet the requirements of a customer. The heads are made either in the regular pull-off type, which automatically opens when the travel of the carriage head is stopped, or they can be furnished with an internal tripping device. The head is also made in both stationary and rotary types, the stationary type being known as Style E and the rotary type as Style R. The rotary heads can be supplied with taper shanks for use on a drilling machine, or with special shanks to fit various automatic machines.

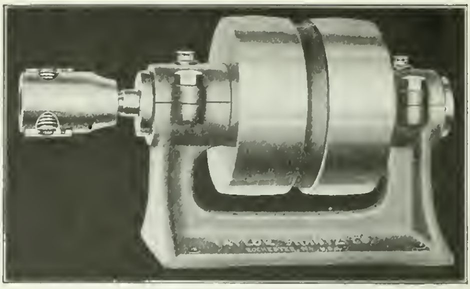


Self-opening Die-head made by the Victor Tool Co.

The head can be opened by simply pulling back on the handle. This permits the machine to be stopped without spoiling the threads already cut. Only one spring is used in the construction of the die, and that is a very heavy coil spring properly tempered and having sufficient strength to insure the positive opening of the die. The die is now made in two sizes only, the ½-inch size having a capacity for cutting threads from ¼ to ½ inch, and the ¾-inch size having a capacity for cutting threads of from ¼ to ¾ inch.

TAYLOR-SHANTZ BENCH TAPPING MACHINE

The bench tapping machine shown in the accompanying illustration is a recent product of the Taylor-Shantz Co., 478-486 St. Paul St., Rochester, N. Y. This machine is designed for use in tapping threads of all sizes up to and including threads of 5/16 inch diameter. The tap is driven in the required direction for tapping when the work is pressed against it, and is automatically reversed when the work is pulled away. A leather-faced disk is employed between the pulleys to minimize the danger of breaking taps. The machine can be driven from the lineshaft with one straight and one cross belt. The bed of the tapping machine is 7⅝ inches by 5 inches; length of the spindle and chuck is 12¼ inches; the pulleys are 5 inches in diameter by 1½ inches face; the height to the top of the pulley is 6½ inches; and the weight of the complete machine is 21 pounds.



Bench Tapping Machine made by Taylor-Shantz Co.

WOODALL-BASCH SELF-CENTERING DRILL AND REAMER HOLDER

The Woodall-Basch Tool Co., 450 Weiting Block, Syracuse, N. Y., has recently placed on the market the self-centering drill and reamer holder shown applied to different operations in Figs. 1 and 2. Referring to Fig. 1, center sleeve *A* has a large head through which a T-slot is milled at right angles to its center line. This sleeve can be furnished with a taper shank or a straight shank, as desired. It has a taper-reamed hole to receive a center that takes the place of the regular center of the machine in which the holder is used.

Fitted to float freely in the T-slot in *A* is a head *B* for holding drills or reamers. This head consists of a malleable-iron casting in the form of a collar connected at one end to bar *C* which is a sliding fit in the T-slot in part *A*. Bar *C* is the part that floats in the T-slot in the sleeve. In one side of the collar end of this head is a hardened steel vee, against which the tools are held by means of a headless screw. The hardened and ground steel center fitted to the tapered hole inside sleeve *A* projects through an opening in bar *C* into the opening back of head *B*, and as previously stated takes the place of the regular center for locating the tools on the center line.

When placing a drill or reamer in the holder, the female center of the tool is placed over the male center of the holder.

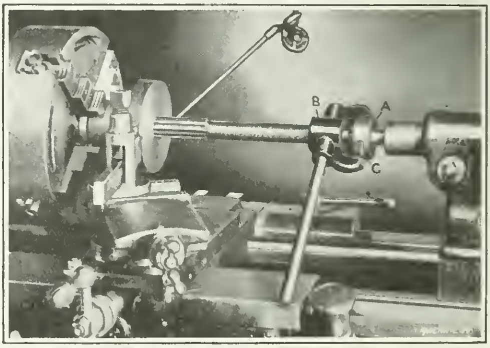


Fig. 1. Self-centering Reamer-holder made by the Woodall-Basch Tool Co.

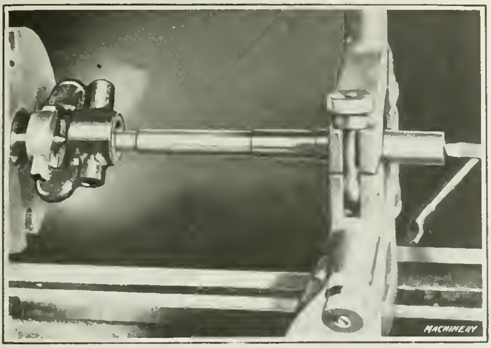


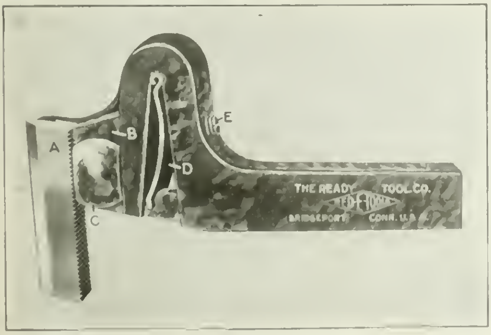
Fig. 2. Self-centering Tool-holder used in Connection with a Steadyrest

The screw in head *B* is then tightened causing the head to float to the tool where it holds it in place and in alignment with the machine spindle.

Fig. 1 shows the holder employed in a reaming operation in a lathe. In this case, the holder is held in the tailstock, a handle being inserted in head *B* opposite the clamping screw to prevent the rotation of the reamer as the tailstock is advanced. When held as shown in this illustration, there is no tendency to produce a tapered hole. As the holder is attached to the tailstock, there is no danger of the drill or reamer slipping off the center, a feature which eliminates tool breakage resulting from this cause. In Fig. 2, the holder is shown mounted in a lathe spindle where it is used as a hold-back in connection with a steadyrest. This method does away with bolts, straps, and belt lacing commonly used in performing centering, turning or boring operations on the ends of shafts. The holder, in this instance, takes the place of a live center, and acts as dog, driver, and hold-back. This holder may also be used for drilling operations.

READY THREADING TOOL

The Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn., has recently placed on the market a spring threading tool in which the familiar gooseneck principle is employed to eliminate chatter and enable the operator to cut smooth threads. Referring to the accompanying illustration, cutter *A* is held at an angle of 15 degrees, and the side angles are accurately ground to cut a 60-degree thread. The cutter being held on the left side of the holder, enables the operator to work close up to a shoulder. The gooseneck construction of the holder permits the tool to spring back slightly on striking hard spots in the work instead of digging in, so that the threaded work may be finished as smoothly with high-speed cutters as with carbon cutters. This feature permits smooth threads to be cut at high speeds.



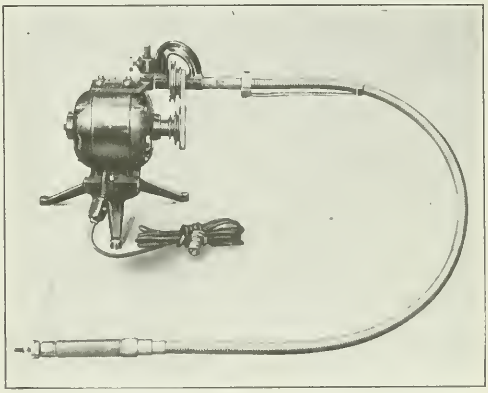
Spring Threading Tool made by the Ready Tool Co.

It will be noted that teeth are cut in the back of the cutter *A*, and also in the front of dog *B*, these two parts being clamped together by bolt *C*, which holds the dog to the tool-holder and eliminates any possibility of the cutter slipping. An auxiliary spring *D* with set-screw *E* is incorporated in the holder. By increasing the pressure on this spring by turning set-screw *E* the holder can be employed for cutting heavy pitched threads such as 4, 6 and 8 threads per inch. When properly adjusted in this manner, the heavier pitched threads can be cut as smoothly as the finer ones.

The top of the cutter only is required to be ground, a feature which permits an inexperienced operator to obtain accurate threads. A Woodruff key is placed in the bottom of the holder to prevent inaccuracies which might otherwise result from side thrust imposed on the tool. This tool can be equipped with V-cutters as well as single-point cutters of the U. S. standard form and cutters of the chaser type. The tool is made in one size only with right-hand offset, the size being ½ by 1 by 7 inches.

HASKINS SWIVEL BASE AND FLEXIBLE SHAFT DRIVE FOR PORTABLE MOTOR

The R. G. Haskins Co., 27 S. Desplaines St., Chicago, Ill., has recently brought out the Haskins new type of swivel base and flexible shaft for portable electric motors, shown in the accompanying illustration. Among the new features incorporated in this equipment is a swivel base which allows the motor countershaft to be rotated a full 360 degrees in a horizontal plane. This means that the shaft will always operate in a normal position, and will therefore be less awkward to handle. It also serves to prolong the life of the shaft by reducing the friction caused by operating in a distorted position. Another improvement is the spring support which further reduces the bend of the shaft at the machine, thereby decreasing friction and prolonging the life of the shaft. This support also takes up any strain that might result by pulling on the shaft in any direction.



Portable Motor equipped with Swivel Base and Flexible Shaft made by the R. G. Haskins Co.

ST. LOUIS ROTARY PISTON PUMP

The St. Louis Pump & Equipment Co., 321 International Life Bldg., St. Louis, Mo., has recently placed on the market a rotary piston pump designed to handle volatile and non-volatile liquids. Fig. 1 gives a good idea of the compact appearance of the assembled pump, while Fig. 2 shows its simple construction. The pump consists of twelve principal parts: A pump-case *A* (Fig. 2), with a dividing partition *B*; two end plates *C* and *D*; a steel shaft *E* with two eccentrics *F* mounted on it; two pistons *G*; two rocker arms *H*; and two checks *J*.

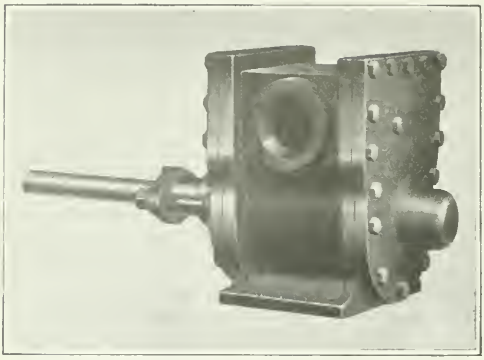


Fig. 1. Rotary Piston Pump made by the St. Louis Pump & Equipment Co.

The two eccentrics *F* are so keyed to shaft *E* that their throw is 180 degrees apart; in other words, they are opposed. Surrounding these eccentrics are the two pump pistons *G*. These pistons are pivoted to rocker arms *H*, which serve to produce the reciprocating movement of the pistons through the cam action of the eccentrics. In this way the composite reciprocating rotary motion of the pump plunger or piston is obtained without actual contact of piston and cylinder walls. The clearance between the piston and cylinder walls, however, is so small that a liquid seal results, and so positive is its action that after long service it has been found to pull better than 29 inches of vacuum. The piston check *J* is the only moving part that touches the cylinder wall, and it functions only at the point of transition at the end of the pump suction movement, or stroke, to the beginning of a new stroke. The wear on this check is taken up automatically. The interval between the so-called strokes is so slight that an even impulse is imparted to the liquid being pumped. While the piston is on the discharge stroke it is acquiring fresh liquid on the opposite or suction side, and the piston in the opposite chamber is functioning conversely, thus giving the pump a balanced action.

The pump is constructed entirely of metal, the kind of metal employed being determined by the kind of liquids to be handled. The parts are so arranged that no two similar metals are in contact at any bearing point. All wearing parts are of the rotative type, a feature which tends to give the pump long life. At every point at which wear is likely to occur, even to a minor degree, self-lubricating bearings capable of long service are used. The head at one end of the pump-case is blind; that is, the shaft does not extend through. This construction eliminates the necessity of packing this end. At the other end a gland which holds the packing material is bolted to the head. This gland is separate from the bearing bushing; it is designed to act simply as a gland and does not serve as a bearing, the latter function being restricted solely to the bearing bushing. This pump is compact, light, and is practically free from vibration.

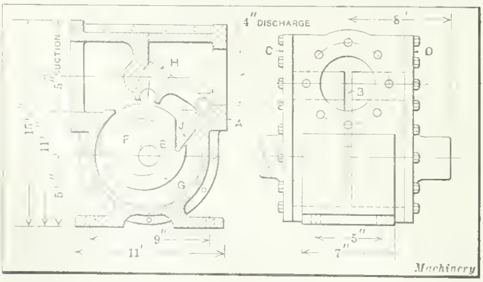


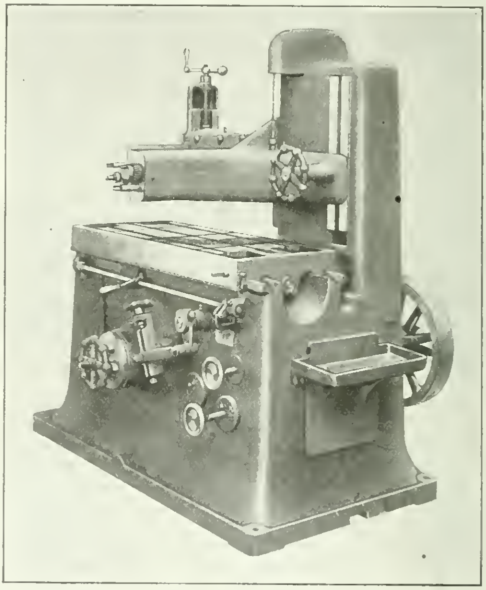
Fig. 2. Diagram showing Construction of Rotary Piston Pump

COULTER SHAPING PLANER

The latest type of Coulter shaping planer built by the Automatic Machine Co., Bridgeport, Conn., is shown in the accompanying illustration. In this machine the quick-return stroke and variable speed of the shaper have been combined with the accuracy and table capacity of the planer to form a tool which is particularly well adapted for tool-room work.

A noteworthy feature of this new product is the combination clutch and brake mechanism, which is operated by a conveniently located lever at the front of the machine. By means of this lever, the table can be stopped and started instantly without stopping the motor or the countershaft. In fact, no countershaft is required where it is possible to belt direct to the machine from the main lineshaft. This feature makes the installation of the machine a comparatively simple matter and is of especial value in shops where the head room is limited.

The clutch and brake mechanism referred to consists of a raybestos-lined brake and a main driving pulley made up of two concentric wheels, the inside rim of one and the outside rim of the other being beveled at an angle, which, by repeated tests has been shown to be most satisfactory for the purpose. When, by movement of the operating handle, the clutch is thrown out, the brake is simultaneously applied. The degree of friction in the clutch can be adjusted by means of a split nut on the driving shaft. The large bearing surface of the clutch insures a minimum amount of wear and gives a maximum torque for the minimum friction developed without appreciable heating. An indicator showing the length of stroke is another improvement found on this machine that should prove particularly useful in performing various machining operations required in tool-room work.



Coulter Shaping Planer built by the Automatic Machine Co.

VAN KEUREN GAGE-BLOCKS

The Van Keuren Co., 362 Cambridge St., Allston Station, Boston, Mass., has placed on the market a set of "microgages," known as the "OK-VK," giving by combination a standard size for every thousandth of an inch from 0.4 inch to over 5 inches. The set, as shown in the accompanying illustration, is designed especially to meet the requirements

"OK-VK Microgages" made by the Van Keuren Co.

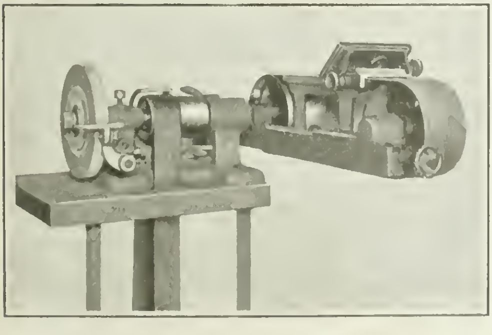
of production departments, small shops, or individual workmen. The obtainable combinations being in thousandths, the set is particularly useful for such purposes as setting sine bars, checking instruments, snap gages, and tools for machining slots, widths, and heights on parts being machined, and for the many uses for which combination gages or size blocks will save time.

The complete set consists of sixteen separate gages which are arranged in four series, each series consisting of four blocks. The thousandth series consists of blocks measuring 0.101, 0.102, 0.103, and 0.106 inch, respectively. The hundredth series consists of blocks measuring 0.110, 0.120, 0.130, and 0.160 inch. The tenth series consists of blocks measuring 0.100, 0.200, 0.300, and 0.500 inch. The inch series consists simply of four 1.000-inch blocks.

The gages are made of high-grade tool steel, scientifically heat-treated and seasoned. They are ground and lapped to a mirror finish, and are standardized by light wave measurement against standards certified by the National Bureau of Standards, Washington, D. C. Each gage is held within a guaranteed accuracy of twenty-five millionths of an inch at the standard temperature of measurement, namely, 68 degrees F. The set is conveniently arranged in a plush-lined leatherette-covered case. Over five thousand standard sizes are said to be obtainable with the set as furnished, and greater range may be secured by adding 1-inch gages to those provided in the set.

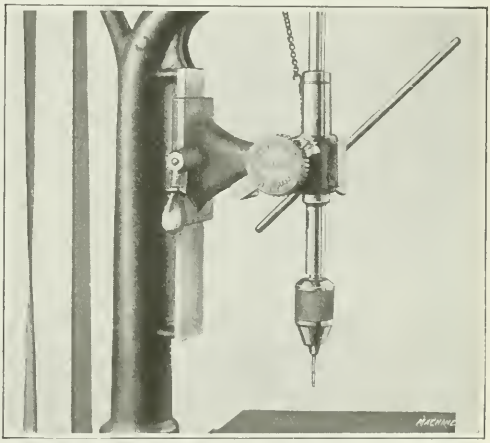
"JUNIOR" SURFACING MACHINE

A general utility surfacing machine known as the "Junior" has recently been placed on the market by the Peerless Surfacing Machine Co., Inc., Troy, N. Y. Referring to the accompanying illustration, it will be noticed that this machine is of compact design and possesses features which make it well adapted for surfacing small parts in machine shops and factories. Although it occupies but little space, it carries a 63- by 4-inch high-speed abrasive belt.



"Junior" Surfacing Machine made by the Peerless Surfacing Machine Co., Inc.

The arm that supports the abrasive belt pulleys can be swung about the center of the driving shaft and clamped in any desired position. This enables the belt surface to be located in a horizontal or vertical position or at any intermediate angle. The machine can be driven from a countershaft, a separate motor, or by direct connection to the end of the shaft. It can also be attached to a table and moved around the shop from one job to another. The main shaft is designed to carry a grinding wheel or disk plate 11 inches in diameter, in addition to furnishing the drive for the abrasive belt. This machine has proved particularly useful for such work as the preparation of mineralogical specimens, the finishing of piano parts, hardware, metal stampings, small castings, switch bases, automobile small parts, and various articles made from hard rubber. The machine weighs approximately 150 pounds and occupies a floor space of 14 by 10 inches. The abrasive belt wheels or drums are 8 inches in diameter by 4¼ inches face width. The belt table is 12⅜ inches by 4¾ inches, and the abrasive belt speed, 2500 feet per minute.



"Martian" Drill Protector made by F-S Machine Specialties, Inc.

"MARTIAN" DRILL PROTECTOR

The "Martian" drill protector shown in the accompanying illustration is a new product of F-S Machine Specialties, Inc., 171 Washington St., Newark, N. J. It is designed for use in connection with sensitive or hand-operated drilling machines for the purpose of preventing drill breakage. Probably 90 per cent of small drill breakage in production work occurs just as the drill breaks through the under surface of the part being drilled. It is claimed that the "Martian" protector will prevent this breakage, but it is not claimed that it will prevent breakage due to incorrect drill grinding or other causes.

The theory on which the design of the attachment is based is as follows: When the drill point approaches the under surface of the work, the resistance of the material rapidly breaks down and unless the operator lightens the feed or carefully feels the way through, the drill will move forward faster than the cutting edges can remove the metal, and instead of acting as a cutting tool the action becomes more like that of a screw; it is under these conditions that small drills are most frequently broken.

The "Martian" protector comes into action just when the drill is about to pierce the under surface, and exerts an upward pressure on the drill spindle, which counteracts the lowered resistance of the work to the advancing drill due to its breaking through. When the protector is properly set, the operator can detect no change in the "feel" of the press feed-lever, as the resistance is shifted to the mechanism of the protector. The operator simply feeds the drill down until it comes to a full stop, which occurs when the drill is entirely through the work, and the hole completely drilled. This device is primarily intended for use in preventing the breakage of drills varying in size from No. 60 up to ⅛ inch in diameter.

ARTER AUTOMATIC PISTON-RING GRINDER

The Persons-Arter Machine Co., 72 Commercial St., Worcester, Mass., has made it possible, by the application of an automatic attachment, to convert the company's grinding machine into an automatic piston-ring grinder having a capacity for grinding 1400 rings on one side per hour, and capable of handling rings of any size from the smallest up to 4¼ inches in diameter on the present model.

The automatic device is so designed that it can be readily attached to any of the company's existing machines by simply drilling one hole through the base of the machine for a rocking bar which operates an air valve by means of which the indexing mechanism of the device is controlled. The frame casting on which the mechanism is assembled, is so designed that the whole mechanism will drop into the same place and be located in the same manner as the water pan on the regular machine.

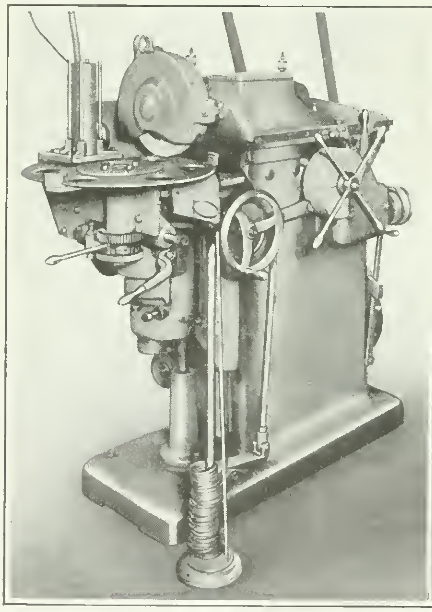


Fig. 1. Persons-Arter Automatic Piston-ring Grinder

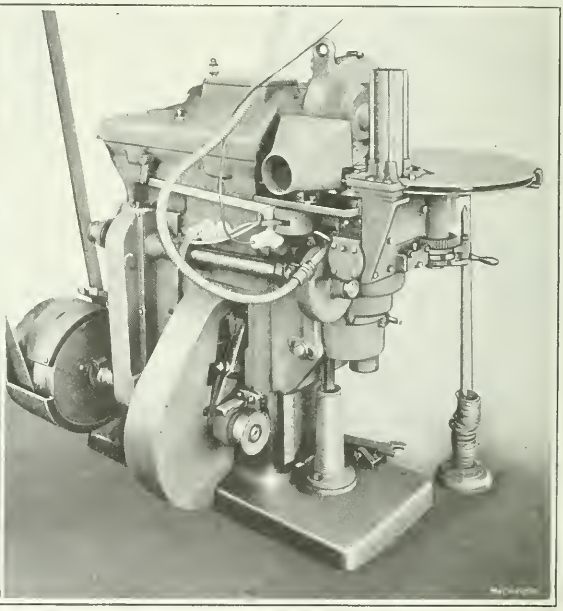


Fig. 2. Another View of the Persons-Arter Automatic Piston-ring Grinder

The accompanying illustrations, Figs. 1 and 2, show the device as applied to the Persons-Arter grinding machine. Fig. 1 shows the carrier disk provided with six holes or receivers into which the piston-rings drop as they pass from the magazine shown, to the grinding wheel. As the carrier disk moves around to the grinding position, actuated by a pneumatic indexing mechanism to be described later, the ring is placed under the grinding wheel and directly above the magnetic chuck regularly provided on the machine, and is held by this magnetic chuck while the grinding takes place.

When the grinding has been completed and immediately before the next indexing movement, a special reversing switch momentarily reverses the current through the chuck and neutralizes any residual magnetism that may be present at the time of the indexing. When again indexing, the ring is passed over a chute shown in Fig. 1, through which it drops on a rod provided for receiving the rings as shown, and a new ring is placed in position for grinding at the same moment. In the three positions between the discharging of the ring and until the holes in the carrier plate again move underneath the magazine, they perform no function, as the whole purpose of the device is simply to feed piston-rings automatically from the magazine to the grinding wheel, underneath which they are held and rotated by the magnetic chuck, and then to discharge the finished rings as shown.

The wheel-slide of the machine is provided with three speeds, making the capacity from 850 to 1400 rings per hour, but still faster speeds would be possible on the roughing operation if consistent with the finish required. As the machine is entirely automatic in its operation, one operator can run six machines.

The operation of the machine is, briefly, as follows: The rings to be ground are stacked in the magazine, the bottom ring dropping by gravity to the receiving plate and inside the holes in this plate, these holes being provided with interchangeable hardened steel disks for receiving the rings. These disks are tongued and grooved into the receiving plate and a locking plate prevents them from rotating. The upright bars of the magazine are also adjustable radially to accommodate rings of different diameter. When a new ring has dropped into the hole in the carrier plate, and the grinding on the ring under the wheel is completed, the wheel having reached its extreme backward position away from the ring, the current energizing the magnetic chuck or work-holder is automatically switched off, thereby releasing the ring on the chuck. As soon as this release has taken place, the regular reversing dogs on the machine operate an air valve, thereby admitting air to the cylinder that operates the indexing mechanism through a piston which rotates the gear and cam mounted on the index-spindle shown in the illustrations. The gear and cam are free on the spindle, the latter controlling the movement of a pawl which, in turn, rotates the spindle through a toothed disk or ratchet shown mounted at the extreme lower end of the indexing spindle and which is attached to it. An index-plate just over this ratchet provides the means of locking the carrier plate in the grinding position, by a plunger sliding into a notch cut in its periphery. In this way any piston-ring resting in the hole in the carrier plate is carried to the center of the magnetic chuck as already described.

When the grinding wheel starts on its forward movement, the magnetic chuck is automatically energized before the wheel touches the piston-ring, this energizing effect being continued until the wheel is in the same position on the backward stroke. As the wheel reaches its furthest position toward the center on the piston-ring, the regular reversing dog on the machine moves the lever controlling the air valve in an opposite direction to that in which it was moved at the end of the backward stroke of the wheel, and the piston in the air cylinder is moved backward, the pawl of the indexing mechanism meanwhile slipping over the teeth in the ratchet gear and being brought into a position ready for a new indexing movement. It will be noted that as the valve is operated from the regular reversing dogs on the machine, it is impossible for the valve and the air cylinder controlled by it to be out of time with the movement of the grinding wheel, so that the indexing mechanism and the automatic forward and return motion of the wheel must always be timed exactly in harmony with each other. Furthermore, the length of stroke of the wheel has no effect upon the action of the indexing movement, as it is controlled directly by the regular reversing dogs of the machine.

The attachment is adjustable in a vertical direction relative to the chuck by merely loosening two screws entering elongated slots and making the adjustment on a screw provided for that purpose at the bottom of the attachment. The regular vertical adjustment of the attachment in conjunction with the chuck, to compensate for wheel wear, is operated directly by the regular vertical feed mechanism, using the handwheel shown. All parts are easily accessible, and the design is such that in any case where parts have to be removed this can be done by loosening the minimum number of screws or nuts.

The wheel may be dressed by dropping a fixture into the place where the ring would ordinarily be held; this fixture is held by the magnetic chuck, and by having a diamond suitably mounted in it, the wheel may be dressed in this way.

In order to eliminate all shock in the indexing movements, an ingenious cushion valve is provided which effectively controls the momentum of the moving parts, and the indexing takes place smoothly and without shock. Chain drive is provided from the main drive of the machine through the universal shaft so as to insure a positive drive for the chuck.

If the air should fail for any reason, the device can be operated by hand by using the lever shown inserted in the cam-plate.

NEWTON DRUM TYPE CONTINUOUS MILLING MACHINES

Various types of continuous milling machines built by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., have been previously described in MACHINERY. In the accompanying illustrations are shown two of the latest machines developed by this company for performing surface milling operations in the manufacture of duplicate parts, such as automobile engine cylinder blocks, crankcases, etc. These machines are known as the Model 0-4 and are adapted for machining either one surface on two castings placed side by side or two surfaces on one casting. In both illustrations, the milling machines are shown performing two surfacing operations on each casting. One of the advantages of this method of milling over the method of milling one surface on two castings is that it eliminates one handling operation. Another advantage is that in milling two surfaces at one time on the same casting a higher degree of parallelism is obtained, whereas if the surfaces are machined separately, it is almost certain that there will be a lack of parallelism.

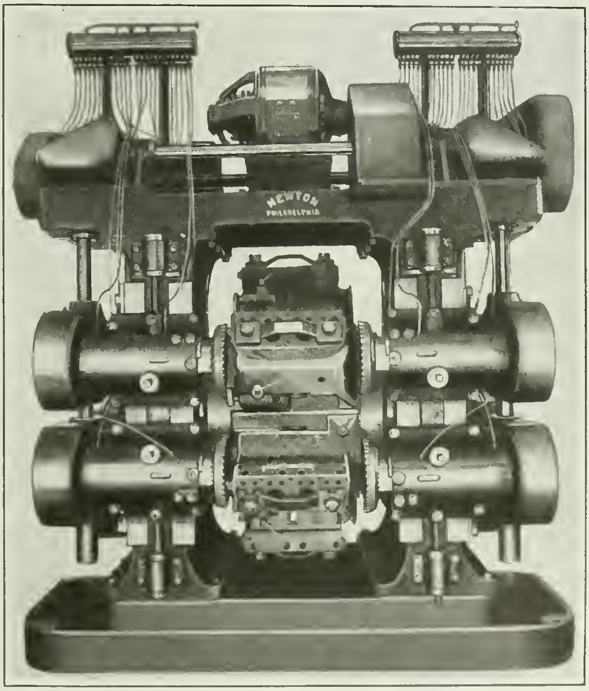


Fig. 1. Drum Type Continuous Milling Machine built by the Newton Machine Tool Works, Inc.

The machine shown in Fig. 1 is equipped for milling or surfacing the ends of cylinder blocks. Two milling cutters are engaged in taking roughing cuts on the opposite ends of one cylinder block, while another pair of cutters is engaged in finish-surfacing the ends of a cylinder block previously rough-machined by the roughing cutters. The machine shown in Fig. 2 is equipped for surfacing the head and the base of a cylinder block. These two surfaces are rough-milled simultaneously by one set of milling cutters while the other set of cutters is finish-surfacing one of the cylinder blocks which has been rough-faced by the roughing cutters.

All spindles have individual adjustment and are driven by worms and worm-wheels, so arranged that the cutting speed of the finishing cutters is 80 per cent of that of the roughing cutters. The speed of the cutters can be varied by means of "pick-off" change-gears. The drum on which the work is mounted is rotated by herringbone gears through a worm and worm-wheel drive, which is also variable by the use of "pick-off" change-gears. The drum spindle is provided with means for making very fine adjustments to prevent end motion, and is also provided with a take-up bushing of the split taper type. All gearing, splined shafts, and revolving parts are fully enclosed, and run in a bath of oil which is pumped from the reservoirs on each side of the machine. The oil, after having passed through the various bearings, returns to the reservoirs. All slow-running members, such as the spindles which are lubricated by pipe connections, have a special system of oiling which prevents flooding, thus eliminating loss of oil and preventing the annoyance resulting from oil leakage.

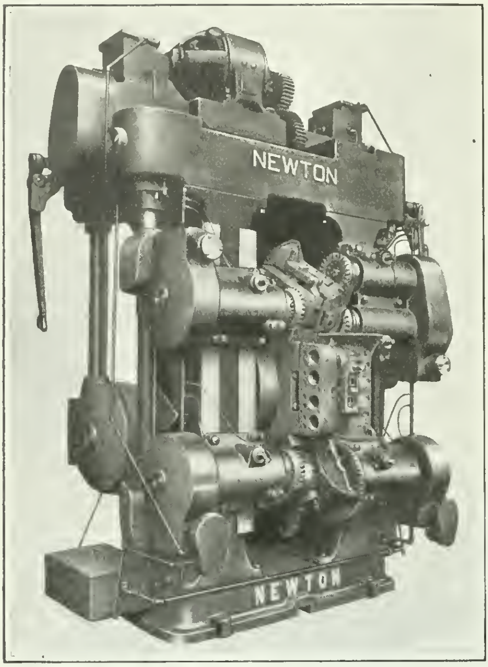
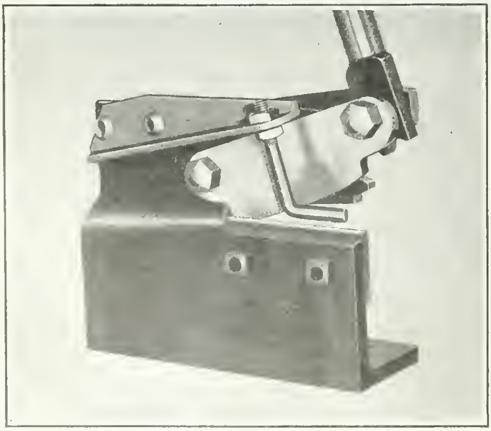


Fig. 2. Another Continuous Milling Machine made by the Newton Machine Tool Works, Inc.

In the chucking of the work, only one clamp as shown in Figs. 1 and 2 is used. It will be noted that the clamp shown in Fig. 1 has a two-point bearing, a feature which simplifies the locating and unloading operation. These machines occupy very little floor space in comparison to their production rates, which in the case of the machine shown in Fig. 1, is thirty-five pieces per hour and in the case of the machine shown in Fig. 2, twenty-five pieces per hour.

DREIS & KRUMP STEEL SLITTING SHEAR

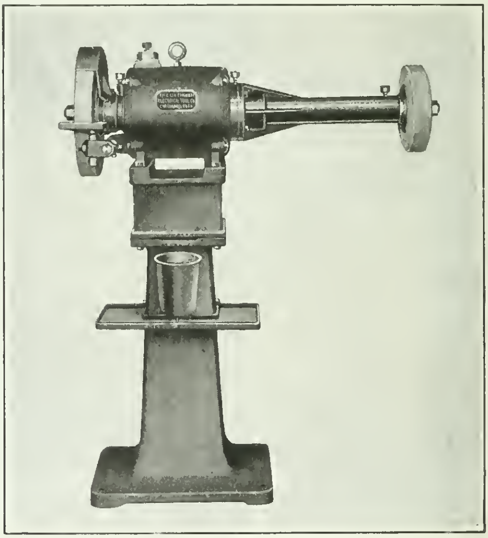
The Dreis & Krump Mfg. Co., 2909-2923 S. Halsted St., Chicago, Ill., has recently placed on the market a device known as the Chicago steel slitting shear. This shear, which is shown in the accompanying illustration, is adapted for slitting or cutting operations on bar stock 2 inches by 3/16 inch and smaller, 10-gage sheet steel, brake band lining, belting, and similar work. The shear is constructed of steel throughout, the frame being pressed from a steel section which gives strength and durability. The knife or cutter is operated by a geared lever which gives great cutting power. An adjustable hold-down is provided as shown. The knives are of crucible steel and all parts are interchangeable. The machine weighs only 22 pounds, and is a very handy tool for all classes of slitting or cutting operations within its capacity, being especially well adapted for use in factories, sheet metal shops, and garages.



Steel Slitting Shear made by the Dreis & Krump Mfg. Co.

COMBINATION GRINDER AND BUFFER

A combination grinder and buffer mounted on a floor stand, which permits interchangeable buffing and grinding without changing wheels, has recently been added to the line of portable electric drills and grinders manufactured by the Cincinnati Electrical Tool Co., 1501-1505 Freeman Ave., Cincinnati, Ohio. As shown in the illustration, the grinding wheel is mounted close to the motor at one end of the motor spindle, while the buffing wheel is carried at the end of a long bearing or extension arm which extends from the opposite end of the motor. The grinding wheel is adapted to both tool grinding and general grinding of all kinds.



Combination Grinder and Buffer made by the Cincinnati Electrical Tool Co.

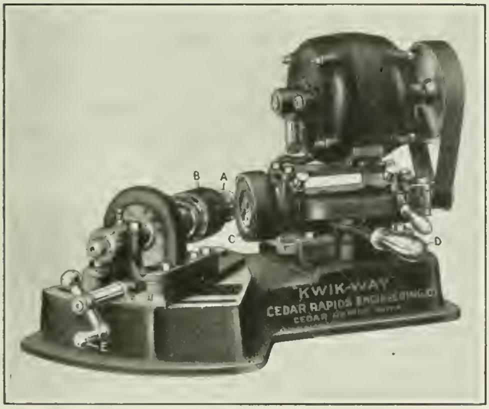
The motor windings are fully enclosed and protected, and the spindles are carefully ground. Annular ball bearings are fitted on both ends of the armature spindle, as well as at the end of the extension spindle on which the buffing wheel is mounted. Dust caps are fitted to the spindle to protect the bearings and windings from emery dust and dirt. The grinders are fully equipped, including tool board and water pot, and can be furnished without floor pedestal if desired. The motors are made for direct or alternating current in ½-, 1-, 2-, and 3-horsepower capacity to carry wheels from 8 to 14 inches in diameter.

CEDAR RAPIDS VALVE FACING MACHINE

The "Kwik-Way" valve facing machine recently placed on the market by the Cedar Rapids Engineering Co., 902 N. 17th St., Cedar Rapids, Iowa, is built for the purpose of refacing motor valves preparatory to grinding them in by the usual method. The leakage of motor valves and the consequent loss of compression not only decreases the power and impairs the performance of a gasoline motor, but is also the direct cause of many other troubles usually attributed to incomplete carburetion, faulty ignition, or worn piston-rings. In order to stop the loss of power, and waste of fuel and lubricating oil resulting from leaky valves, it is necessary that the valves be properly reground. In order to do this, the face of the valve should be trued up in relation to its stem, and the valve seat should also be ground to line up with the valve-stem guide. After this has been accomplished, the valves must be ground in with a fine grinding compound. By the use of the valve facing machine here illustrated, valve seats can be quickly and accurately trued up so that the final grinding-in operation will require but a moment.

Referring to the accompanying illustration, the valve *A* which is to be ground is held by a specially designed chuck *B* and rotated while the face is being trued up with the high-speed grinding wheel *C*. The base of the machine is a one-piece casting heavily ribbed and reinforced to insure rigidity and freedom from vibration. The grinding wheel shaft or spindle is hardened and ground to an accuracy of one-half thousandth of an inch, and runs on ball bearings made dust-proof and packed in grease. The grinding wheel is of special shape and grit produced expressly for this machine by the Norton Co., and is regularly carried in stock.

The special chuck is really two universal three-jaw chucks in one, with each chuck working independently of the other. This specially designed and patented chuck centers the valve stem at two points, 2½ inches apart, on that section of the valve stem that works in the valve guide. This insures accuracy in centering a used valve for refacing. The chuck and chuck shaft are one unit. All parts are hardened and ground, and the chuck shaft runs in reamed bearings, which are adjustable for wear, and is driven at a speed of 200 revolutions per minute by worm-gearing from the grinding wheel shaft, which has a speed of 6000 revolutions per minute. Both the grinding wheel shaft and chuck shaft are mounted on sliding carriages, the ways of which are gibbed to compensate for wear.



"Kwik-Way" Valve Facing Machine made by the Cedar Rapids Engineering Co.

The grinding wheel is moved across the face of the valve by means of a hand-lever *D* at the front of the carriage. The adjustment of the valve relative to the face of the grinding wheel is accomplished by turning the small crank *E* at the left end of the chuck carriage. This machine will take any size valve up to and including one having a 3-inch head, and a stem ½ inch in diameter. By means of graduations the machine can be set to grind any angle from 25 to 65 degrees. The machine is driven through a friction clutch pulley on the grinding wheel shaft by means of a motor.

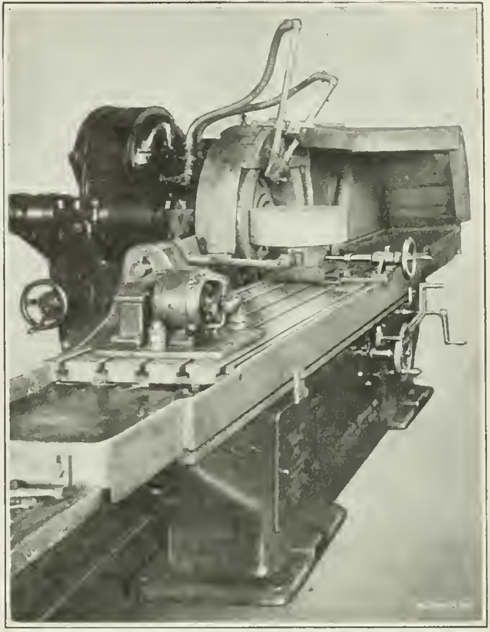


Fig. 1. Crowned-pulley Grinding Attachment applied to a Diamond Heavy-duty Face Grinding Machine

DIAMOND CROWNED-PULLEY GRINDING FIXTURE

The crowning of pulleys by grinding may be done by using a formed wheel covering the entire face of the pulley or by using a straight-face wheel; in the latter case either the wheel or the work is set at an angle to form the crowned face. A third method of crowning, which is the one to be described, differs from those just referred to in that a ring or cylinder wheel is employed instead of an ordinary disk wheel. A fixture used in conjunction with this third method has been brought out by the Diamond Machine Co., Providence, R. I. This fixture is shown in Fig. 1 applied to a Diamond heavy-duty face grinding machine. The diagram, Fig. 2, illustrates how the pulley is ground with a wheel of this kind, and also how the amount of crown is varied by changing the position of the pulley relative to the wheel. If the pulley is rotated inside of the wheel or in position *A*, the crown will have the same radius as the inside of the wheel, and the amount of crown can be reduced to zero as the position of the pulley is changed from *A* to *B*. It is even possible by this method to obtain a negative crowning or a concave face by rotating the pulley against the outside of

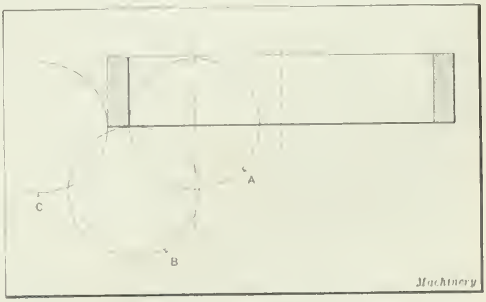


Fig. 2. Diagram showing how Amount of Crown is varied by changing Position of Pulley Relative to Wheel

the wheel, as indicated at *C*. While concave faces are not required for pulleys, this feature might be of value for other classes of work.

The faces of the pulleys are ground from the rough, although the pulleys are chucked and the edges finished preparatory to the crown-grinding operation. As Fig. 1 shows, this fixture consists of two units. One unit is composed of the motor with its reduction gearing, and the other is the work-holding member, the two being connected by a universal-joint shaft. The work-holding member has a faceplate with driving pins or dogs that enter between the pulley spokes, and there is also a vertical spindle, the diameter of which is made to fit the hole in the hub of the pulley. The base of the work-holding member is free to slide, and is adjusted relative to the grinding wheel by the handwheel seen in Fig. 1. A slight change will enable this fixture to be adapted for grinding webbed pulleys.

The production obtained with this method of grinding pulleys varies somewhat, according to the amount of stock to be removed and the uniformity of the castings. When grinding pulleys having a diameter of 12 inches and a face width of 4 inches, an average production time, from floor to floor, of two or three minutes is readily obtained. Pulleys 18 inches in diameter with a 5-inch face width have been ground in four minutes, which is the time from floor to floor, but a better average would be six to eight minutes. Face widths as great as 10 inches have been ground successfully by this method. Pulleys 24 inches in diameter and with an 8-inch face width were ground in six and one-half minutes, and a day's production can be maintained at the rate of one in twelve minutes.

Since pulley castings are usually very thin and often chilled, they are frequently difficult to machine; and if the work is done on some type of lathe, low speeds and feeds are often necessary and the percentage of breakage may also be high. Owing to these difficulties, it is believed that the grinding method just described will find favor in many places where the machining of pulleys has heretofore proved to be a somewhat difficult and expensive operation. This general method of grinding can also be applied successfully to the grinding of malleable-iron brake-shoes, rollers for conveyors, wheels for small trucks, and similar work.

MARQUETTE PRESSURE LOCKING DEVICE

In the operation of a double-action power press, the regular cycle of movements is as follows: First, the blank-holder descends on the work; second, the upper die descends to perform the required operation; third, the upper die returns to its starting position; and fourth, the blank-holder is raised. This sequence of movements works out satisfactorily with the equipment ordinarily used on a press of this type, but the application of a pneumatic die cushion of the kind made by the Marquette Tool & Mfg. Co., 319-331 W. Ohio St., Chicago, Ill., makes it necessary to provide special means of controlling the movement of the lower die in such a way that it descends independently of the so-called pressure-ring or blank-holder, and is locked to this member during the return stroke.

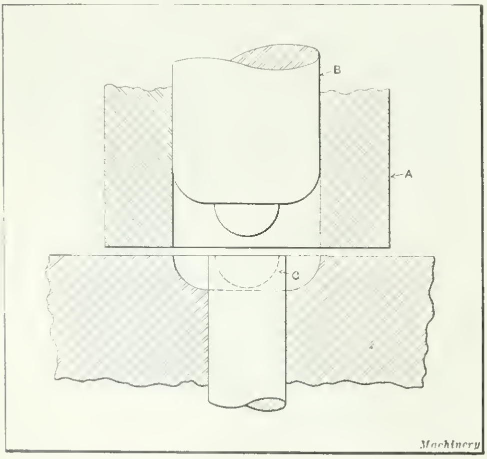


Fig. 1. Diagram showing Arrangement of Upper and Lower Dies and Blank-holder

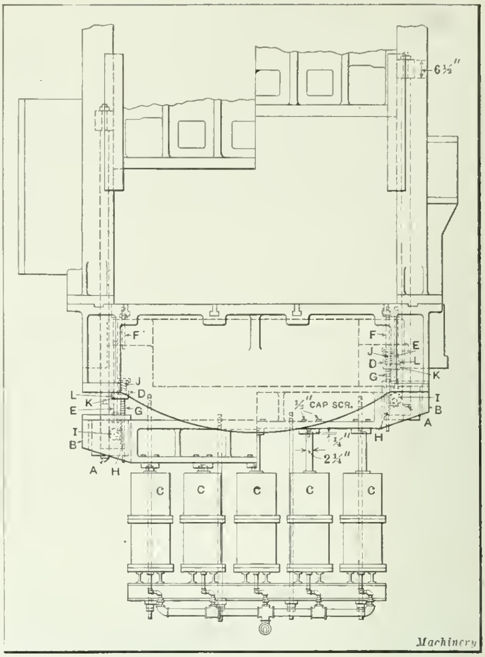


Fig. 2. Marquette Pressure Locking Device shown with the Power Press Ram in its Upper and Lower Positions

From the following description, it will be apparent that if such provision were not made, the action of the pneumatic cushion would cause it to raise the lower die member as soon as the pressure of the upper die was released, and thus distort the work which is still held down by the die-holder. This difficulty is overcome by having the lower die and the blank-holder locked together for their return stroke in the manner previously mentioned. Having made this preliminary statement of the purpose of this mechanism and of the way in which it functions, we are in a position to enter upon a detailed description. Attention is first called to the diagram Fig. 1, which shows the outline of upper and lower die members and of the blank-holder for drawing a sheet-metal part.

In conformity with the stated sequence of operations, these members will function as follows: Blank-holder *A* descends on the work; next upper die *B* descends, carrying the center member *C* of the lower die with it; then upper die *B* returns to its starting point; and finally, the blank-holder *A* returns to its starting position. This is the regular sequence of operations, but it will be evident that as center member *C* of the lower die is supported by one of the Marquette pneumatic cushions, it will tend to return to the starting position with the upper die *B;* and as blank-holder *A* does not rise at this time, the work would be destroyed by such a method of operation. But if die member *C* drops independently of blank-holder *A*, but rises with it, no difficulty will be experienced in using the die cushion. It is this control of movements of the upper die and blank-holder that is accomplished by the device which is here described.

Fig. 2 shows the locking mechanism in two positions. Various parts of this mechanism are shown at the left-hand side of this illustration in the positions which they occupy at the conclusion of the downward stroke of the press; and at the right-hand side, the press has returned to its starting position and the lower die member has been released from the blank-holder, ready for the next stroke of the press. On the first stage of the downward movement of the press ram, two locking bars *A*, which are secured to the blank-holder, move freely through openings provided in the ends of pressure-beam *B* for that purpose. Also, it will be seen that the pressure-beam is supported by pneumatic cushions *C* which resist downward movement of the lower die members. At the conclusion of the first stage of the ram's downward movement, the blank-holder and bars *A* have reached their lowest position. When the second step of the downward movement causes the lower die member *C* of Fig. 1 to descend, pressure-beam *B*, Fig. 2, is also depressed through the action of the upper dies on the corresponding lower die members.

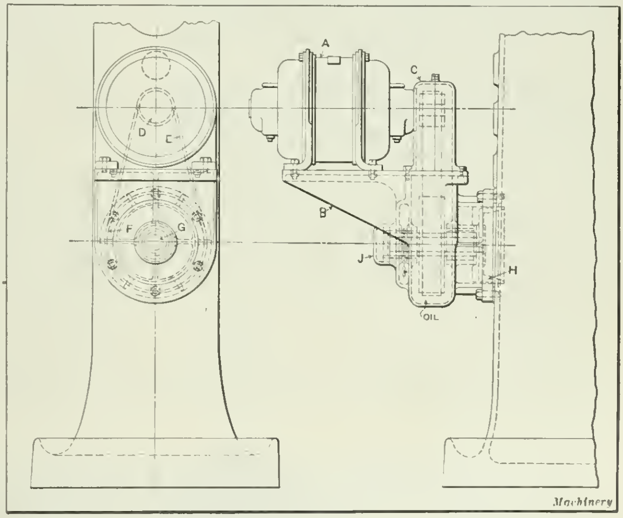
In the initial position of the mechanism, two cylindrical spring housings *D* are in contact with set-screws *F* carried by the bed of the press, and connecting springs *G* are compressed between the top of pressure-beam *B* and the bottoms of housings *D*. When the pressure-beam descends, springs *G* are free to expand, and by lifting housings *D* they cause an upward movement of two racks *H* that mesh with cams *I* which have teeth cut in one side to mesh with the teeth of racks *H*. As the pressure-beam *B* drops, the tendency of springs *G* to lock cams *I* against locking bars *A* is retarded by frictional resistance of the sliding movement of cams *I* on bars *A*; but when the pressure-beam has reached the bottom of its travel, the full force of springs *G* becomes effective in locking bars *A* by means of the cams *I*. At this point, the dies have completed their drawing operation and the press is ready for the return of its various members to their starting positions.

As previously stated, the first step in the upward motion is the return of the upper die to its starting position. When this takes place, cams *I* have locked the pressure-beam *B* and the lower die members carried by it to rods *A* that are secured to the blank-holder; and as a result, die cushions *C* cannot cause the lower dies to rise and destroy the work. Next in the sequence of operations comes the return of the blank-holder and its lower dies to their starting positions, and when this takes place bars *A* and pressure-beam *B* rise together, until such a time as the tops of housings *D* come back into contact with set-screws *F*, arresting the upward movement of housings *D* and thereby causing the springs *G* to be compressed during the further upward movement of beam *B*. The locking friction between cams *I* and rods *A* prevents any movement of racks *H* which continue moving with beam *B*, thereby compressing springs *J* until beam *B* reaches the bottom of the press bed. At this instant the upward movement of beam *B* is arrested, but rods *A* continue their upward movement thus releasing the frictional resistance between cams *I* and rods *A*, and allowing compressed springs *J* to act on the head of racks *H*, turning cams *I* out of contact with rods *A*, as shown on the right-hand side of Fig. 2.

A complete cycle of movements of this mechanism has been described in the foregoing, but it is also necessary to make provision for releasing the pressure of pneumatic cushions *C* at the time that dies are being changed. Otherwise, releasing of this pressure would cause pressure-beam *B* and the lower die members to fall and lock the mechanism. This is prevented by having a small yoke *K* at the side of each housing *D*, through which rod *E* projects. On each of the two rods *E* there is a key *L*, and before releasing the pressure from cushions *C*, the squared upper end of each rod *E* is gripped with a socket wrench, while in the position shown at the right-hand side of Fig. 2, and the rod is turned so that key *L* engages the upper side of yoke *K* and prevents the compression springs *G* from raising racks *H*, and thus turning the locking cams *I*. When held in this manner, the pressure may be released from the air cylinders *C* and the dies changed; then when the necessary adjustments have been made, the keys *L* are turned back so that they slide through the spaces in yokes *K*, thus enabling the press to function in its normal manner.

MOTOR DRIVE FOR CLEVELAND MILLING MACHINES

The Clark-Mesker Co., 18511-18517 Euclid Ave., Cleveland, Ohio, has recently developed a motor drive for the No. 1 and No. 2 Cleveland milling machines. This drive is attached to the milling machine as shown in the accompanying illustration. The regular pulley housing is removed and the bracket flange bolted to the machine in its place. The motor *A* is supported on the flat surface of bracket *B*, and is secured to it by means of four cap-screws. This arrangement makes the motor easily accessible, brings it up away from dirt and chips that gather on the floor, and at the same time does not make the machine top-heavy or give it an unbalanced appearance. This method of attaching the motor to the machine base also eliminates the necessity of providing overhead belts and countershafts. It therefore simplifies the work of installation, and in many cases permits the machine to be used where it would be difficult to install a belt drive.



Motor Drive for Cleveland Milling Machines, developed by the Clark-Mesker Co.

From the end of the motor spindle, which extends into housing *C*, power is transmitted by means of a sprocket *D*, a Morse silent chain *E*, sprocket *F*, shaft *G*, and clutch *H*, to the main drive shaft of the machine. An adjusting nut *J* is provided for adjusting friction clutch *H*. The incorporation of the friction clutch in the drive permits slippage in case the machine should be suddenly overloaded. A 5-horsepower motor running at 1200 revolutions per minute is recommended for the No. 1 milling machine, and a 7½ horsepower motor of the same speed for the No. 2 machine. The silent chain runs in oil, and the motor can be adjusted to take up wear on the chain.

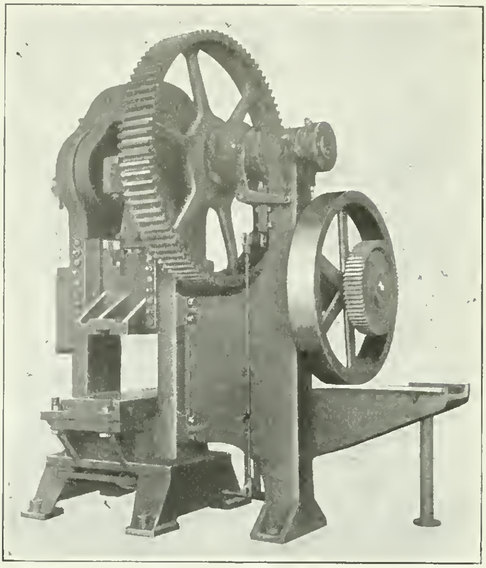


Fig. 1. No. 6 Straight-sided Trimming Press built by Williams, White & Co.

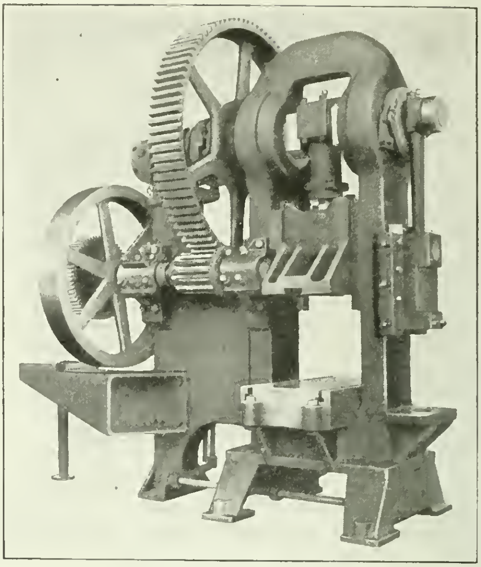


Fig. 2. Rear View of Straight-sided Trimming Press, showing the Outside Slide

STRAIGHT-SIDED TRIMMING PRESSES

The line of straight-sided trimming presses manufactured by Williams, White & Co., Moline, Ill., has recently been redesigned, and a larger press known as the No. 6 has been added. While these machines are primarily intended for trimming flashings from drop-hammer forgings, they are also adapted for perforating, blanking, embossing, stamping, redrawing and similar operations, owing to the large table and ram face areas. The accuracy resulting from the use of exceptionally large hand-scraped guide surfaces and the provision of gibs to take up wear makes possible the use of high-grade dies.

The frames of the machine are made of semi-steel. The outside slide is a convenience when auxiliary operations are to be performed. Steel gears with cut teeth are used. The automatic clutch is of ample size, and its operation positive and quiet. On the No. 6 machine it has six teeth, and is 21 inches in diameter. A screw adjustment mechanism in the pitman moves the ram up or down to adjust the die space to suit the work. The bushed pin connection between the ram and the pitman simplifies adjustments and repairs. The thrust end of the pitman works in a bronze-lined steel block. A leather-lined brake is provided on the main shaft. Motor or belt drive may be supplied. With the latter type, the flywheel serves as a tight pulley. The illustrations show a solid-frame construction, but a tie-rod construction can be furnished if preferable.

ROCKFORD AUTOMATIC LATHE

The accompanying illustrations show front and rear views of an automatic lathe now being manufactured by the Rockford Machine Tool Co., Rockford, Ill., which is especially adapted for machining pistons, pulleys, cone pulleys, gear blanks, and other work where multiple tools can be used for turning and facing operations performed at the same time. The machine was designed along the lines of a 22-inch heavy-duty lathe to insure absorption of vibration and to withstand the most severe service likely to be demanded. It is provided with three changes of speeds obtained by operating a gear-shift lever. The main driving gears of the machine are of the helical type to secure a smooth and powerful drive. The machine has a positive geared feed, driven direct from the spindle through a train of spur gears, the lower two of which are changeable so that variations of feed may be obtained. The headstock is cast integral with the bed.

The front or turning carriage is mounted on a bar 3½ inches in diameter, provided with long bearings in both the headstock and tailstock, the outer end of the carriage being supported on a hardened steel way

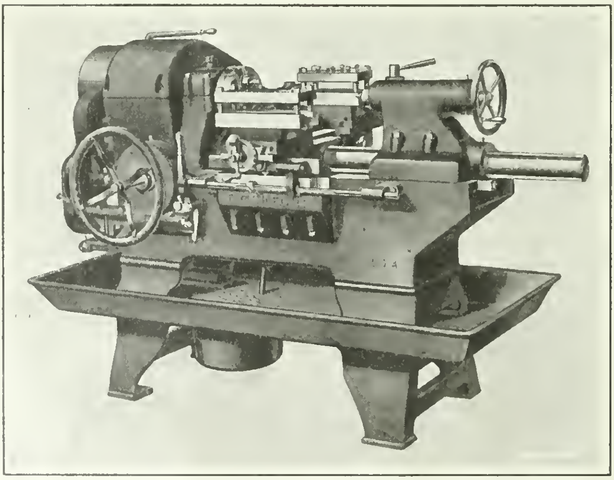


Fig. 1. Front View of Automatic Lathe built by the Rockford Machine Tool Co.

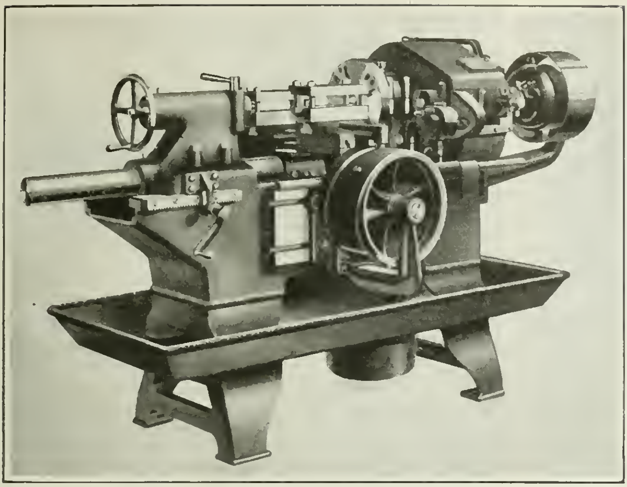


Fig. 2. Rear View of Automatic Lathe shown in Fig. 1

which can be machined to give the work a taper, convex, or concave form. Rack teeth cut in the carriage bar mesh with the cross-spindle of the machine for obtaining the feed. A worm and worm-wheel driven direct from the feed gears furnish power to the cross-spindle, the worm being mounted in a drop frame so that the feed may be ended at any predetermined position.

The back or facing head is mounted on a bracket at the back of the machine and is adjustable longitudinally to accommodate the work. Both the turning and facing carriages are provided with suitable tool-blocks so that a number of tools may be used at the same time. The power feed for the facing head is obtained through a cam-drum which may be clearly seen in Fig. 2 and which is driven from the cross-spindle by a rack and pinion, enabling both the turning and facing heads to be controlled by the same stop. By this arrangement, the time required to finish an operation is equal to the time necessary for taking the longest cut. Various cams may be mounted on the drum so that it is possible to secure different feeds on the rear head from those provided by the feed gears for the turning head.

The tailstock has a quick-acting spindle for releasing the center, and is moved longitudinally on the machine by a rack and pinion. The bed has an oil-pan for coolant which is fed to the work by a pump driven from the pulley shaft. The machine can also be furnished with motor drive, the motor being connected direct to the pulley shaft by means of spur gears. Some of the principal dimensions of this machine are as follows: Swing over turning carriage bar, 14 inches; swing over facing carriage, 10½ inches; maximum distance between centers, 18 inches; and travel of turning carriage, 12 inches. The weight of the machine is about 3500 pounds.

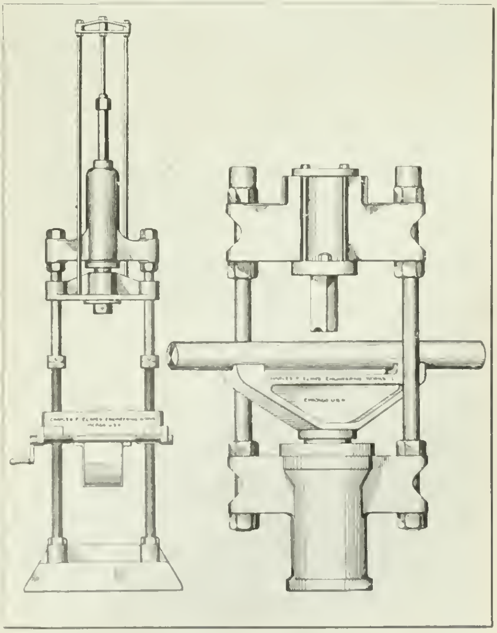
ELMES HYDRAULIC PRESSES AND PUMP

Several new hydraulic presses have been developed by the Charles F. Elmes Engineering Works, 222 N. Morgan St., Chicago, Ill. The press shown diagrammatically at the left of the accompanying illustration, was designed for rapid broaching and will accommodate work requiring pressures up to twenty tons. The distance between the columns is 18 inches, and the platen or table may be raised and lowered quickly by means of the crank at the left. The minimum height between the ram and the platen is 14 inches, and the maximum, 36 inches. A removable plate set in the platen has an opening through it for the broaches. This plate may be replaced by others having any desired size of opening.

A hopper below the table receives the broaches as they pass through the work and the table. The ram is hydraulically operated and is returned to its uppermost position by means of a hydraulic pull-back. The operation of the press is controlled by a single lever valve, and the speed of operation can be regulated to suit conditions. The ram may be stopped at any point of the stroke, this arrangement giving an accurate control at all times. From fifteen to twenty-five strokes per minute may be made with this machine.

The combination hydraulic shop press which is shown at the right in the illustration is known as the "Five-in-one" and was designed to meet the demand for an inexpensive all-around press to be used in small shops or for repair work, etc. This press is suitable for a large variety of forcing, bending, straightening, and broaching operations requiring pressures up to fifty tons. The illustration shows it being used as a straightening press and provided with a removable straightening attachment. When this attachment is removed, the press may be employed as a vertical forcing or arbor press. By adding the proper platens, the press may also be used for forming or compressing operations, and by removing the side bars and the top head, a fifty-ton jack is obtained. On account of its light weight, this machine can be readily employed as a portable press, and used in either vertical or horizontal positions. The press weighs about 500 pounds; the distance between the columns is 18 inches, and the distance from the ram to the top head is about 20 inches.

A high- and low-pressure hydraulic pump which will give a pressure up to 5000 pounds per square inch on the high-pressure plunger and up to 250 pounds per square inch on the low-pressure plunger is also being manufactured by this concern. The pump is so designed that a ¼-horsepower motor will operate it at a speed of 100 revolutions per minute. It is arranged to shift automatically from low to high pres-



Hydraulically Operated Presses built by the Charles F. Elmes Engineering Works sure when the limit of the low pressure has been reached. This feature enables the pump to raise the ram of the press up to the work at low pressure with considerable speed, and as soon as the ram reaches the work and the resistance is increased to the amount for which the low-pressure plunger is set, the automatic valve lift permits the high-pressure plunger to continue the working stroke of the ram. The pump is provided with a 1½-gallon tank for oil or water, and has a direct-connected motor.

CRUBAN THREADING TOOLS

Several novel thread-cutting appliances have recently been introduced by the Cruban Machine & Steel Corporation, 63 Duane St., New York City. At *A* in Fig. 1 is shown a single-point threading tool holder intended for cutting any style of thread. The tool is held by means of a set-screw in a swiveling block, which can be turned through an arc of sufficient magnitude for the tool to clear the work, this movement being accomplished by operating the knurled handle. Thus, in cutting a thread, after the tool has been traversed across the work, the position of the cross-slide relative to the center of the work, need not be altered in order to return the carriage to the starting position prior to taking another cut. It is only necessary to tilt the tool in the manner described, and the carriage can be moved along the work without experiencing any interference between the threads and the tool.

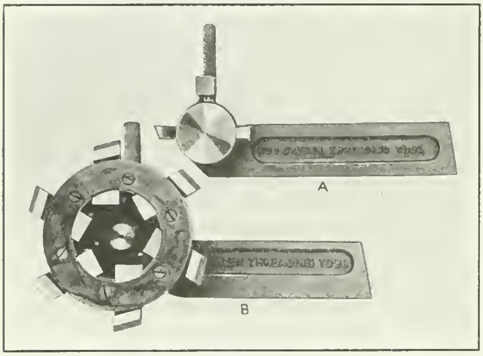


Fig. 1. Single-point and Multiplex Threading Tools made by the Cruban Machine & Steel Corporation

The multiplex threading tool holder shown at *B* was designed for cutting any size or style of thread without necessitating a readjustment of the cross-slide during the entire operation. The holder is provided with six tools, each of which extends a certain amount farther from the center of the tool than the preceding one. The circular part in which the tools are mounted can be rotated by operating the knurled handle, and is provided with twelve equally spaced saw teeth at the back, into which a plunger operates, so that each of the tools can be held in the proper position for taking a cut or at such an angle that it clears the thread. Thus, in cutting a thread, tool No. 1 is fed across the work, after which it is tilted and the carriage returned to its original position. Tool No. 2 is then fed across the work, the cycle being continued until the thread has been completely formed. Each bit is adjustable and can be readily removed for regrinding. Chasers can also be used in the tool.

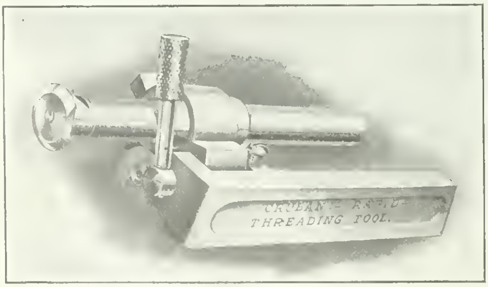


Fig. 2. Internal Threading Tool provided with Circular Cutter

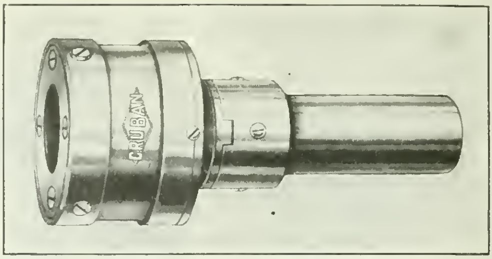


Fig. 3. Releasing and Floating Tap- and Die-holder which is Self-aligning and has Hollow Shank

An internal threading tool is illustrated in Fig. 2. The circular threading tool used in this case can be tilted from the work after it has reached the end of the cut, so that it can be returned to its starting position without marring the thread that has been cut.

The particular feature of the releasing and floating tap- and die-holder shown in Fig. 3 is that it is self-aligning. After a set-up on an automatic screw machine or turret lathe has been in use for some time, the various tools are likely to have changed their location to such an extent that the work is spoiled when the tap or die used in threading the part comes into contact with it. With this holder, however, this danger is entirely eliminated. A hole is provided through the shank of the holder so that a thread may be cut for an indefinite length, depending upon the travel of the machine carriage. The holder can be employed for cutting either left- or right-hand threads by using suitable dies. No adjustments are required when inserting these dies.

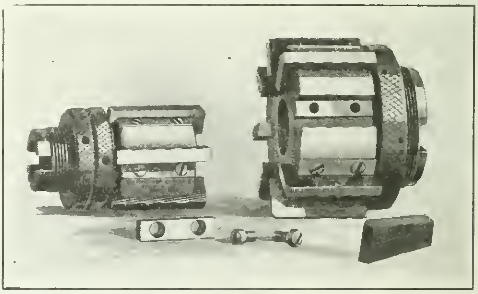


Fig. 1. Reamer having a Double Adjustment, made by the Cleveland Cutter & Reamer Co.

CLEVELAND ADJUSTABLE REAMERS AND INSERTED-TOOTH CUTTERS

The Cleveland Cutter & Reamer Co., 1619 Merwin Ave., Cleveland, Ohio, is now manufacturing an adjustable reamer of the design shown in Fig. 1. This reamer has a double adjustment; thus by screwing back the lock-nuts at the ends of the blades 5/16 inch, an adjustment of 0.083 inch may be obtained; then, by placing the blades up one step they may be again adjusted 0.083 inch. The adjustment can be continued until the blades are worn out, when they are replaced with a new set. These reamers are furnished with blades which are set in the body straight or parallel with the axis, as shown in the illustration, but reamers having spiral or inclined blades may be obtained at slight additional cost. These reamers may also be equipped with a floating movement.

An inserted-tooth side milling cutter now being made by this company is shown in Fig. 2. The blades are serrated or corrugated on the back to eliminate slipping and tilting as well as packing under the blades. As the result of this method of holding the blades, it is claimed that they can be moved out an unusual length and still be held rigidly. All blades are interchangeable.

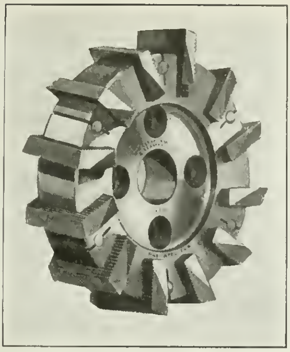


Fig. 2. Side Milling Cutter with Serrated Blades

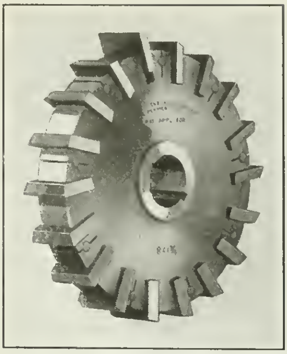


Fig. 3. Face Milling Cutter also having Serrated Blades

Fig. 3 shows an inserted-tooth face milling cutter which also has corrugated blades. These cutters have a machine-steel body, and can be furnished either with carbon or high-speed steel blades. The body of the cutter has a taper hole and a keyway for driving, the cutter being held on the arbor by a screw in the end. This same design of cutter can be made with a threaded hole for mounting directly on the machine spindle or to fit a milling machine having a flanged spindle.

ROCKWELL DIRECT-READING HARDNESS TESTING MACHINE

A portable direct-reading hardness testing machine known as the Rockwell, which is intended for hardness tests on steel, brass, copper, and some of the harder alloys is being manufactured by the Wilson-Maeulen Co., Inc., 736 E. 143rd St., New York City. The principle employed, like that in the Brinell testing method, is to apply a known load to a ball penetrator and then measure the indentation. In the Brinell method the diameter of the impression of a 3/8-inch diameter ball is measured by removing the piece to a microscope, while the Rockwell machine is designed to measure the depth of the impression of a 1/16-inch diameter ball, the measurement being shown directly on the indicator of the machine. The size of the ball permits the testing of wire of small diameter, and the light impressing load permits the testing of the outer surfaces of small tubes having a wall as thin as 1/32 inch without putting a mandrel through the tube. Thin sheet stock and such pieces as clock springs can also be satisfactorily tested.

When making a test on the machine, an initial pressure is applied by turning the handwheel, raising the test piece until the indicator shows that pressure is being applied. This insures that the test piece is held to a firm seating and that the ball breaks through dirt, scale, or other superficial matter. The indicator is then made to register zero, after which the push-button seen clearly in Fig. 2 at the base of the machine, is touched, releasing the major load. This load is later withdrawn, leaving again only the initial pressure, so that the indicator shows the depth of the impression made by the major load. The indentation is small and hardly noticeable. The machine weighs approximately 57 pounds and is furnished with several tables to accommodate various shapes of work. Generally, about six tests a minute can be made by means of the device. The greatest value of this machine for shop use is as a comparative tester.

NO. 2 STANDARD MILLING MACHINE

A hand milling machine which can be equipped with an attachment for moving the table in a horizontal direction by power has been added to the line of machines manufactured by the Standard Engineering Works, Pawtucket, R. I. The column, as shown in the accompanying illustration, is of a sufficiently rigid construction to avoid spring when heavy

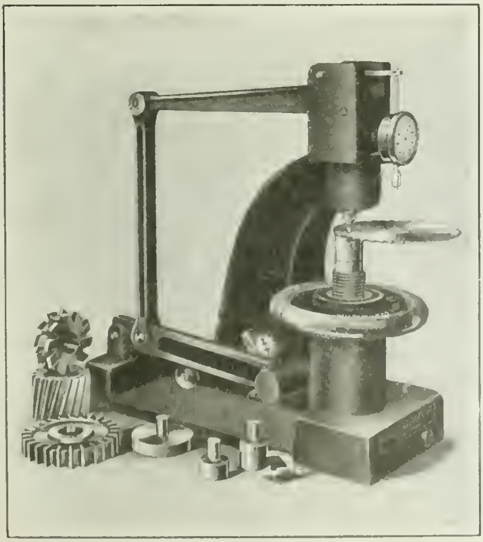


Fig. 1. Hardness Testing Machine manufactured by the Wilson-Maeulen Co.

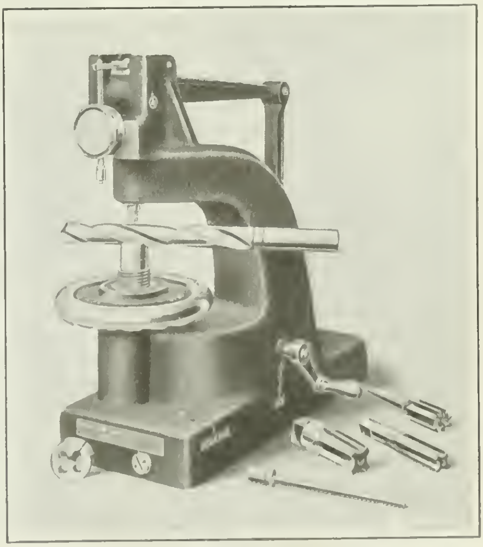
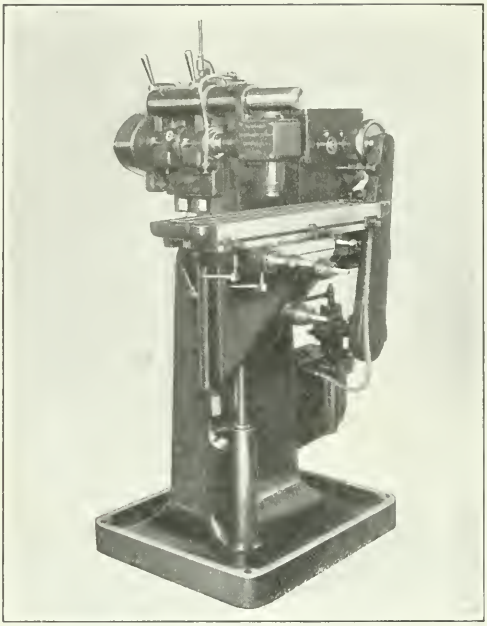


Fig. 2. Operating Side of Rockwell Hardness Testing Machine shown in Fig. 1



Milling Machine which may be fed by Hand or Power, manufactured by the Standard Engineering Works

work is being handled. The carriage is also of a heavy construction to meet the stresses likely to be imposed on it. The table is provided with three standard T-slots, and has deep oil-pockets at the ends. The headstock is gibbed to the column to permit vertical movements, but means are also provided for clamping it in any desired location. The headstock is furnished with deep oil-chambers from which the spindle is lubricated by means of felt wicks.

The spindle is made of a high-carbon steel, carefully ground and fitted, and is provided with adjustment for wear. It is supported by a phosphor-bronze bearing, and is driven by a Link-Belt silent chain which connects it to the change-gearing on the back of the machine. Twelve spindle speeds ranging from 80 to 1950 revolutions per minute are obtainable. Six of these are secured by having a 29-tooth sprocket on the spindle and a 19-tooth sprocket on the back-shaft of the change-gear box. The other speeds are obtained by placing the 29-tooth sprocket on the back-shaft and the 19-tooth sprocket on the spindle. Two levers located on the gear-box within easy reach of the operator control the various spindle speeds.

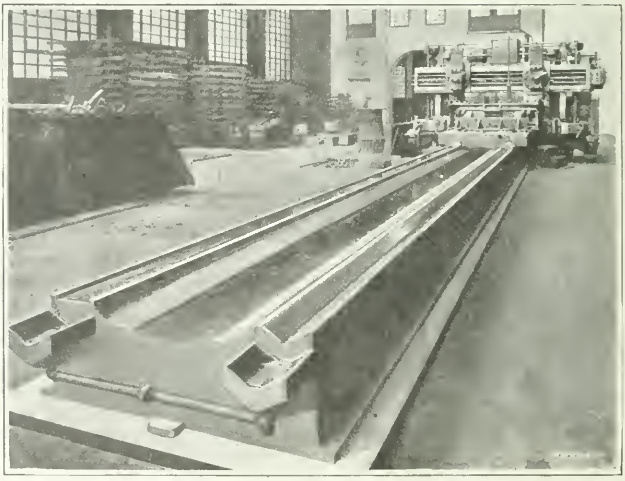
The power feed attachment for traversing the table in a longitudinal direction permits feeds ranging from 0.004 to 0.062 inch per revolution of the spindle. These feeds are obtained through a gear-box on the rear of the machine, which is located beneath the spindle change-gear box. Four feed changes can be obtained for each spindle speed by the movement of a lever easily accessible from the working position of the operator. The feed is positive, being geared from the spindle drive through a train of gears to a telescoping shaft having universal joints, which drives a worm and worm-wheel located in a rocker box. The worm-wheel is fixed on the rocker shaft which transmits power by means of a pinion to the rack on the under side of the table. An automatic and adjustable knock-off dog is located on the table. The means employed to feed the table by power and the convenient arrangement of all operating parts enable one operator to tend several machines. The machine can also be used as a hand miller without removing the power feed attachment.

A reversible geared pump with an automatic relief valve is furnished as part of the lubricating system, the relief valve permitting the stopping or regulation of the oil supply without stopping the pump or machine. The pump is driven by a small roller chain protected by a cast-iron guard. The oil tank has two compartments separated by a fine-mesh screen so that only clean oil can be drawn into the pump. When a motor drive is furnished, the machine is driven by means of a Link-Belt silent chain. This driving method can be used both on the plain and power feed machine. A one-horsepower motor running at a speed of 1200 revolutions per minute is recommended. Any of the attachments manufactured by the concern, such as a plain vertical head, universal head, and vertical spline-milling head, can be used on the machine.

SOUTHWARK PLANER

The planer shown in the accompanying illustration is one of three that the Southwark Foundry & Machine Co., Philadelphia, Pa., has recently built for the Baldwin Locomotive Works. This planer is designed for heavy-duty service on locomotive frames, and its dimensions are 7 by 3 by 42 feet. The table is made in two sections, which are joined by means of four 3-inch square key-bolts and dowels. The cross-section of the table is box shaped, and is 12 inches deep at the center and $9\frac{3}{8}$ inches deep at the sides, with all ribs running in the transverse direction. The top flange of the table is provided with three longitudinal T-slots and 900 stop holes $1\frac{5}{8}$ inches in diameter. The table slides upon one flat and one V-bearing, and is also guided sidewise by two vertical surfaces which resist any force that may have a tendency to push the table up the incline of the V-bearing. Both the flat and V-bearings are lubricated by a pump especially installed for this purpose.

The cross-rail is of the extended back type having a bearing of 26 by $40\frac{1}{2}$ inches on the face of the uprights, as well as a 6-inch bearing on the inside of the uprights, to which it is clamped in the usual manner. As shown in the illustration, two heads are fitted to the cross-rail and two to the uprights. The bed is built up in three sections of heavy



Long Planer built by the Southwark Foundry & Machine Co.

box-section design having cross-ribs spaced 18 inches from center to center throughout the entire length of the two end sections. The middle section is also a heavy box section design having the center box between the ways left out near the middle, in which space the drive gears are mounted. All gears of the drive gearing run idle on their shafts and are bushed with phosphor-bronze bushings. The shafts are fitted to "dead eye" bearings and locked with set-screws. This arrangement makes the removal of gears a very simple matter, should it become necessary to do so in making repairs.

The planer is driven by a regular reversing type of planer motor of 75 horsepower, having a speed range of from 250 to 1000 revolutions per minute, which gives cutting speeds of from 20 to 40 feet per minute. Safety devices are provided in the control panel to take care of low voltage, no voltage, overload, and emergency stop. The master switch is operated by the usual type of table stops and dogs. A portable pendant switch is also provided for the use of the operator. The return speeds are selective, and range from 40 to 80 feet per minute.

The machine will plane work 84 inches in width, 36 inches in height, and 42 feet in length. The table is 6 feet wide and 44 feet in length. The width of face of the upright is 22 inches and its depth, from front to back, 6 feet 9 inches. The cross-rail has a face width of 26 inches; its depth at the center is 23 inches and at the uprights 8 inches. The table rack is provided with teeth of 1¾ inches circular pitch, which have a face width of 14 inches. The total weight of the machine is approximately 250,000 pounds.

CURTIS & CURTIS PIPE THREADING MACHINE

The accompanying illustrations, Figs. 1 and 2, show one of the pipe threading machines manufactured by the Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn. The feature of the machine to which particular attention is called is the self-centering vise which is employed to hold the pipe during the threading operation. This vise is opened and closed by means of the large handwheel at the top of the machine frame, and will not only hold any size pipe within the capacity of the machine, but will also properly center each size with the threading die.

In Fig. 1 the vise is shown gripping a pipe of minimum size, while in Fig. 2 it is shown gripping a pipe which is nearly the maximum size for which the machine is adapted.

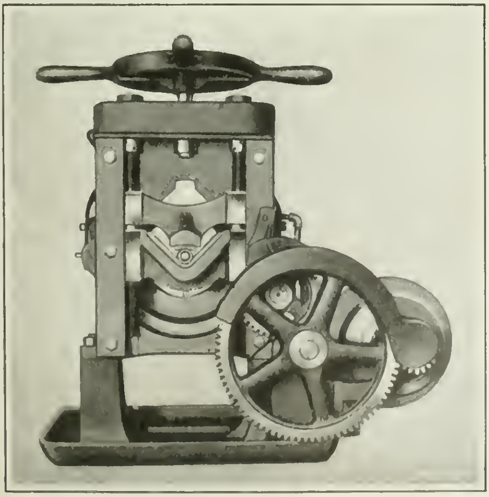


Fig. 1. Pipe Threading Machine made by the Curtis & Curtis Co., showing Vise Jaws closed on Small Pipe

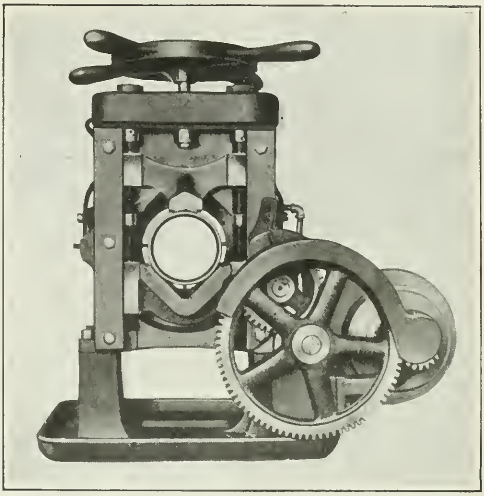


Fig. 2. Machine shown in Fig. 1, but with Vise Jaws gripping Large Pipe and still maintaining Alignment with the Threading Die

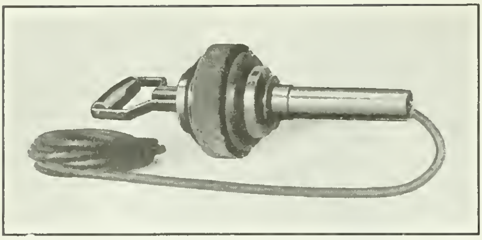
These two illustrations show clearly the exceptionally wide range of the machine. The method of obtaining the self-centering feature will be apparent from the illustrations. It will be noted that both the upper and lower jaws of the vise are actuated by two screws which pass through the ends of the members to which the serrated vise jaw plates are attached. In order to center all sizes of pipes with the die-head, it will be evident that the rate of travel of the upper jaw and the lower V-jaw must be different. This condition is obtained by cutting threads of different pitch on the upper and lower ends of the vertical screws, which will give the proper ratio between the movement or travel of the upper and lower jaws.

The pipe is put into the machine from the back, and clamped by the self-centering vise with the end to be threaded against the back of the dies. As the die-carrying gear is revolved by the pinion, the gear recedes into a shell, and the dies are brought into contact with the pipe. When the thread is cut, the dies are drawn back by a slight turn of the cam-ring and the pipe can be taken out without running back over the thread. On account of the principle of construction of this machine, which is to hold the pipe stationary and revolve the comparatively light die-head around it, pipe bends or pipes with assembled fittings attached may be threaded as easily as straight pipe. In addition, the machine is portable and requires minimum floor space.

FORBES & MYERS HAND GRINDER

The hand grinder shown in the accompanying illustration is a new product of Forbes & Myers, 178 Union St., Worcester, Mass. This grinder is intended for use in snagging castings and is especially designed to combine power with light weight. The field of the motor is mounted directly on a stationary shaft which is provided with handles at each end by which the operator can hold and control the tool. The motor is of the three-phase induction type, and the rotating part which surrounds the windings consists of a malleable iron core with copper bars welded to copper rings at each end. In order to utilize all weight to the best advantage, both the wheel flanges and the end shields are designed to carry magnetic flux, the end shields being lined with copper for this purpose.

The motor gives a maximum output of ¾ horsepower, and the weight of the grinder complete is only 20 pounds. A special insulation has been developed for the windings that cannot be burned out, even at a dull red heat, so that



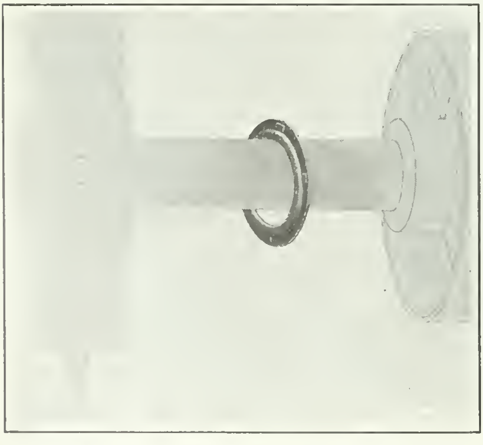
Hand Grinder made by Forbes & Myers for snagging Castings

it is practically impossible to injure the motor by overloading. The motor itself is wound for a 110-volt, three-phase circuit. For two- or three-phase circuits of higher voltage, a small transformer is provided. The switch is located in the handle of the grinder, and is so designed that a forward motion of the handle applies the current.

The grinding wheel is 7 inches by 2 inches and is mounted between a safety flange of more than ordinary taper. Tests for breakage in which a wheel was struck by a hammer and the machine was thrown against a casting failed to break out a piece of the wheel more than 1/4 inch across, which was not held by the flanges. The bearings are of copper graphite composition, and are held in an aluminum sleeve. These bearings require no lubricant and can be readily replaced when worn. Although this grinder is designed primarily for snagging castings, its power and portability adapt it for many other purposes.

AMERICAN METAL PRODUCTS SHAFT CLEANERS

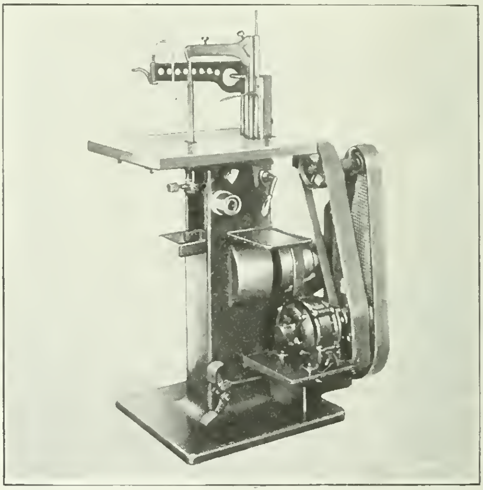
A simple but effective method of keeping shafting clean is by the traversing-ring method. The ring is somewhat larger in diameter than the shaft, and it automatically travels to and fro between pulleys or bearings, the reversal being due to the change in the angular position of the ring when the leading side strikes a pulley hub or bearing at either end of its travel. As the ring is continually moving along the shaft, the latter is kept clean. These rings of the "homemade" variety are usually made of some material such as fiber or leather. The American Metal Products Co., 72 W. Adams St., Chicago, Ill., has placed on the market a metal shaft-cleaning ring which is shown herewith applied to a shaft. These rings are much cheaper than the fiber rings, and they can readily be applied or removed with the shafting in place. In fact, they are intended to be applied after the shafting is up and the pulleys located. The ring is made of four semicircular stampings of heavy nickel-plated sheet zinc and is non-corrosive. The joints on opposite sides are located 90 degrees apart, and the sections are locked together by four wide staples made of the same material as the rings. The ring has a circular recess which is filled with felt for gathering and distributing any drops of oil that collect on the shaft, the object being to spread the oil thinly on the shaft so that it will oxidize and scale off.



American Metal Products Co.'s Shaft-cleaning Ring applied to a Shaft

REARWIN NO. 6 DIE-FILING MACHINE

The accompanying illustration shows a No. 6 die-filing machine built by W. D. Rearwin, 716 Monroe Ave., Grand Rapids, Mich. This machine is similar in design to the No. 5 machine, but is capable of handling work of larger dimensions. It is provided with a 20- by 24-inch table, the top of which is 30 inches above the floor, and may be used in filing various other classes of work besides dies. The head is made of steel and is adapted for saws and files of lengths up to 14 inches, having an adjustable stroke up to 7 inches. Extra arms are provided to accommodate hacksaws and to permit the special filing of parts where the under side has a shoulder or is closed. There is a distance of 9 inches between the file and the slide of the machine, and the minimum distance between the top of the table and the upper arm is 6 inches. The file is withdrawn from the work on the up stroke. The machine can be furnished with a motor or countershaft drive, or it can be driven direct from a lineshaft.

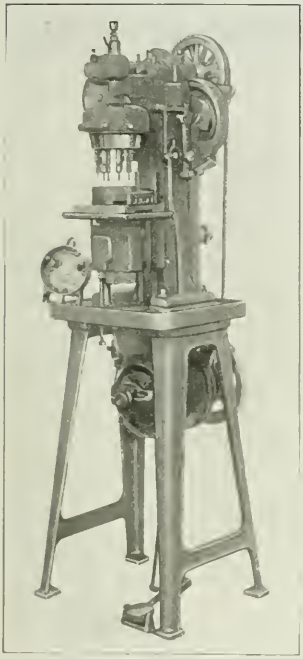


No. 6 Die-filing Machine built by W. D. Rearwin

LANGELIER MULTIPLE TAPPING MACHINE

Several interesting features have been added to the semi-automatic multiple tapping machine here illustrated, which is built by the Langelier Mfg. Co., Arlington, Cranston, R. I. The machine is shown equipped for tapping eleven holes in a meter case, a completed piece being shown in an upright position on the stand on which the machine is mounted. The rate of production on this work is six cases per minute, the machine being operated by either a girl or boy. The operator sets the machine in motion by depressing a foot-treadle, located conveniently at his right, which operates the belt-shifting mechanism, moving the round leather driving belt quickly over the forward driving pulley and instantly setting in motion a horizontal shaft at the top of the machine. The principal function of this shaft is to drive the main spindle of the multiple tapping head to which it is connected by bevel gearing.

The various spindles in the tapping head are crank-driven, machined out of solid alloy steel bars, hardened, heat-treated, carefully ground, and located with extreme accuracy on fixed centers in a phosphor-bronze spindle bearing. This bearing can be quickly removed from the machine to permit the insertion of other heads having the tapping spindles arranged to suit a different class of work, provided all the holes in the latter are within a circle 5 inches in diameter. In this way several parts can be tapped with the same machine by using different tapping heads interchangeably. The tapping spindles in each head are provided with special compensating arrangements which permit each tap to follow its own lead independently of any other tap. This feature insures that every hole will have a clean cut thread, allows the threads of different pitches to be tapped simultaneously and produces work which is uniformly accurate and interchangeable.

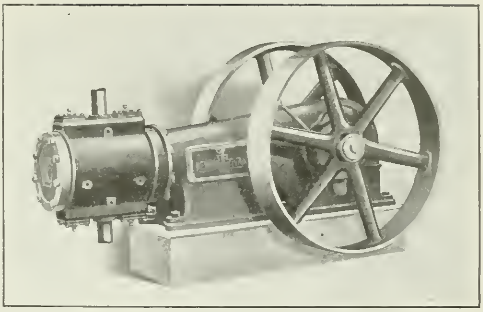


Redesigned Semi-automatic Multiple Tapping Machine, built by the Langelier Mfg. Co.

The taps are reversed automatically when the holes have been threaded to the required depth by the method described in the following. The horizontal shaft driving the tapping head spindle also drives a short horizontal shaft at the left of the machine, through spiral gearing. This shaft, in turn, drives a shifting dog gear on the back of the machine. The shifting dog gear has an edge cam over which rides a roller trunnioned to the feed rack of the work-table. During the tapping operation the work-table is progressively raised by means of this edge cam and roller until the taps have penetrated to the desired depth. An automatic trip then operates, shifting the round driving belt over on the reversing pulley. This causes the instantaneous reversal of the taps and the lowering of the table at almost twice the raising speed. When the table reaches its lowest position, the trip shifts the round driving belt to the loose pulley so that the machine is stopped.

This cycle of operations is repeated with exactness and rapidity during the tapping of each part. The automatic trip may be set to stop the table at any desired point. The upward and receding speeds of the work-table may be closely adjusted to correspond in each case with the pitch of the taps used, and the extent of the movement may be regulated to suit the thickness of the work. These provisions eliminate breakage of taps and over-traveling of the table.

PENNSYLVANIA AIR COMPRESSOR AND VACUUM PUMP



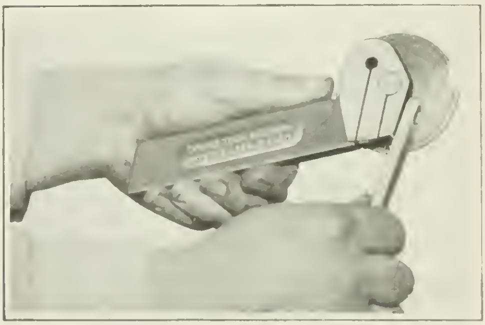
Air Compressor made by the Pennsylvania Pump & Compressor Co.

A design of air compressor now being manufactured by the Pennsylvania Pump & Compressor Co. of Easton, Pa., is shown in the illustration. This company also makes vacuum pumps. The general design of these machines is in accordance with the modern practice of using enclosed dust-proof construction, with provision for the splash system of lubrication for the driving parts. The bored guide type of cross-head is used, which nearly fills the guide portion of the compressor frames. This head supplemented by a baffle plate placed ahead of the cross-head serves to prevent oil from the splash lubricating system entering the air cylinder.

A feature which may be mentioned in connection with the splash oil system is the provision of an oil float gage which indicates at all times the level of the oil in the basin. In the construction of the driving parts, a forged crankshaft is used which is provided with removable bronze bearings that can be quickly adjusted and easily replaced. The use of a forged crankshaft permits the employment of a solid box on each end of the connecting-rod, the eye of the connecting-rod being slipped over the crankshaft and the adjusting gibs and wedges inserted in place. The flywheels are mounted on the tapered ends of the crankshaft, being keyed and held in place by a washer and capped bolt, as shown in the illustration. A ring plate type of valve which it is said cannot cock or get out of alignment is employed. Both air compressors and vacuum pumps are of the same general construction, except that the air cylinder of the vacuum pump is of considerably greater diameter for the same stroke size, and the position of the valves is reversed. That is, while the discharge valves are at the top in the air compressor, they are placed at the bottom in the vacuum pump. These machines can be furnished in the steam-driven type with a balanced piston valve steam end, or they can be equipped for belt drive.

R. G. SMITH CUTTING-OFF TOOL

A new type of cutting-off tool having a cutting circumference extending over 300 degrees has been designed by the R. G. Smith Tool & Mfg. Co., 317 Market St., Newark, N. J., for use in connection with this company's patented tool-

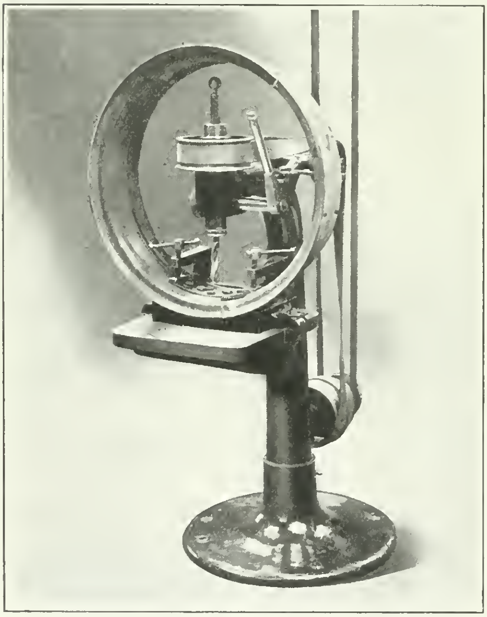


Cutting-off Tool Intended for Use with the Tool-holder made by the R. G. Smith Tool & Mfg. Co.

holder. This cutting-off tool is made in such a manner that sufficient clearance is maintained throughout the entire cutting circumference. The clearance is secured by gradually thinning or tapering down the thickness of the cutting edge, giving the tool ample side clearance. The manner in which the tool is secured to the holder will be apparent from the illustration, the tool being provided with a shank that extends into a hole in the holder and is clamped by means of a machine screw. The tool is particularly adapted for use on screw machines and turret and engine lathes. It is a simple matter to regrind the cutting edge as it becomes worn.

REED RIM DRILLING MACHINE

A machine adapted for drilling operations on the inside of rims of various kinds, built particularly for automobile rims, has been brought out by the Francis Reed Co., 43 Hammond St., Worcester, Mass. The machine, as shown in the accompanying illustration, is so designed that it will drill holes on the inside of rims of a minimum diameter of 20 inches and upward. The distance from the center of the drill spindle to the column is 12 inches, so that holes can be drilled in the center of a rim 24 inches wide. The machine has a capacity for driving drills up to ¾ inch diameter, and is provided with a No. 2 Morse taper in the spindle. The total vertical movement of the spindle is 5 inches, the vertical movement of the table, 3 inches. The table work-surface is 15 by 17 inches.



Rim Drilling Machine built by Francis Reed Co.

The spindle is hollow, and has a knock-out rod for removing the drills instead of the usual taper wedge arrangement. The spindle is provided with ball thrust bearings, and all oiling for the spindle bearings and driving pulley is provided for by two oil-holes at the top of the spindle mounting, which provide lubrication for all the bearings in the head. The spindle is fed by means of a reversible ratchet feed providing for convenient operation. All the pulleys are machined all over, and all the bearings are ground. A separate countershaft is furnished for the machine. The height of this machine is 50 inches, it having been made low because of the special purpose for which it was designed. The weight is 400 pounds.

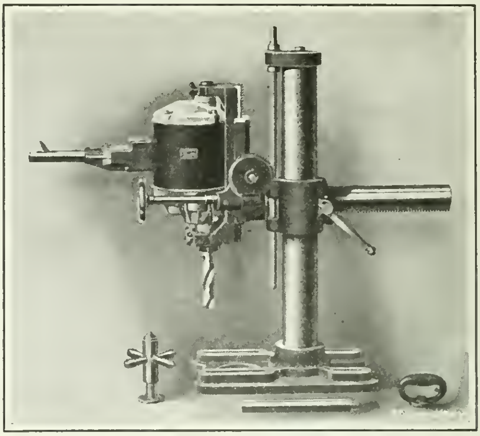


Fig. 1. Radial Drill Stand made by the Hisey-Wolf Machine Co.

HISEY-WOLF RADIAL DRILL STAND

The Hisey-Wolf Machine Co., Cincinnati, Ohio, has recently brought out a No. 3 radial drill stand designed for use with the portable electric drills of this company's manufacture. This stand has the same general dimensions and operating features as the Types NN and NNA radial drills, also made by this company. In Fig. 1 the stand is shown with a portable drill attached in position for vertical drilling operations, and Fig. 2 shows the portable drill without the stand. This stand will hold portable drills up to 1¼ inches capacity, either single- or two-speed machines. The stand greatly increases the usefulness of a portable electric drill, as it gives the user the advantages of both a radial and portable drill.

The drill-holding head may be tilted at an angle with the base, and a graduated collar facilitates setting the head at any desired angle. The method of obtaining horizontal adjustment by means of a rack and pinion, and vertical adjustment by means of a screw are apparent from the illustration. The drill has a nine-inch travel, the feed being controlled by the handwheel shown. A quick-return movement is obtained by operating a crank which can be attached to a pinion-shaft. The operating radius of the machine is 20 inches in any direction and at any angle. The handwheel and worm-box may be operated in either a horizontal or a vertical position, a feature which permits the drill to be used in corners.

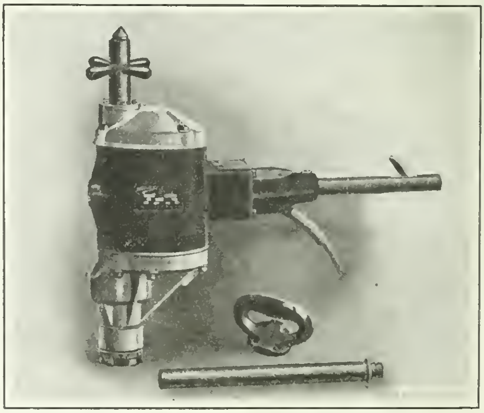


Fig. 2. Portable Electric Drill detached from Stand

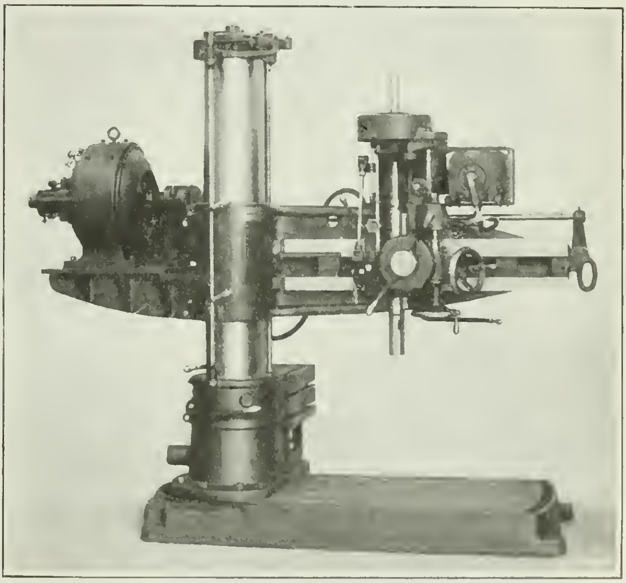
The direct-current motors are compact, and of the bi-polar type. The frames are of the enclosed type to protect the working parts from injury. The alternating-current motors are of the induction type, with laminated field and armature—the field winding being of the familiar pyramidal form, and the armatures of the familiar squirrel cage type. All motors are air-cooled by means of a fan mounted on the armature shaft.

FOSDICK RADIAL DRILLING MACHINES WITH STANDARDIZED MOTOR ON ARM

The accompanying illustration shows the 4-foot heavy-duty radial drilling machine built by the Fosdick Machine Tool Co., Cincinnati, Ohio, equipped with a five-horsepower Robbins & Myers 3-to-1 variable-speed motor on the radial arm, and a Cutler-Hammer controller directly on the spindle head. One advantage of this arrangement is the saving of power through the elimination of two sets of bevel gears. The motor is also away from dirt which accumulates about the floor, the arm is partially balanced, and additional floor space about the base of the machine is available.

The outstanding point of this particular application is the standardization feature, which means that 3-to-1 variable-speed motors of any standard make or speed may be used, thus avoiding the customary delay caused by making special patterns and castings for each particular type of motor. There is a bakelite pinion on the motor shaft, which varies in size according to the speeds of the motor as selected. All other gears are kept standard.

The fact that but one motor is used is regarded as a strong feature. The elevating mechanism drives from this motor through the regular standard gear arrangement. The controller, shown mounted on the spindle head, is made more convenient to operate by the bevel gear connection to the handwheel below it. This type of control is preferred in shops where the work is usually on large castings, the spindle head being frequently at the upper and outer extreme. A more popular location for the controller is on the arm girdle, convenient to the operator's left hand. This eliminates the large flexible conduit in the rear of the arm, and is the most satisfactory position for the average run of work. This type of motor drive is furnished on the 4-, 5- and 6-foot heavy-duty radial drilling machines.



Fosdick Radial Drilling Machine with a Standardized Motor Drive on the Arm and a Controller on the Spindle Head

NEW MACHINERY AND TOOLS NOTES

Truck Frame Riveter: Baird Pneumatic Tool Co., Kansas City, Mo. A pneumatic riveter designed especially for riveting industrial cars and truck frames, which is adapted for any steel fabrication within its range, provided the work is suspended from above. The machine is 38 inches high, weighs approximately 600 pounds, and drives and heads ¾-inch diameter rivets, hot.

Tapping Attachments for Drilling Machines: Bessler Movable Stairway Co., 1900 E. Market St., Akron, Ohio. Automatic attachments which adapt drilling machines for the performance of tapping and countersinking operations, the attachments being placed on the cross-shaft and driving shaft of the machine. Tapping and reversing movements are automatic, and any size of tap can be used.

Straightedge or Folding Rule Attachment: Barnes & Irving, Inc., Syracuse, N. Y. A device known as the "Arrow Angler," intended primarily for attachment to a straightedge or folding rule, in order to adapt it for use as a T-square, try-square, and depth or scratch gage. It forms a quick means of laying out or finding angles, centers, diameters or tangents of circles, and of bisecting angles.

Pressed-steel Machine Handle: Rockwood Sprinkler Co., 34 Harlow St., Worcester, Mass. A hollow pressed-steel handle made by a special process which combines lightness of weight with ample strength to resist any strain to which such a part is liable to be subjected. It is suitable for the operating levers and handwheels of machine tools and similar machinery, and is made in ten sizes.

Hand Knurling Tool: A. D. Knurling Tool Co., 120 E. 128th St., New York City. A hand knurling tool which can be used on work held in a drilling machine spindle or turned by hand about work held in a vise. The work is placed between three knurls, the distance between the jaws carrying these being adjustable. By means of this device, non-circular work such as elliptical, hexagonal or square, can be knurled.

Quick-change Chuck and Collets: Charles L. Jarvis Co., Gildersleeve, Conn. A quick-change chuck and collets intended for use where different operations such as drilling, reaming, counterboring, tapping and stud setting are done with one spindle, especially when working on heavy castings with a radial drilling machine. However, it is also adapted for lathe operations. The chuck can be furnished with the type and size of taper required to fit the spindle of the machine.

Oil-burning Rivet Heater: Hoffman Products Corporation, Harrisburg, Pa. An oil-burning rivet heater in which the oil is not atomized so that the cost of motor and air compressor plants and their maintenance, is eliminated. It does not use the oil under pressure nor does it preheat the oil, thus also eliminating the possibility of carbonization. The burner is made for either vertical or horizontal installations, and temperatures up to 2500 degrees F. are obtainable in one hour.

Keyway Cutter: Velco Mfg. Co., Greenfield, Mass. A staggered-tooth cutter-bar or broach for the cutting of keyways. The bar resembles two small keyway cutters welded together, with the teeth of one advanced a distance of half the pitch. This staggered relation of the teeth allows the bar to be milled deeper, and at the same time gives it strength by making possible the machining of the cutting teeth at the root to a large radius. The cutter may be used on any broaching machine.

Induction Motor: General Electric Co., Schenectady, N. Y. A type of alternating-current motor for the operation of cranes and hoists, which was designed to take the place of the former M. T. C. and I. T. C. types. It is smaller in dia-

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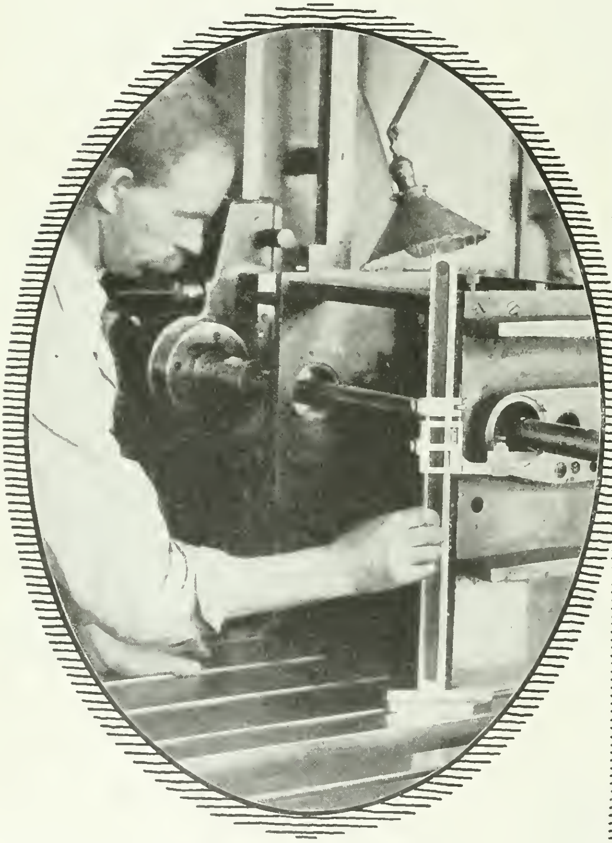

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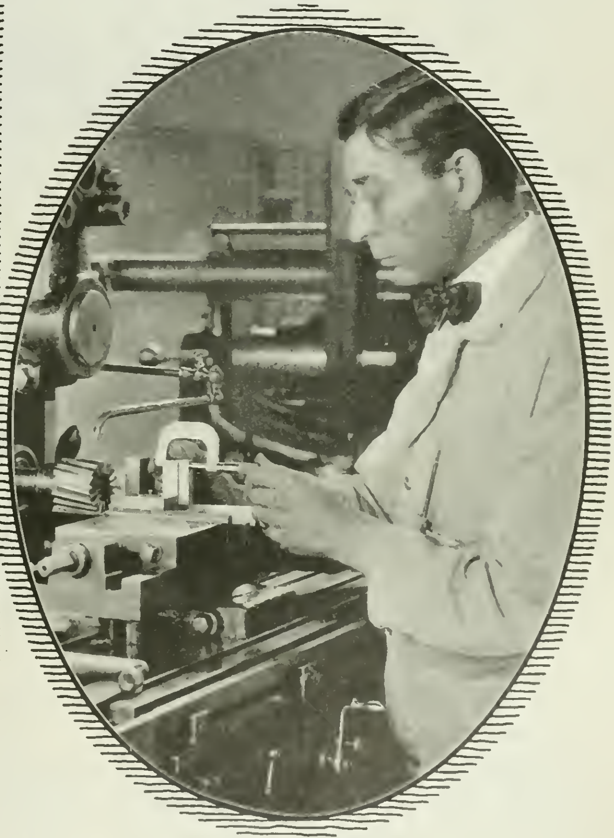

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PROVIDENCE, R. I., U. S. A.

meter and greater in length than motors of the same horsepower of former designs, thus reducing the flywheel effect of the armature. A resister has been developed for the motor, which reduces the maximum current demand and protects the motor from abuse.

"Micro-adjustable" Boring Head: Porter-Cable Machine Co., Syracuse, N. Y. A boring head on which a cross-slide is gibbed to the body, the cross-slide being controlled by an adjusting screw, the head of which is graduated to read in thousandths of an inch. The body is provided with a ½-inch diameter shank, and the boring tools are held in a ¼-inch draw-in chuck mounted on the cross-slide. On account of the adjustability of the boring head, it is possible to utilize tools having long lips.

Self-lubricating Bearings: Reliance Machine & Specialty Co., 101 Green St., Jamaica Plain, Boston, Mass. A new oilless or self-lubricating bearing or bushing which is composed of two parts, an inner casing of bronze and an outer casing of steel tubing machined for a drive or press fit. In some instances the outer casing is made of bronze. The inner casing contains a large number of tapered holes which are filled with a lubricating mixture under pressure. These inner casings can be removed if the lubricant wears below the point of usefulness, and new ones inserted.

Manufacturing Reamer: Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. A manufacturing reamer made in three body types — shell, straight shank, and taper shank — in which any of the following blades are interchangeable: Right-hand spiral for fast reaming in steel; left-hand spiral for fine finish in steel, aluminum, and bronze; and straight blades for cast-iron work. The reamer is especially suited for machining large quantities of duplicate work. It can be readily adjusted in the tool-room, but is so constructed that the machine operator is not likely to attempt readjustments.

Tire-turning Lathe: Putnam Machine Co., Fitchburg, Mass. A heavy 54-inch tire-turning lathe for car, tender and engine truck wheels, which has a bed 23 feet long, and weighs 86,000 pounds. The tool-slide arrangement reduces the turning of a pair of tires to two operations, both of which are performed without changing the cutting tools. The tailstock is moved along the bed by power. Each faceplate is equipped with four non-slip driving dogs and the maximum distance between the faceplates is 10 feet 9⅞ inches. A calibrating attachment is furnished, which remains on the machine, and, when specified, the machine can be equipped with a pneumatic crane to facilitate the mounting of work.

Heavy-duty Horizontal Boring Machine: Rockford Drilling Machine Co., Rockford, Ill. A heavy-duty horizontal drilling and boring machine adapted for various classes of automobile work such as boring cylinders, crankcases and transmission cases for tractors, trucks, and passenger cars. It is also suitable for performing facing, counterboring, drilling and reaming operations. The head of the vertical heavy-duty drilling machine made by this concern, complete with driving gear, spindle and feed mechanism, is used. The spindle travel ranges from 12 to 40 inches. Two work-holding fixtures mounted on an indexing table are provided so that while one fixture is being unloaded and loaded, the piece in the other is being machined.

Surface Grinding Machine: Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich. A No. 78 surface grinding machine developed to meet the exacting requirements of precision tool and gage grinding. Particular attention was given during its design to the location of all operating controls, so that it is unnecessary for the attendant to leave his working position to adjust the wheel-head, to change the amount of cross-feed, or to dress the grinding wheel with the built-in wheel truing device. The table has a working surface of 6 by 22 inches and three T-slots which allow the clamping of long work or the use of a magnetic chuck. The longitudinal and transverse movements of the table are automatic in both directions. Vertical adjustment of the wheel-head is accomplished by means of two elevating screws. This machine is regularly furnished for wet grinding.

* * *

Three engineering firms in England have formed an organization known as the United British Manufacturers, Ltd., for the purpose of trading with Russia. The following are the associated companies and their products: Spear & Jackson, Sheffield, steels, saws, files and small tools; John Pickles & Son, Hebden Bridge, woodworking machinery, etc.; B. R. Rowland & Co., Ltd., Reddish, Stockport, grinding machinery and abrasive wheels.

PERSONALS

C. R. Weber has been elected treasurer of the Sherritt & Stoer Co., Inc., Philadelphia, Pa., to fill the vacancy made by the retirement of C. H. Stoer. Mr. Weber had previously been in charge of the accounting department.

Frank Conrad, consulting engineer of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been appointed assistant chief engineer. Mr. Conrad has been connected with this company for almost thirty years.

Edward S. Jenison has been made acting general sales manager of the Goulds Mfg. Co., Seneca Falls, N. Y., manufacturer of Goulds pumps, to succeed W. E. Dickey, who is retiring from business. Mr. Jenison has been manager of the Philadelphia branch for the last five years.

Hugh R. Corse who, for the last six years, has been general sales manager of the Titanium Bronze Co. is now connected with the Lumen Bearing Co., Buffalo, N. Y., in the capacity of sales engineer. Mr. Corse has a large acquaintance with the executives and engineers of the automotive industries as well as with the machine tool industry.

A. A. Rackoff, Wilkinsburg, Pa., announces that he is now engaged in private practice for the designing, developing, estimating, and supervising of the latest method of purifying liquid steel for various grades in open-hearth plants. Mr. Rackoff also specializes in a new type of reversing gears for coke oven batteries for all movable parts at the oven.

Hugh A. Brown has been appointed sales manager of the Electro Dynamic Co., Bayonne, N. J. He will have his office at the Bayonne works, and will have entire charge of the marketing of the company's products, which include alternating- and direct-current motors and direct-current generators. Mr. Brown has previously been connected with the Crocker-Wheeler Co. and the Burke Electric Co.

William Printz has been placed in charge of the New York territory for the Wilson-Maeulen Co., 736 E. 143rd St., New York City, manufacturer of pyrometers. Mr. Printz has been actively associated with the sale and installation of pyrometers throughout the Middle West for the last five years. His headquarters will be at the main office and the works of the company at 383 Concord Ave., New York City.

H. L. Dean, has resigned as manager of the compressor and engine sales division of the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. To fill the vacancy thus formed, J. F. Huvane has been appointed eastern manager of compressor and engine sales, with headquarters at 6 E. 44th St., New York City, and G. C. VandenBoom has been appointed western manager, with headquarters at 300 N. Michigan Blvd., Chicago, Ill.

R. F. Eissler has been appointed assistant to the vice-president of the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. W. C. Straub, formerly district manager of the New Orleans branch, has been appointed district manager of the Pittsburg branch to succeed Mr. Eissler. Ross Wyeth, who was formerly connected with the Pittsburg branch, has been appointed district manager of the New Orleans branch to succeed Mr. Straub.

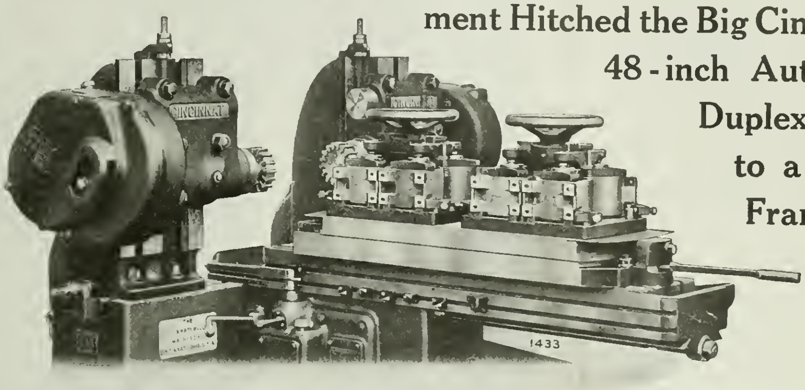
* * *

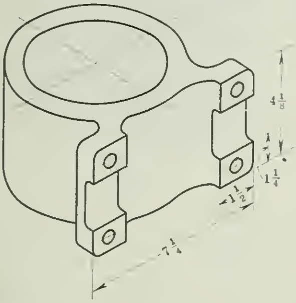
THE AMERICAN RAILWAY ASSOCIATION OPPOSES THE METRIC SYSTEM

The American Railway Association, which includes almost all the railroads in the country, representing in its mileage a total of 310,000 miles—practically the total mileage of the United States—at a meeting of the Engineering Division of the association in 1920 in Chicago passed resolutions in opposition to the use of the metric system. The Mechanical Division of the association passed similar resolutions at a meeting held in Atlantic City. Under date of November 24, 1920, a communication was received by the American Institute of Weights and Measures, 115 Broadway, New York City, from J. E. Fairbanks, general secretary and treasurer of the association, from which the following is quoted: "On the recommendation of the executive committee, the American Railway Association, at its session on the 17th of November. 1920, adopted the following resolution:

'Resolved: That the American Railway Association hereby ratify the action taken by the Engineering and Mechanical Divisions in opposition to the adoption of the metric system of weights and measures to the exclusion of the English or American system at present in general use, and express its hearty approval of the effort which is now being conducted to combat the propaganda being waged throughout the country urging the enactment of legislation whereby the metric system would be made the sole standard of weight and measure.' "

TWO PER MINUTE—How Our Service Department Hitched the Big Cincinnati 48-inch Automatic Duplex Miller to a Motor Frame Job





Wouldn't you like to cut your milling costs? Our service increased the production on this operation from 15 per hour to 120 per hour. The engineering ability behind the largest plant in the world devoted exclusively to Milling is at your service.

The operation is milling the feet on small motor frames, which are held in fixtures mounted on our new indexing base.

Each fixture holds four frames, which are secured by compensating clamps, operated by a single large hand wheel.

The cutters are high speed steel, inserted tooth mills, running 39 r.p.m., feeding 5⅝″ per minute.

While the cut is being taken, over the four frames in one fixture, the operator removes and replaces the four frames in the other. The only time that the machine is not cutting is that required for automatically advancing the table to the cutters again. This requires only 15 seconds. One operator mills the frames at the rate of 120 per hour.

How is it done?—The indexing base eliminates loading time. The quick-acting automatic features speed up the approach and return. The adjustable dogs on the side of the table jump the cutters over the gap at 100″ per minute—no time is wasted cutting air.

Finally, don't forget that this equipment and this process were developed by our Service Department.

The Cincinnati Milling Machine Company
Cincinnati, Ohio, U. S. A.

VONNEGUT MACHINERY CO.'S NEW BUILDING

The Vonnegut Machinery Co., Indianapolis, Ind., has moved into its new home at 19-29 W. South St. The building is of reinforced concrete, fireproof construction, 95 by 300 feet, with two stories and basement of heavy construction, permitting of adding several stories later. The building has been carefully planned for efficient service. The first floor has a ceiling height of 18½ feet; a 10-ton crane runs the entire length of the building to facilitate the handling of heavy tools, and ample trucking facilities have been provided for by a 40- by 60-foot driveway, each end of which has a loading platform 20 by 20 feet, level with the truck. Elevators are provided at each of these loading platforms, one being of 5-ton and the other of 2½-ton capacity. The floors are constructed to take a live load of 300 pounds per square foot, and a dead weight of approximately 1000 pounds per square foot. The shipping department is provided with 5-ton dial scales built into the floor.

The entire front of the main floor will be devoted to the display of heavy machinery. Behind this there is a department for small tools and grinding wheels, with an individual office and an individual sales force. The power transmission stock is displayed in especially designed racks and bins, and the used machinery department, including a machine shop for rebuilding old machine tools, is at the rear of the main floor. Surplus or storage stocks are carried in the basement. One section of the main floor is devoted to executive and sales offices, while the general offices are located on the balcony floor immediately above.

OBITUARIES

E. C. Parshall, general manager of the Bay City Forge Co., Erie, Pa., died January 11.

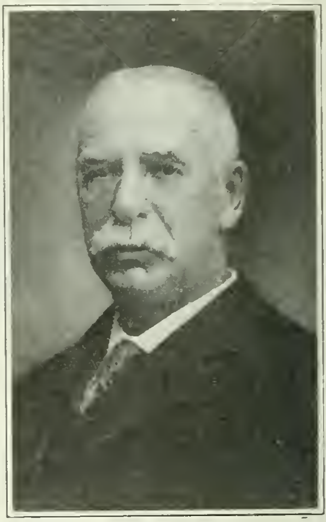
Charles H. Armstrong, secretary and treasurer of the Armstrong Mfg. Co., Bridgeport, Conn., died January 1.

Alfred G. Ely, president of the Trimont Mfg. Co. of Boston, Mass., manufacturer of wrenches, died suddenly January 20, at his residence, the Murray Hill Hotel, New York City, at the age of seventy-four. Mr. Ely had not been active in business for several years.

Folke W. Weston, master mechanic of the F. Wesel Mfg. Co. of Brooklyn, N. Y., died suddenly on December 20, aged forty-four years. Mr. Weston came to this country from Sweden about twenty-seven years ago. He early showed an aptitude for things mechanical, and as master mechanic of the F. Wesel Mfg. Co. was very active in the development of machinery produced by this company, which includes machines for printers, electrotypers, stereotypers and photoengravers. He had several patents to his credit. Mr. Weston was of pleasing personality, and had the ready cooperation of the men under his direct charge. He is survived by a widow and three children.

ELMER A. BEAMAN

Elmer A. Beaman, treasurer and general manager of the Beaman & Smith Co., Providence, R. I., died January 4 at his home in Providence. Mr. Beaman was born in Worcester, Mass., September 2, 1846. Part of his early life was spent in the West, where his family moved when he was about seven years old. Here he attended school in a log schoolhouse three months in the winters, and as soon as he was old enough, he worked on a farm during the summers.



Later Mr. Beaman's family returned to the East. In the winter of 1862 he enlisted in the Twenty-third Regiment, New York State National Guard and served in the Civil War, taking part in the battle of Gettysburg. He was discharged from the service in 1863, when he went to Worcester to learn the machinist's trade. In 1864 he again enlisted, this time in the Forty-second Regiment, Massachusetts Volunteer Militia, and remained in the service until the end of the war. He then returned to Worcester and finished his apprenticeship, studying evenings to improve his education.

In 1866 he came to Providence, and has since lived in that city. He was there associated with the Star Tool Co., of which concern he served as treasurer. He was also for many years a salesman for the Brown & Sharpe Mfg. Co., which he left in 1886 to found the Beaman & Smith Co. with George H. Smith, who at that time was chief draftsman for the Brown & Sharpe Mfg. Co. Mr. Beaman acted as treasurer and general manager of the Beaman & Smith Co. until obliged to resign on account of ill health last October.

Mr. Beaman was a member of the American Society of Mechanical Engineers and the Providence Chamber of Commerce, and was a past-president of the Providence Branch of the National Metal Trades Association. He is survived by his wife, one daughter, and two sons, one of whom, L. E. Beaman, is now treasurer of the Beaman & Smith Co.

COMING EVENTS

February 8-12—Convention of the Pressed Metal Association in Youngstown, Ohio. Headquarters of the association, Illuminating Bldg., Cleveland, Ohio.

April 27-29—Convention of the Society of Industrial Engineers in Milwaukee, Wis. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel.

May 19-20—Spring convention of the National Machine Tool Builders' Association in Atlantic City, N. J.; headquarters, Hotel Traymore. General manager, Charles E. Hildreth, Worcester, Mass.

The February sectional meetings of the American Society of Mechanical Engineers are as follows: February 7—Hartford section at the City Club, Hartford, Conn.; February 8—Boston section at the Engineers' Club, Boston, Mass.; February 10—Utica section in the Auditorium of the Utica Gas & Electric Co., 406 Lafayette St., Utica, N. Y.; February 11—Columbus section at the Southern Hotel, Columbus, Ohio; February 18—Detroit section in the Auditorium of the Board of Commerce, Detroit, Mich.; February 18—Toledo section in the Auditorium of the Railway & Light Co., Toledo, Ohio; February 23—Atlanta section in the Carnegie Library, Atlanta, Ga.; February 28—Philadelphia section at the Engineers' Club, Philadelphia, Pa.

SOCIETIES, SCHOOLS AND COLLEGES

Division of Engineering of the National Research Council, 29 W. 39th St., New York City. Booklet outlining the purpose and work of the National Research Council and the Division of Engineering.

Lowell Textile School, Moody St. and Colonial Ave., Lowell, Mass. Quarterly bulletin for November, 1920, containing an article entitled "Organic Research," relating to work done in the Organic Laboratory of the school.

NEW BOOKS AND PAMPHLETS

Use of Ammonium Persulphate for Revealing the Macrostructure of Iron and Steel. By Henry S. Rawdon. 9 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 402 of the Bureau of Standards. Price, 5 cents.

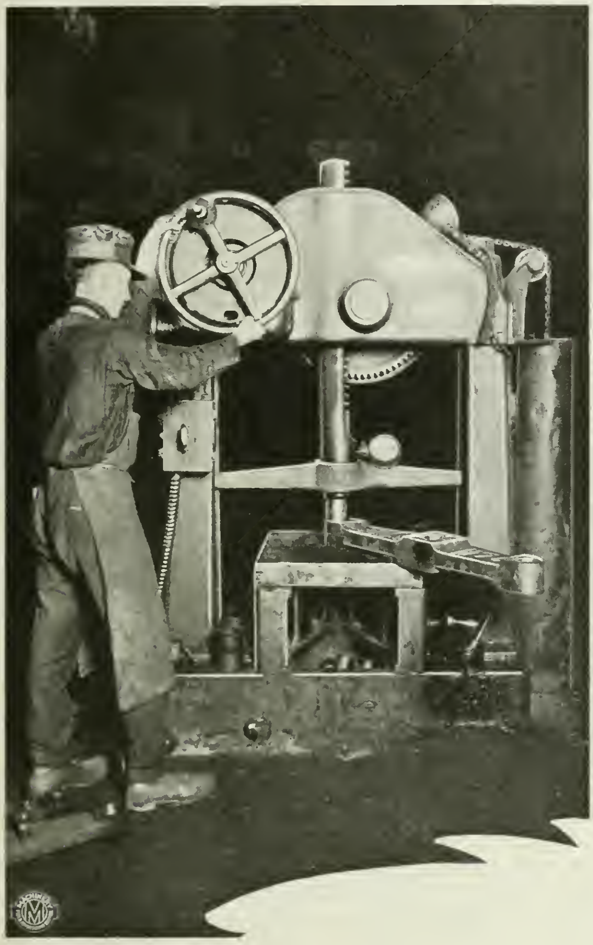
Tests of Bond Resistance between Concrete and Steel. By W. A. Slater, F. E. Richart, and G. G. Scofield. 66 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 173 of the Bureau of Standards. Price, 25 cents.

Employment Methods. By Nathan W. Shefferman. 573 pages, 6 by 9 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $5.

The author of this book was formerly personnel director for the Lycoming Foundry & Machine Co., the Baltimore Copper Smelting & Rolling Co., and the C. F. Sauer Co., and his wide experience has therefore given him an opportunity to present the subject dealt with in a very comprehensive manner. The book is divided into thirty-one chapters, each dealing with some specific phase of the subject, the material covering in general the functions and developments of an employment department, methods of hiring employes, and methods of retaining employes; there is also a special section on the human element. Office employes are dealt with in a separate section, and every phase of the subject is quite completely covered. The book is well illustrated by forms used for different purposes in connection with employment management, and should be of interest to employers in general, and particularly to those who are engaged in employment management and in the hiring and discharging of industrial workers

Practical Mathematics for Toolmakers, Draftsmen, and Machinists. By John M. Christman. 169 pages, 5½ by 8 inches; 500 illustrations. Published by John M. Christman, 215 Rhode Island Ave., Detroit, Mich. Price, $2.75.

This book is intended for toolmakers, draftsmen, and machinists who wish to study mathematics without the aid of a teacher. The appearance of the book is unique, as it is not printed from type but from plates made from typewritten copy. The problems presented have been accumulated for the last ten years from various tool-rooms and drafting-rooms. The contents are as follows: Fractions; Decimal Fractions; Proof of Multiplication and Division; Percentage; Formulas and Grouping Symbols; Gear and Lead-screw; Ratio and Proportion; Graduated Dials; Square Root; Pythagorean Theorem; Vernier Instruments; Cutting Speeds and Feeds; Geometry and Mensuration; Areas and Volumes; Angle Problems; Similar Figures; Taper Problems; Trigonometry; Sine Bar; Gage Problems; Checking Holes Bored at an Angle; Spur Gear; Bevel Gear; Worm-gear; Dividing Head; Continued Fractions and Convergents; Gearing of the Lathe; Gearing of the Mill; Backing off Spiral Fluted Hobs; Spiral Gear Cutting; Special Sine Bar for Tapers; Solutions and Answers; Trigonometry Table; and Factor Table.



A LUCAS

Power Forcing Press At Work in the D L & W's Scranton Shop

There are two of these simple and effective machines in this busy railroad shop—one a 30-ton press, the other with 50 tons capacity. The oldest has been in use for five years and both are giving excellent satisfaction.

The operation shown is forcing a bushing 4″ long by 2½″ diameter into a locomotive hanger forging to be used in brake rigging, and is readily accomplished with 3 to 4 tons of pressure.

The sphere of the Lucas Power Forcing Press covers that big tract of "no man's land" where the hand or screw press is too small and the hydraulic too large to work to advantage.

Control and adjustments center in the wheel, which automatically applies power when the ram meets with the resistance of the work. Action is rapid and positive.

Power is obtained from a worm wheel on the pulley shaft through a friction clutch and is transmitted to the ram by means of gearing controlled by the hand wheel.

No valves to leak—no pipes to freeze—no packing to renew. "A good all round tool" is the verdict on this machine wherever it is installed, whether for bending, straightening, forcing, marking, forming or broaching and new uses develop for it every day.

Illustrated Circular tells the whole story.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin. Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Loweuer, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

Straight Business in South America. By James H. Collins. 305 pages, 5 by 8 inches. Published by D. Appleton & Co., 85 W. 32nd St., New York City. Price, $2.50, net.

This book presents observations made by the author during an eight months' trip to South America, and consequently contains first-hand information on business conditions in the countries visited. It deals with the getting, building, and handling of business with South America. The material has been drawn entirely from five South American countries, namely, Argentina, Brazil, Chile, Uruguay, and Peru. An idea of the treatment of the subject will be gained from a list of the chapter headings, which are as follows: Wanted—Business Imagination for Export; What South America is Like; What the People and the Countries are Like; The Tools of the Trade: Our Own Banks—Our Own Ships—Investments—Distribution — American Retailing — American Consumer Advertising; Doing Business with South America; Why South America Needs Continental Methods; The Other Fellow—Our Competitor; What do South Americans Think about Yankees?; The Importance of Buying as well as Selling; About "Picking up" the Spanish Language; What Chance for Me in South America; What You will Need in South America; The South American Farmer; Who was Who in South America—Paragraphs of History; and the Canal Zone—A Sample of Us.

Mechanical World Year Book for 1921. 318 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 2s. 6d., net.

This is the thirty-fourth edition of a well-known pocket book for mechanical engineers. The present edition contains a classified buyers' directory published in French, Russian, and Spanish, in addition to the material in the year book proper. Among the subjects covered in the present year book are: steam engines; steam turbines; steam boilers; gas engines; oil engines; Diesel engines; suction gas producers; properties of metals and alloys; structural iron and steel work; toothed gearing; grinding; limit gages; ball and roller bearings; belting; rope driving; friction and lubrication; water and hydraulic work; steam heating; heating and evaporating liquids; shrinkage of castings; screw-cutting tables; weights of bolts and nuts; dimensions of steam pipe fittings; weights of bar iron and steel angle; metric conversion tables; areas of circumference of circles; tables of squares, cubes, and roots; tables of logarithms and trigonometrical ratios. The sections on cast-tooth gearing and on ball and roller bearings are new features of the present edition. The matter on chain gearing has been rewritten and extended, and a new table has been introduced on the properties of saturated steam. Other revisions have been made and new illustrations incorporated.

The Electric Furnace. By Henri Moissan. Translated by Victor Lenher. 313 pages, 6 by 9 inches; 42 illustrations. Published by the Chemical Publishing Co., Easton, Pa. Price, $3.50.

This is the second edition of a work originally written in French, which contains the results of chemical researches with the electric furnace made by Henri Moissan. It is of interest primarily to metallurgists, the material being confined entirely to research work rather than to the industrial application of the electric furnace. The book is divided into four chapters. In the first are described different forms of laboratory electric furnaces, and their application to a study of the fusion and volatilization of a number of refractory bodies. The second chapter contains a study of the three varieties of carbon—amorphous carbon, graphite, and diamond. The third chapter describes the preparation by means of the electric furnace of a number of elements. In it is described the work done with the electric furnace on chromium, manganese, molybdenum, tungsten, uranium, vanadium, zirconium, titanium, silicon, and aluminum. The forth chapter contains the results of research carried out on a new series of binary compounds—the carbides, silicides, borides, phosphides, arsenides, and sulphides. It deals with the discovery of new compounds, their preparation, properties, and analyses. The preparation of calcium carbide has been the subject of new investigation which is gone into in detail. General conclusions complete the work.

Factory Organization and Administration. By Hugo Diemer. 398 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $4.

This book is now in its third edition, modifications having been made in the original text in order to conform to the evolution of management and standards of present-day practice. The changes that have been made are in the chapters relating to general organization, the personnel department (including employment and industrial relations), and functional control of production. The book treats of practice in both organization and administration. It discusses the details of the subject from factory location and building through department organization and relation to costs and wage systems. The material is divided into twenty-eight chapters, headed as follows: The Principles, Field, and Methods of Industrial Management; Industrial Finance; Organization and Control; Typical Factory Organizations; Factory Accounts; Departmental Reports; Factory Location; the Planning of Factory Buildings, and the Influence of Design on their Productive Capacity; Personnel Department; Office Management; the Order Department; Bills of Material; the Drafting Department; the Pattern Department; the Purchasing Department; Stores and Stock Department; Planning and Supervising Production; Foundry Systems; the Machine Shop and Tool Department; Shipping and Receiving Departments; Time Taking; Cost Department; Aids in Taking Inventory; Inspection Methods in Modern Machine Shops; Rate Fixing and Time Studies; Wage Systems; Principles Underlying Good Management; and a Bibliography of Works Management.

Financial Engineering. By O. B. Goldman. 271 pages, 5½ by 8½ inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.50, net.

This book is written as a text for consulting, managing and designing engineers and students. The author calls attention in the preface to the fact that an engineer, besides needing to be familiar with the properties of materials, the action, limitations, and application of machines and instruments, must be able to translate engineering factors into dollars and cents. This work gives rules by which the engineer may determine the value, economically, of the different types and installations of machinery. It gives a basis for rate-fixing by translating units of time and power into dollars. Methods are outlined for determining the financial efficiency of a system when the mechanical efficiency is known. The book should be useful in organizing new plants or systems where economy is effected by choosing units of proper size. It is written primarily for the practicing engineer. All mathematical deductions are worked out in detail. Many examples are also fully worked out to illustrate the practical applications of the technique. The contents are as follows: Cost Segregation; Fundamental Financial Calculations; Basic Costs; Vestances; Unit Cost Determination; Determination of Size of System for Best Financial Efficiency; and Determination of Type and Size of Units. In the second chapter on cost segregation, among the important points discussed are interest and rents, depreciation and appreciation, materials consumed, maintenance, stock account, and storage, sale, and distribution. The chapter on basic costs considers the prices and operating costs of steam engines, oil engines, motors and generators, boilers, etc., and also gives prices of standard wrought-iron pipe, wood pipe, and riveted steel pipe.

NEW CATALOGUES AND CIRCULARS

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Sheets for loose-leaf catalogue, containing dimensions and prices of electric controlling apparatus for December, 1920.

Bickett Machine & Mfg. Co., Cincinnati, Ohio. Leaflets illustrating and describing Bickett heavy-duty 28- by 28-inch by 6-foot metal planer, and 36- by 36-inch by 12-foot metal planer.

Stever-Beagle Mfg. Co., 214 Temple St., Syracuse, N. Y. Circular describing and illustrating the application of the Beagle ball lubricator for lubricating shafts or spindles in motion.

Walworth Mfg. Co., Boston, Mass. Circular showing the different styles and sizes of brass gate valves, brass globe and angle valves, and brass check valves made by this company.

Metal Saw & Machine Co., Inc., Springfield, Mass. Circular descriptive of the Napier horizontal multiple stock holder for use in connection with the Napier horizontal metal-cutting machine.

Allegheny Gear Works, Pittsburg, Pa. Publication entitled "Gear Teeth," containing material of interest to gear users, relating to Allegheny gears as well as to the gear industry in general.

National X-Ray Reflector Co., Chicago, Ill. Calendar for 1921, showing on each sheet lighting fixtures and equipment suitable for illuminating factories, offices, show windows, show cases, etc.

Uehling Instrument Co., 71 Broadway, New York City. Bulletin 111, describing the construction and principle of operation of the Uehling carbon dioxide recording equipment for use in boiler plants.

W. M. & C. F. Tucker, Hartford, Conn. Catalogue 2, containing illustrations, descriptive material, and specifications for Hercules shears and rod cutters, which are made in six sizes for cutting flat sheets and bar iron.

Ross Heater & Mfg. Co., Inc., Buffalo, N. Y. Catalogue F, descriptive of the Ross closed or tubular type heater for heating fluids. The catalogue also describes condensers, expansion joints, coolers, and airjector pumps manufactured by this company.

General Electric Co., Rock Drill Department, Fort Wayne, Ind. Bulletin 48902, illustrating and describing in detail the Fort Wayne Type A electric rock drill for use in mines, tunnels, quarries, and other places where rapid advancement of the work is demanded at low drilling cost.

Wright Mfg. Co., Lisbon, Ohio. Catalogue descriptive of high-speed hoists, screws, differential blocks, and steel trolleys. A section of the catalogue is devoted to a discussion of the various types of hoists and the field of usefulness of each. Copies will be furnished upon request.

Holz & Co., Inc., 17 Madison Ave., New York City. Bulletin 41, containing a history of magnetic analysis in the United States, as well as a detailed description of the Burrows defectoscope and magnetic analyzer for inspecting steel rails, rods, wire cable, and all other steel and iron stock of uniform section.

Bristol Co., Waterbury, Conn. Bulletin 303, covering the Bristol line of recording, indicating and controlling instruments, which includes pressure and vacuum gages, liquid level gages, thermometers, pyrometers, voltmeters, ammeters, wattmeters, mechanical and electrical time recorders, temperature controllers, etc.

Diamond Machine Co., Providence, R. I. Bulletin entitled "The Diamond on the Job," describing and illustrating a number of different jobs successfully performed on Diamond heavy-duty face grinding machines. The bulletin, which covers 48 pages, includes on every page a description of some specific job together with one or more half-tone illustrations.

Cowan Truck Co., 16 Water St., Holyoke, Mass. Catalogue entitled "Transveyor Picture Book," containing seventy views of installations of the Cowan transveyor in machine shops, automobile factories, printing plants, freight terminals, textile factories, rubber factories, foundries, and numerous other industries. A diagrammatic view of the Type G all-steel transveyor is shown, on which is indicated the distinctive features.

National Tube Co., Pittsburg, Pa., Bulletin 14C, treating of the characteristics and advantages of National tubular steel poles, and discussing the types of service for which they are especially fitted, which include trolley lines, telegraph or telephone lines, transmission lines, street lighting, signal or semaphore poles, flag poles, etc. The bulletin also contains tables of dimensions, capacity, etc., for steel poles, and properties of pipe.

Alvord Reamer & Tool Co., Millersburg, Pa. Catalogue 5, containing illustrations and tables of dimensions and prices of the line of reamers, drills, milling cutters, structural workers' tools, special tools, and drop-forgings made by this company. Catalogue 5-A, containing specifications relating to tools for automobile repair work. These catalogues also contain tabular matter covering tables of decimal equivalents, tap drill sizes, etc.

Smalley-General Co., Inc., Bay City, Mich. Circular (Series A) containing time studies for performing various thread-milling operations on sixteen different parts, giving the equipment, dimensions of work being operated on, material, and time consumed. Leaflet illustrating and describing the Smalley-General No. 23 hollow-spindle thread and form miller, which has a swing of 20 inches, and a normal milling capacity of 13 inches outside diameter and 17 inches inside diameter.

Tate-Jones & Co., Inc., Pittsburg, Pa., is issuing a monthly publication entitled "Metal Heating," devoted to the interests of heat-treaters and forgers. It contains articles on carburizing, case-hardening, and the heat-treatment, in general, of various classes of metals for different uses, and shows heat-treating furnaces and other equipment made by Tate-Jones & Co. for this purpose. The journal is offered without cost to all who are interested in the heat-treatment of metals.

Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. Catalogue 4, illustrating and describing Hanna pneumatic riveters. The book describes in detail the construction and operation of this type of machine, including an explanation of the Hanna motion for actuating the dies, which is an exclusive feature of this machine. The different sizes and styles of machines are illustrated, and a large number of views show their application to boiler, tank, structural, bridge, car, automotive, and steel shipbuilding work.

Norton Co., Worcester, Mass. Catalogue treating of balancing equipment for grinding wheels, containing general information on the balancing of grinding wheels, as well as an outline of the several methods of putting a wheel in balance. The Norton line of balancing equipment is illustrated, including balancing ways, bushings and spiders, balancing centers, balancing bands, and balancing flanges. Special directions are given for balancing offhand wheels, 5-inch hole wheels, and wheels with 12-inch and larger holes.

Bausch & Lomb Optical Co., Rochester, N. Y. Catalogue of projection apparatus, including a new model balopticon for lantern slides, a new model for the production of large opaque objects, and improved apparatus for microscopical projection. The first part of the catalogue contains a discussion of optical projection and its various applications, and gives specifications for equipment for this purpose. The remainder of the catalogue is devoted to balopticon accessories, including lenses, spectroscope attachments, etc.

General Electric Co., Schenectady, N. Y. Bulletin 42300A, illustrating and describing General Electric steam-engine-driven generating sets, which are especially manufactured for marine installations, and range in size from 2½ to 60 kilowatts. A cross-section drawing shows an assembly view of 6½- by 5-inch cylinder forced lubrication sets. Each part in the construction of these sets is described separately and fully illustrated. Reference is also made to alternating-current generating sets and their uses.

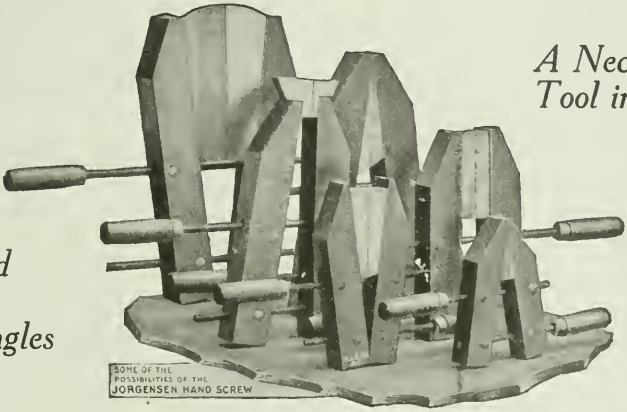
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis. Catalogue containing 48 pages illustrating and describing the complete line of cranes made by this company. Illustrations show the different styles of cranes, and this equipment in use in different plants. One section of the book describes the Milwaukee horizontal drilling and boring machine, which is especially designed for operating at one setting on pieces that are too long and bulky to be handled on the usual type of machine. Copies may be obtained upon request.

Your Pattern Shop Should Be Interested in the

JORGENSEN
ADJUSTABLE
HAND SCREW

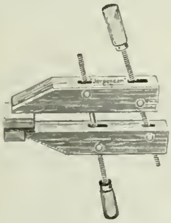
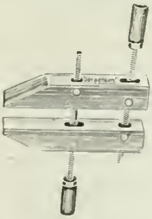
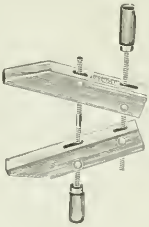
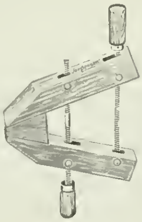
A Necessary Tool in the Shop

The Hand Screw of Many Angles



A SINGLE CLAMP will adjust to any of the positions shown, or any modification of them. One jaw can also be made to overlap the other.

More than that, these Adjustable Hand Screws have Steel Spindles which are practically indestructible. They have a Right and Left Thread, and open and close almost twice as fast as old style clamps—more time saved.

Send for Circular No. 551 and read more about them. To prove to you the practicability of this Hand Screw send for a No. 4 and try it out—you will be convinced.

HAMMACHER, SCHLEMMER & CO.

HARDWARE, TOOLS AND FACTORY SUPPLIES

New York, Since 1848 4th Avenue and 13th Street

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill. Calendar for 1921, containing on each sheet, besides a calendar for three months, a list of the company's domestic and foreign sales offices, and an illustration of one of the products of this company, including pneumatic riveting hammers, air drills, electric drills, pneumatic geared hoists, pneumatic rammers, etc.

Standard Tool Co., Cleveland, Ohio. Calendar for 1921, showing illustrations of the drills, reamers, taps, milling cutters, and other tools made by the company. On the back of each sheet of the calendar is printed tabular matter, including decimal equivalent tables, metric conversion tables, weights of round, square, and hexagon steel, tap drill sizes, tap and reamer speeds, and other useful information.

Blanchard Machine Co., 64 State St., Cambridge, Mass. Catalogue containing 40 pages illustrating and describing the Blanchard No. 16 B high-power vertical surface grinder and attachments. The illustrations show the machine with the different types of drive with which it is equipped, including direct motor drive, floor motor drive, overhead motor drive, and countershaft drive. Typical examples of the work handled by this machine are also shown. The construction is made clear by the liberal use of both halftones and line engravings. This catalogue supersedes all previous editions relating to the No. 16 surface grinder.

Brown & Sharpe Mfg. Co., Providence, R. I. Booklet entitled "A Few Brown & Sharpe Graduates," containing the names of a great number of the men who have completed the Brown & Sharpe training course in the machinery trade in connection with the company's apprenticeship system. On account of difficulty of obtaining exact information as to present positions and locations of many of the graduates and apprentices, the list is but a partial one. The company would like to add as many names as possible to the next edition and would be glad to send one of the booklets to any reader of MACHINERY who is a former Brown & Sharpe graduate apprentice with a view to eliminating all omissions by the aid of men formerly trained at the Brown & Sharpe works.

Steel Products Engineering Co., Springfield, Ohio. Circular descriptive of the construction of the No. 1 universal gage grinder, giving a list of the labor-saving features and other noteworthy features of the machine, as well as complete specifications. The machine has a capacity of 4½ inches in depth and 21½ inches in length. Circular illustrating and describing in detail the 21-inch back-geared shaper formerly made by the H. J. Averbeck Shaper Co. and now manufactured by the Steel Products Engineering Co. The circular also illustrates the patented balanced driving mechanism with which this machine is equipped. Circular illustrating and describing the details of construction of the 17-inch automatic-feed regulating back-geared crank shaper formerly made by the H. J. Averbeck Shaper Co.

Cushman Chuck Co., Hartford, Conn. General catalogue for 1921 covering the Cushman line of lathe chucks. A brief account is given of the development of this business, from the time when the first Cushman chuck was made in 1862. Information relating to lathe chucks is given under the following headings: Outfits for Lathes; How to Increase the Efficiency of Lathe Chucks and Prolong their Usefulness; How Cushman Chucks are Attached to Lathes; Dimensions of Intermediate Flange Plates; and Repairs and Replacement Parts—How to Order Them. Each style of chuck is fully described, and in connection with the sizes, prices, and code words will be found carefully prepared line drawings and tables showing the dimensions of the various parts, as well as the weights when packed for shipment in various quantities. Tables are also included giving price lists of all replacement parts.

Pawling & Harnischfeger Co., Milwaukee, Wis., is distributing a publication known as the "P. & H. Chronicle," which contains a historical and descriptive sketch of the company, its personnel, size, facilities, and products. The book is illustrated with portraits of the founders of the company and the various officers, as well as with exterior and interior views of the plant. The sections devoted to P. & H. machinery and excavating machinery contain a large number of illustrations of electrical cranes, hoists, and monorail overhead conveying systems, horizontal drilling and boring machines, and various types of excavating machinery for trench and general excavation. Bulletin 5X, dealing with the P. & H. excavator crane No. 205. The pamphlet describes the many varied uses of this crane, and illustrations show the excavator at work. Details of construction and specifications are included.

TRADE NOTES

Crowell Mfg. Co., formerly at 298 Taafe Place, Brooklyn, N. Y., has moved into its new building at 319 Franklin Ave., Brooklyn.

R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland, announces that the business which it has heretofore carried on has been transferred to Trading Co. R. S. Stokvis & Zonen.

Peterson Tool & Die Works, Inc. have engaged in business as designers and makers of dies, tools, fixtures, and special machinery, at 142 Clifton Place, Brooklyn, N. Y.

Wagner Electric Mfg. Co., St. Louis, Mo., has removed its Cincinnati office to 20 E. 9th St., where it has also opened a service station. I. W. Pettingill is in charge as district manager.

Ward, Crosby & Smith, 233 Broadway, New York City, is a new firm formed by S. Mortimer Ward, Jr., Gorham Crosby, and Dyer Smith to engage in the practice of patent and trademark law.

Allison Experimental Co., Indianapolis, Ind., has changed its name to **Allison Engineering Co.** This is a change in name only, the ownership, management, and scope of work remaining the same as before.

Thomson Electric Welding Co. and **Thomson Spot Welder Co.**, Lynn, Mass., announce that their New York office has been removed from 1604 United States Express Bldg. to Room 3225, 120 Broadway.

Robinson, Cary & Sands Co., St. Paul, Minn., has distributed an announcement to the trade in celebration of its semi-centennial, or the completion of a half century of business dealing in machinery and railway equipment.

Welever Piston Ring Co., manufacturer of the "Wel-Ever" oil control piston rings, is now located in its new brick building at 1713 Canton St., Toledo, Ohio. The plant is equipped with new and special machinery for rapid production.

Purves Mfg. Co., Syracuse, N. Y., has moved into a factory building which has been erected for the company at Genesee and Ammon Sts. The company manufactures lubricators and oil-cups, and does a general tool and die manufacturing business.

Myers Machine Tool Corporation, Columbia, Pa., has recently completed a new two-story factory building, 52 by 220 feet, of modern construction. With the added facilities the company will be in a position to supply lathes, drilling machines, grinders, polishing machines, arbor presses, etc., in large quantities to the trade.

Reynolds Machine Co., Massillon, Ohio, manufacturer of automatic screwdriving machinery for machine screws and wood screws, announces that the company has made a substantial reduction in the price of its products, effective at once, covering the several sizes and types of automatic magazine-feed screwdriving machines.

Blodgett Engineering Co., Detroit, Mich., manufacturer of tools, die, jigs, gages, and special tools, is now located in its new plant at Roosevelt Square near the Michigan Central Railway passenger depot. The new building is a modern two-story steel and brick structure, 100 by 150 feet, equipped with up-to-date machinery.

Arrow Pump Co., Detroit, Mich., has been organized with executive and sales offices at 318 Park Bldg., 1438 Washington Blvd., Detroit, Mich., to manufacture a full line of small pumps for automobiles and machine tools, as well as for general pumping purposes. These pumps will be sold under the trade name of "Arrow."

Rivett Lathe & Grinder Co., Boston, Mass., manufacturer of precision lathes and grinding machines, announces a substantial reduction in prices, of the grinding machines and lathes built by the company. These reductions amount approximately to from 25 to 40 per cent of the peak price quoted on the company's machines of different types.

Whiting Foundry Equipment Co. has changed its firm name to **Whiting Corporation.** The authorized capital stock of the company has been increased from $700,000 to $3,000,000. The corporation remains under the same management and will continue the manufacture of cranes, foundry equipment, and railway specialties as heretofore.

Porter-Richards Machinery Co., has been organized at 19 S. 7th St., Philadelphia, Pa., by S. G. Porter and E. I. Porter, for many years associated with the D. Nast Machinery Co. of Philadelphia, together with J. R. Richards, formerly with the Fairbanks Co. The new company will serve the trade with high-grade machine tools and accessories.

Commercial Camera Co., 10 Weybosset St., Providence, R. I., has changed its name to **Photostat Corporation.** The officers, personnel, business connections, and policy will continue the same as before, the purpose of the change in name being merely to more readily identify the company with its products, which include photostats, photostat paper, and photostat chemicals.

Summit Tool Co., Summit and Mulberry Sts., Toledo, Ohio, is a new concern engaged in the manufacture of jigs, fixtures, dies, tools, and special machinery. The company is located in a new brick building, 50 by 100 feet. The officers are William Coghlin, president and treasurer; Walter L. Coghlin, vice-president; James A. Kirkby, secretary; and George E. Roberts, assistant manager.

Pawling & Harnischfeger Co., Milwaukee, Wis., held a general meeting and business session of the district managers and sales engineers of the company at the Pawling & Harnischfeger plant auditorium in Milwaukee, January 25 to 27. The past year's business was discussed, and plans were made for future sales in the company's various lines—cranes, hoists, excavating machinery, and machine tools.

Calumet Truck Body Corporation, Calumet, Mich., has been organized with a capitalization of $200,000 to build what will be known as the Calumet "All-purpose" body for automobile trucks. The company desires to receive catalogues and prices from manufacturers of malleable and drop-forging parts and fittings used on truck bodies and cabs, as well as catalogues and prices of tools and shop equipment.

Northern Engineering Works, Detroit, Mich., manufacturers of cranes and hoists, have established a new office in the Pittsburg district at 990 Union Arcade Bldg. J. B. Laird, who has hitherto represented the company in western New York and northern Pennsylvania, will be in charge of the new office. Mr. Laird will cover the entire East and the Ohio valley, and will also look after the Buffalo district for the present.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., has established an office at St. Louis, Mo., in the Railway Exchange Bldg., Suite 2111. This office is a branch of the Chicago district office, and its need has been felt for some time because of the increasing amount of business done in the St. Louis territory. Harold Phillips, formerly of the engineering department of Chicago and later office manager of the Chicago office, will be in charge of the new St. Louis branch.

Hoenscheid Forged Twist Drill & Tool Co., 1450 Twenty-first St., Detroit, Mich., has been incorporated with a capitalization of $50,000. The new concern will manufacture a complete line of forged twist drills, reamers, milling cutters, and special tools. The officers are P. J. Hoenscheid, Sr., president; George P. Hoenscheid, vice-president; G. W. Craighead, treasurer; and C. C. Meyers, secretary. P. J. Hoenscheid, Sr., has been the organizer of many twist drill companies and is well known as a pioneer twist drill maker.

Tock Screw Machine Products Corporation, 199-203 Eighth St., Long Island City, N. Y., announces that its business has grown so rapidly that it has been found necessary to effect a reorganization with increased capital, in order to provide more adequate facilities for the conduct of the business. The **Automatic Products Corporation** has therefore succeeded the former company, taking over its assets and assuming its liabilities. There will be no change in the personnel, and the business will be carried on as heretofore.

Sundh Engineering & Machine Co. announces that it is established in its new location at 1105 Frankford Ave., Philadelphia, Pa., where it is engaged in the manufacture of finishing machinery for brass mills and for makers of hot- and cold-rolled steel strip. The company is incorporated with a capitalization of $100,000. The officers are G. R. Rebmann, president; A. Sundh, vice-president; and H. F. Winters, Jr., secretary and treasurer. The sales manager is Wadsworth Doster, who was for ten years associated with the Torrington Mfg. Co., Torrington, Conn., manufacturer of brass mill machinery.

James H. Matthews & Co., 3946 Forbes Field Pittsburg, Pa., manufacturers of marking devices and metal signs, announce that on December 24 the company gave to the workers in its organization life insurance policies, calling for increased amounts, depending upon the years of continuous service, with a maximum policy after five years. These policies were given to every worker who had been in the employ of the company one year or more, which included 64 per cent of the force. Those who received maximum policies, having been in the employ of the company over five years, constituted 21 per cent of the total number of employes.

Lumen Bearing Co., Buffalo, N. Y., announces that the company has increased its capitalization from $200,000 to $500,000, of which $100,000 is to be distributed to the present stockholders as a stock dividend of 50 per cent. The balance of the new issue is to be used to take care of the rapidly increasing business. The executives of the company are as follows: W. H. Barr, president and treasurer; C. H. Bierbaum, vice-president; N. K. B. Patch, secretary; N. F. Young, assistant treasurer; H. P. Parrock, general manager; and L. S. Jones, general sales manager. In addition to its Buffalo plant the company has also a plant in operation at Youngstown, Ohio.

Millholland Sales & Engineering Co. has been formed in Indianapolis, Ind., by W. K. Millholland and E. Millholland, who have disposed of part of their interest in the Millholland Machine Co. W. K. Millholland has been president and general manager of the latter company for the last six years, and E. Millholland has been works manager for about ten years. Temporary offices have been opened at 304 Rauh Bldg., Indianapolis, and a sales and display room will be opened about March 1. A ten-year lease has been taken on the machinery store at Capital Ave., which has been occupied in the past by Marshall & Huschart. The entire attention of the new company will be given to selling machine shop and foundry equipment and to consulting engineering work.

Detroit Machine Tool Co., 6545 St. Antoine St., Detroit, Mich., announces that it will specialize in the manufacture of ten automotive parts. The firm will also continue to make the Detroit centerless cylindrical grinder and the Detroit semi-automatic drilling machine, which have been its chief products for several years. The capitalization of the company has been increased from $150,000 to $300,000, and a larger factory has been constructed, which affords a total floor space of 37,200 square feet. The first story of the building is 120 feet wide by 220 feet long, and the second story is 120 feet wide by 90 feet long. A course in the principles of centerless grinding will be given in the grinding department, for training workmen to be expert operators on the centerless grinding machine. H. J. Swanson will be in charge of the parts manufacturing division of the company, as well as acting in the capacity of sales manager.

VOLUME 27 MACHINERY NUMBER 7

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It is understood that all contributed articles pertaining to machine shop practice and machine design are submitted exclusively to Machinery; when accepted and published, payment is made at our regular space rates unless other terms have been agreed upon

FOREIGN MACHINERY MERCHANTS PAGES, 388-389 ADVERTISERS INDEX, 419-420 PRODUCT INDEX, 390-416

The Editor's Monthly Talk

LEADING men in the mechanical field predict that we are entering upon a new era in production, that competition will be keen, and that as wages, freight rates and manufacturing costs generally are high, industry must find ways to bring down the unit cost. Some of this reduction in cost may come through greater efficiency of labor, but in large measure it must come through the adoption of more efficient mechanical equipment and shop methods. Automatic and semi-automatic machines will find an ever-increasing field. The less skilled labor a machine requires for its operation, the greater will be its value in the years of high-tension activity sure to come.

The automatic machine must not only perform the machining operations without the attention of an operator, but must be so designed that it will automatically feed the work to the cutting tools as well, and discharge the finished article with a minimum of attention from the costly human element. The recognition of this important factor has led to highly developed designs of magazine feeds through which the work is passed to the cutting tools with speed and precision. These mechanisms constitute an important part of the equipment in the modern machine shop devoted to quantity production. Their design and operation are of great importance. Some highly developed mechanisms of this type are described in the leading article in this number of MACHINERY—"Magazine Feeds for Automatic Screw Machines."

Production Control

In the small shop, where the superintendent can keep in close touch with the progress of each job, a system for production control is hardly necessary. But as the plant increases in size, the problem of supervision of production increases in difficulty. In large plants manufacturing typewriters, sewing machines, automobiles, vacuum cleaners, electric motors and a score of other machines and devices in large quantities, it would manifestly be impossible to maintain an even flow of production through the plant, keeping to predetermined production schedules, without a carefully devised and reliable system enabling the production manager to ascertain with accuracy, at any moment, the actual progress in the shop.

An effective system for this purpose is that of the American Multigraph Co., Cleveland, Ohio. A complete description of this system, showing all the forms and blanks used in connection with it, will be found in this number of MACHINERY. The description is accurate and authentic, being based upon an interview with Mr. R. G. Pack, vice-president in charge of production, who has personally checked this detailed account.

A series of articles dealing with practice in railway shops begins in April MACHINERY. It is a well-known fact that very few of the railway shops are equipped with modern tools for the work they have to do. There are some good railway shops, however, and their efficiency stands out by comparison. It is not from choice that railway mechanical executives use antiquated equipment. On the contrary, they are as alert and efficient as executives found in other lines. The fault lies in general railway organization and routine—but that is not a problem for us.

Methods in Railway Shops

In the series on railway shop practice beginning in April, MACHINERY will describe practice which, in general, meets the requirements for up-to-date methods. These articles will contain information of definite value to railway executives, especially in regard to the class of equipment that should be found in every railway repair shop. They will show good examples of modern railway shop practice, and it is to be hoped that good practice will spread. The railways pay hundreds of millions of dollars a year for locomotives and other rolling stock, and then, generally speaking, depend upon out-of-date and inefficient shop equipment to maintain this expensive equipment in working condition. True economy dictates the installation of the latest and most efficient tools and machines available. It is high time that the railway machine shop was put on a modern low-cost production basis. That is the way to keep the modern rolling stock in condition at all times

Besides the articles mentioned, March and April MACHINERY will offer a variety of interesting articles gathered from many sources in the mechanical field. In the present number there are descriptions of die constructions for blanking and drawing purposes, in addition to the manufacturing articles dealing with the making of precision bench lathes, jigs and fixtures, tractor engine plant practice, planer practice, drill chuck manufacture, etc. In April MACHINERY, besides the leading article on railway shop practice, numerous phases of machine shop practice and design will be dealt with as usual. There will be no less than fourteen principal articles, in addition to the many letters on practical subjects, articles relating to domestic and foreign machinery trade, shop kinks, etc.

Mechanical practice steadily grows and widens. There is an incessant flow of new machines, tools and devices. To keep its many readers—scattered all over the world—accurately informed on these new developments, is the inspiring task of the engineering journal.

MARCH MACHINERY 1921

Magazine Feeds for Automatic Screw Machines

Special Equipments Developed by the Cleveland Automatic Machine Company, for Handling Second-operation Work

It is a matter of general knowledge among men in machine shops that automatic screw machines are employed for the production of duplicate pieces, without requiring attention from an operator until such a time as the supply of stock is exhausted. For the usual operations on bar stock, provision is made in the design of the machine for feeding the work to the tools; but when it comes to the performance of second operations on pieces that have been cut off from the bar after completing the first sequence of cuts, special means have to be provided for economically loading successive pieces of work into the chuck for performing the second sequence of operations. If an automatic screw machine is to approximate its maximum efficiency on such work, it is necessary to furnish a magazine to deliver successive pieces of work automatically to the chuck, because a large part of the benefit resulting from automatic control of the cutting tools would be lost if the operator had to set up and remove each piece of work by hand.

Recognizing this fact, the Cleveland Automatic Machine Co., Cleveland, Ohio, started a number of years ago to develop magazine feeding mechanisms that are adapted for handling some of the various classes of work done on automatic screw machines of this company's manufacture. Some of these devices are of essentially standard design, a case in point being the so-called "tilting rotary" magazine, shown in the heading illustration of this article, that is used for carrying cylindrical shaped pieces of work to the chuck. Evidently there are a vast number of pieces of this kind which could be handled on automatic screw machines, and by having a magazine consisting of an endless conveyor chain by which pieces of work are carried around to the work-spindle, with means for transferring the work from the carrier to the chuck, and for ejecting the finished pieces, it will be evident that high rates of production should be secured. A benefit of this type of magazine is that there is a wide variety of cylindrical shaped pieces of work to be machined, and by simply equipping the conveyor chain with carrier bushings of the proper size, the same magazine may be adapted for handling a variety of pieces.

This is by no means the only case in which a magazine may be adapted for handling more than one class of work, but the example is typical. Several special types of magazine feeding mechanisms have been developed by the Cleveland Automatic Machine Co., in order to adapt automatic screw machines of its manufacture for handling unusual jobs. These magazines are described in the present article, not only because they are of rather unusual mechanical interest, but also because of the possibility of advantageously employing similar methods for other machining operations.

In order to employ an automatic screw machine for a second operation on parts that have been cut off from the bar, it is necessary to provide an equipment for delivering successive pieces to the chuck, without requiring attention from the operator. Unless such provision is made, the machine is unable to function in a way that enables advantage to be taken of its automatic operating feature. For several years, the Cleveland Automatic Machine Co. has made standard types of magazine feeds for use on machines of its manufacture, which have previously been described in these pages. In the present article, an account is given of special magazines designed and built by this firm for handling unusual pieces of work for which magazines of the standard designs are not adapted.

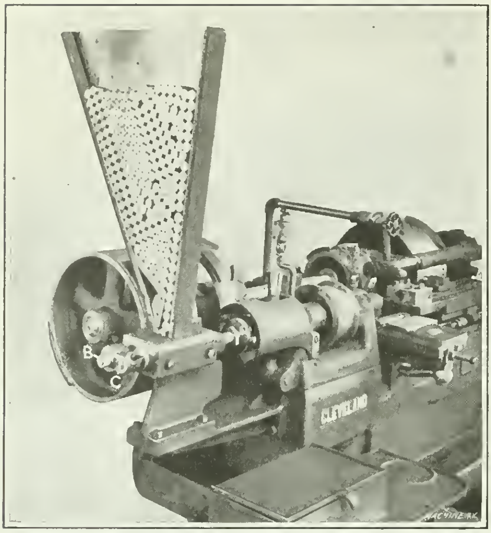

Fig. 1. One-half-inch Automatic Screw Machine equipped with a Magazine Feeding Mechanism for delivering Chain Bushing Blanks to the Chuck for performing a Drilling Operation

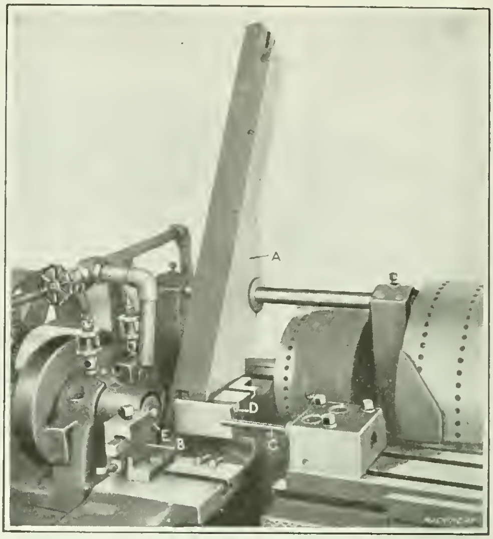

Fig. 2. Five-eighth-inch Automatic Screw Machine equipped with a Feeding Magazine for delivering Bolt Blanks to the Chuck for performing a Shaving Operation on the Head

Magazine Feeding Mechanism for Delivering Chain Bushing Blanks to the Chuck

At the plant of the Spaulding Chain Co., in Bloomfield, N. J., a ½-inch Model B Cleveland automatic is used for the performance of a second operation on chain bushing blanks. As these pieces come to the machine they have been turned, faced and cut off to length, and the second operation consists of drilling a hole through the bushing. Fig. 1 illustrates the magazine furnished for the machine on which this drilling operation is performed, and in Figs. 3 and 4, the arrangement of the feeding mechanism is more clearly shown. In this case, the magazine is made with two compartments, each of which is kept filled with blanks; in Fig. 1 one of the side plates has been removed in order to illustrate the way in which the blanks are stored in the magazine.

It will be evident that the hopper is carried by a bracket mounted at the left-hand end of the machine, where it is conveniently located in relation to the drum on which cams are mounted for actuating a plunger that pushes the blanks through a feed-tube to the chuck, in which successive blanks are held for drilling with a twist drill carried on the milling slide. Referring to Fig. 3, the arrangement of the mechanism is as follows: Located behind the magazine there is a cam-roller *A* that runs in contact with a cam carried on the drum shown in Figs. 1 and 3. The stud that carries roller *A* extends through a slot in the frame, so that it is free to move laterally through the cam action. This stud is carried by a bar *B* coupled to a plunger *C* that provides for pushing the blanks through a guide tube *D* to the chuck *E*. Contained in the coupling between bar *B* and plunger *C*, there is a spring compensator *F* that provides for taking up any slight difference which exists in the lengths of the blanks.

Operation of the Transfer Mechanism

In designing the cams for operating this mechanism, a double-action cam was provided for actuating the blank-feeding plunger, and the sequence of operations is as follows: Cam-roller *A* moves plunger *C* forward to advance one blank into the chuck; and then the cam which controls the movement of the milling slide, feeds the drill forward to

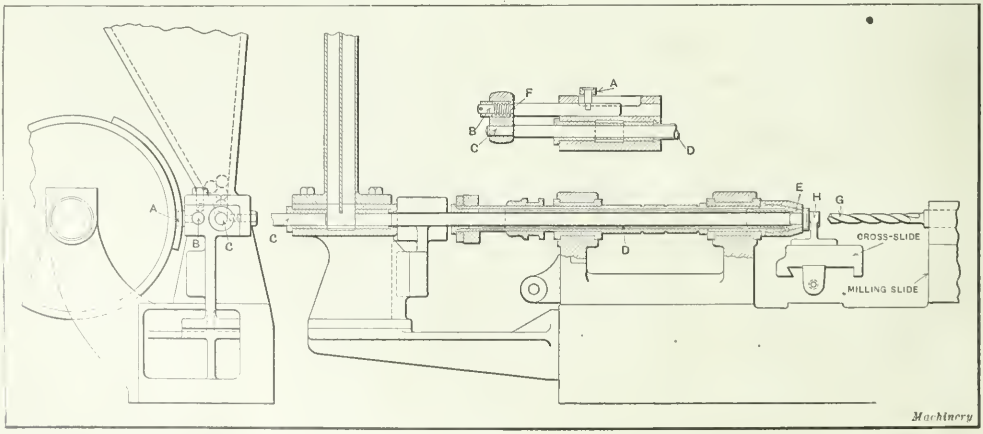

Fig. 3. Mechanism of Feeding Magazine shown on the Machine in Fig. 1. This Magazine is mounted at the Left of the Spindle Head, and a Cam-operated Plunger pushes Blanks through a Delivery Tube to the Chuck

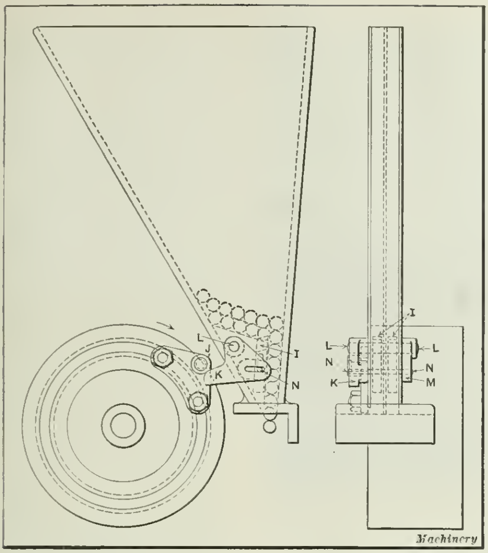

Fig. 4. Agitator which keeps Chain Bushing Blanks running freely through the Magazine shown in Figs. 1 and 3

produce the required hole in this bushing. After the drill recedes, the cam running in contact with roller *A* has a second rise which continues the forward movement of plunger *C* to bring a second blank in place for drilling.

After drill *G* has been advanced to drill this piece and has receded, the cam and roller *A* withdraw plunger *C* to its starting position, so that two more blanks may drop from the hopper into the pocket that is in line with the guide tube *D*. It will be apparent that as plunger *C* pushes the blanks forward into the feed-tube, it also serves the purpose of a stop which holds the remaining blanks up in the hopper of the magazine, and the pushing forward of one blank into place in the chuck provides for the ejection of the previously drilled bushing. Endwise location of each bushing blank in the chuck is accomplished by means of a gage-stop *H* which is carried on the cross-slide; and the camming is so arranged that at the same instant that a bushing drops out of the chuck, stop *H* slides across the face of the chuck and checks the forward movement of the undrilled blank, when it has reached the proper position between the jaws. The guide tube *D* is kept full of blanks so that the complete stroke of plunger *C* is only slightly in excess of the length of two blanks.

Arrangement of the Agitator

In all forms of magazine feed mechanisms where there is any danger of the blanks failing to run freely from the hopper to the chuck in which they are held for machining, some form of agitator must be used to assure the continuous feeding of work. Fig. 4 illustrates the device used on the magazine shown in Figs. 1 and 3. It will be seen to consist of a block *I* contained in each of the compartments of the hopper, which is agitated up and down by a cam mechanism to prevent danger of having the blanks become blocked at the entrance to the channel through which they run down to the guide tube that carries them over to the chuck. Secured to the cam-drum there is a block on which a roller *J* is mounted, and this roller engages a cam *K* on the agitating mechanism at each revolution of the drum. Cam *K* is secured to a rod *L* that extends through to the opposite side of the hopper, where a block *M* of quite similar form to cam *K*, is mounted on the rod.

When roller *J* oscillates cam *K*, pin *N* which projects through the hopper, so that its ends are secured to cam *K* and block *M*, causes the two agitating plungers *I* to rise and loosen any of the blanks which may have become stuck at the bottom of the hopper. Horizontal clearance slots are provided in cam *K* and block *M;* and vertical clearance slots are provided in the walls of the hopper, in order to give pin *N* the necessary freedom of movement; but attention is called to the fact that this pin is a tight fit in the two agitating plungers *I*, and its vertical movement is accomplished by the raising of cam *K*, and the transmission of this movement through rod *L* to block *M*. In this way the cam and block lift opposite ends of pin *N* and raise the agitators *I*.

Magazine for Holding Bolt Blanks

The William H. Ottemiller Co., of York, Pa., uses Cleveland ⅝-inch Model B automatic screw machines for the performance of a shaving operation on the heads of bolt blanks. As the blanks come to these machines, they have had the shank turned and the under side of the head has been faced, and these points are used for the double purpose of locating the blanks in the chuck and for guiding them through the feed-chute that is utilized for delivering the blanks to the chuck. One of the Cleveland automatics equipped with a magazine of this kind is illustrated in Fig. 2, and from this illustration it will be apparent that in the present instance the magazine is mounted at the rear of the cross-slide. The operation consists of shaving the bolt head to the desired form, and the magazine comprises a slotted member which receives the turned shanks of the bolt blanks, and a second slotted member which receives the heads. The blanks are introduced at the top and run down by gravity, without danger of blocking, so that in this case no agitating device is required.

Arrangement of Magazine on the Cross-slide

The magazine *A* is mounted at the rear of the cross-slide, and the formed shaving tool *B* is at the front of this slide, while the plunger *C* for pushing successive blanks from the magazine to the chuck is carried on the milling slide of the machine. The sequence of movements in feeding a blank to the chuck and performing the required operation on its head is as follows: Cams for actuating the cross-slide and

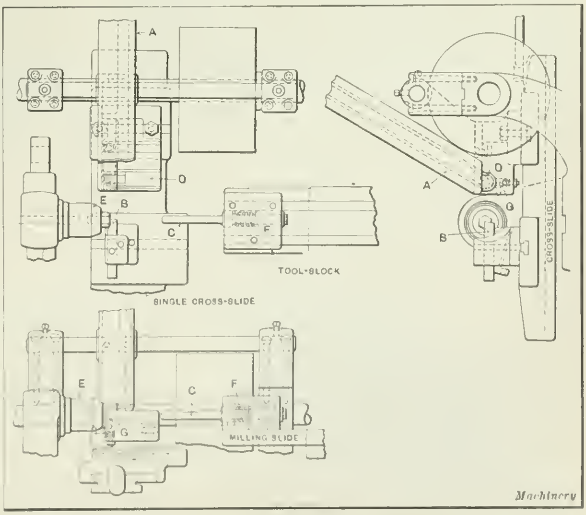

Fig. 5. Mechanism of the Feeding Magazine shown on the Machine in Fig. 2

the milling slide are so timed in relation to each other that the cross-slide first moves forward to bring the guide bushing *D*, in which a bolt blank rests at the base of the magazine, into line with chuck *E* carried by the spindle of the machine; then the milling slide cam moves this slide to the left, so that plunger *C* can push the bolt blank from bushing *D* into place in chuck *E*. Behind plunger *C* there is a spring compensator *F*, Fig. 5, that provides adjustment for any slight difference which exists between the length of successive bolt blanks.

From the end view, Fig. 5, it will be apparent that the head of the bolt blank rests in bushing *D*, and such being the case, it will be evident that provision must be made for supporting the blank at the shank end. Such provision is made by a small plunger *G* supported on a spring. The top of this plunger is concave to fit the bolt shank and it is beveled at the right-hand side, so that when plunger *C* pushes the bolt into the chuck, the square edge at the under side of the bolt head strikes the inclined face of plunger *G* and forces it down against the spring tension, to enable the bolt to enter the chuck. Then when plunger *C* is withdrawn, plunger *G* springs back into place and another bolt blank drops from the feed-chute into position for the next operation. After the milling slide has receded sufficiently so that plunger *C* is clear of the magazine, the cross-slide cams move this slide backward, so that shaving tool *B* that is mounted at the front of the slide comes into contact with the head of the bolt carried in chuck *E*, to perform the necessary shaving operation.

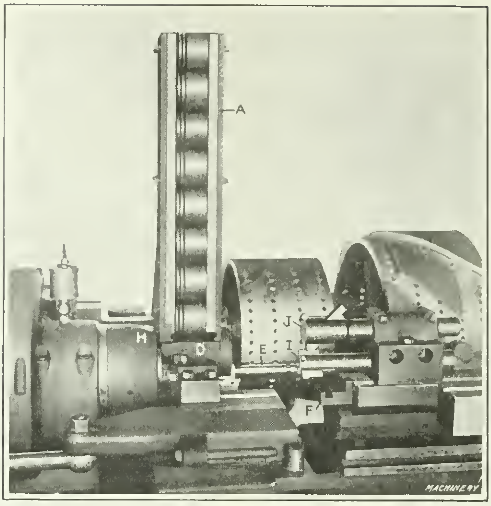

Fig. 6. Two- by Two and Three-fourth-inch Automatic Screw Machine equipped with a Feeding Magazine for delivering Pistons to the Chuck for performing a Boring and Facing Operation on the Skirt

Magazine Used for Boring and Facing Pistons

At the Northway Motor & Mfg. Co.'s plant in Detroit, Mich., Cleveland 2- by 2¾-inch Model B automatic screw machines shown in Fig. 6 are used for boring and facing pistons. The machines used for this purpose are of the double slide type, and the magazine rests on the rear cross-slide. As illustrated in the end view, Fig. 7, the magazine *A* is pivoted on the camshaft *B* and the force of gravity holds it down on a block *C* carried on the rear cross-slide in the manner previously described. At the front of block *C* there is a cradle *D* which holds one piston. When the rear cross-slide is drawn back, cradle *D* comes into place under the magazine so that one casting can drop into it; then, as the cross-slide is pushed forward, this casting is brought into line with the spindle of the machine, so that the piston may be pushed out of cradle *D* into the chuck. Meanwhile, the top surface of block *C* is under the magazine and holds the other castings until the cradle has been drawn back under the magazine.

When cradle *D* carries a piston forward into line with the spindle, a plunger *E* carried by the magazine moves forward so that a hook on the end of this plunger engages a slot in a bracket *F* carried at the front of the milling slide. To understand this arrangement, it will be best to refer to both Figs. 6 and 7. Timing of the cams that actuate the cross-slide and the milling slide is worked out in such a way that when a piston has been brought into line with the spindle, plunger *E* is engaged by hook *F* on the milling slide, and this slide advances so that plunger *E* will push forward a finger *G* that comes into contact with the piston and carries it into place between the jaws of chuck *H*. Plunger *E* is made in two sections, with a compression spring between them, which affords the necessary compensation for differences in the size of the casting, thus protecting the machine from damage in case there is any substantial variation. After the milling slide has moved back to its initial position, the cross-slide is withdrawn, thus carrying the magazine and plunger *E* out of the way, so that a Kelly reamer *I* and a combination boring and facing tool *J* can bore the inside of the piston and counterbore and face its open end, when the milling slide is again moved forward.

Magazine for Handling Fiber Disks

The American Vulcanized Fiber Co. of Wilmington, Del., makes various products in the manufacture of which

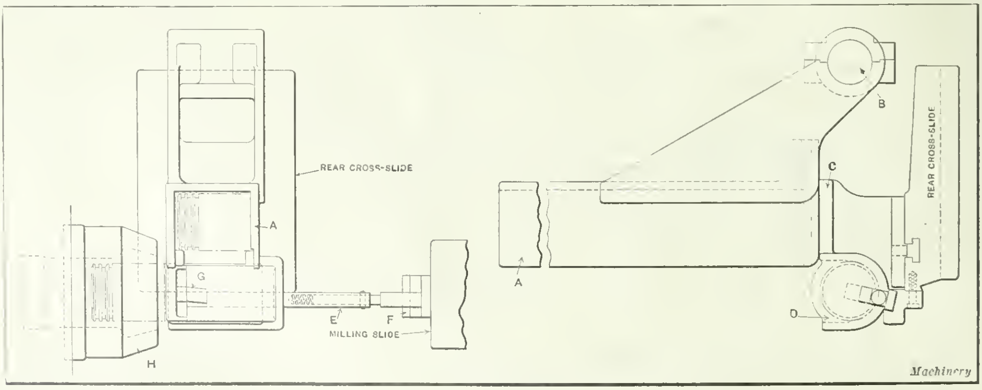

Fig. 7. Arrangement of Mechanism of the Feeding Magazine shown on the Machine in Fig. 6

it is required to stamp out washers and similar shaped pieces from sheet fiber. The small disks cut from the center holes in such parts are available for use in the making of other products, and in Fig. 9 there is shown the magazine feed mechanism used on a Cleveland ⅞-inch Model B automatic screw machine that is employed for the drilling of holes in these salvaged fiber disks. This magazine is mounted on the rear cross-slide of a double slide type of machine, and referring to the illustration it will be apparent that the magazine *A* is constructed from two pieces of angle-iron with retaining strips on the inside, as shown in the cross-sectional view; this construction provides for holding the disks in the magazine when they are dropped in edgewise.

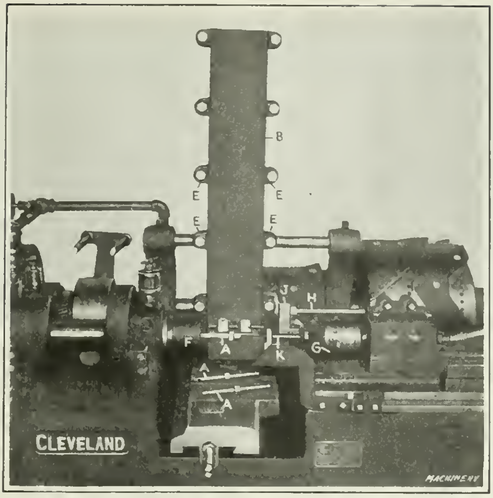

Fig. 8. Seven-eighth-inch Automatic Screw Machine equipped with Magazine for feeding Double-ended Screws to the Chuck in which they are held while performing the Threading Operation

The arrangement of the mechanism for transferring successive pieces of work from the magazine to the chuck is quite similar to that of the magazine shown in Figs. 6 and 7. The movement is derived from the milling slide, and as the cross-slide carries the magazine forward to bring a blank into line with the chuck, a hook on the end of plunger *B* carried by the magazine is engaged by a slot in the milling slide, so that when this slide moves forward, provision is made for advancing plunger *C* that pushes the blank into the chuck. Connection between plungers *B* and *C* is accomplished by a link *D*, and it will be seen that there is a spring compensating device at *E* to adjust for any differences in the thickness of the blanks. After a blank has been pushed into the chuck *F* and the milling slide has returned to its initial position, the cross-slide withdraws magazine *A* and plunger *B* back to their starting point, so that twist drill *G* may be moved forward by the milling slide to provide for drilling a hole in the disk which has been chucked for that purpose.

One of the most interesting features of this blank-feeding mechanism is the provision made for holding the bottom blank in magazine *A* in a vertical position while it is being pushed over into place in the chuck *F*. In the position which it occupies at the bottom of the magazine, the center of this blank is 1/16 inch above the spindle center; and at the left-hand side of the magazine, there is an opening cut through the side plate on an incline, as indicated at *H*. The bottom blank in the magazine is supported by a cradle *I*; and when plunger *C* moves to the left to push this blank into the chuck, the blank is pushed downward by the beveled edge of opening *H*, so that its center comes into line with the center of the spindle.

Cradle *I* is secured to a pivot *J* which also has a short lever *K* secured to it. At its lower end, this lever *K* bears against a plunger that moves back against a compression spring *L*. Hence, when plunger *C* pushes a blank to the left and this blank moves vertically downward, due to the beveled edge of opening *H*, cradle *I* moves downward against the pressure of spring *L*, and after the blank has entered the chuck and plunger *C* has been withdrawn, this spring returns cradle *I* to its initial position. After being drilled, the work is ejected from the chuck by a push-rod.

Magazine for Holding Double-ended Screw Blanks

At *A* in Figs. 8 and 10, there is shown a screw that has a head at the center and a threaded stem at each end. Screws

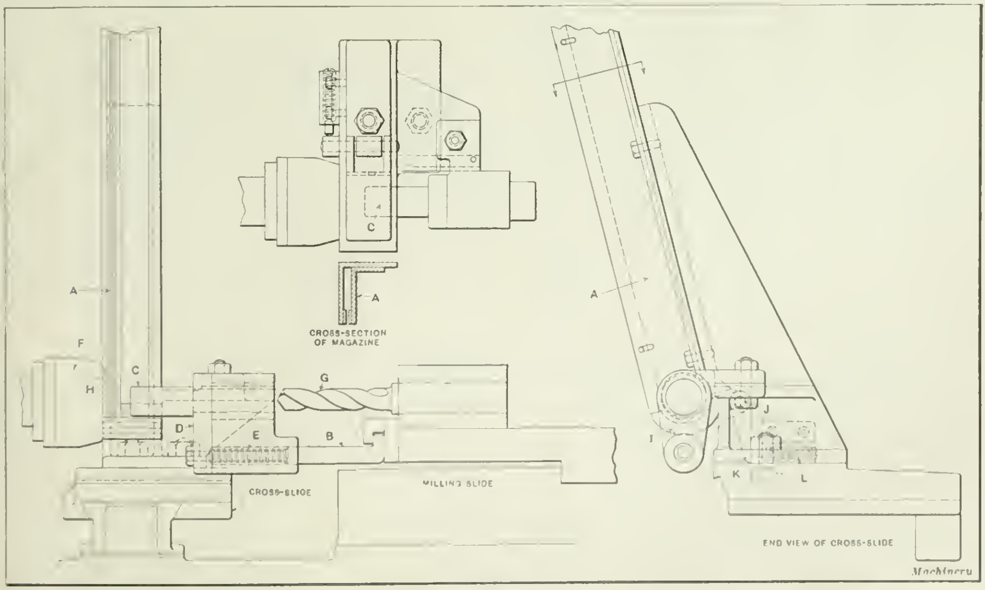

Fig. 9. Feeding Mechanism mounted on the Cross-slide of a Seven-eighth-inch Automatic Screw Machine used for drilling Holes in Fiber Disks

of this type are used for adjusting demountable rims for motor car wheels made by the Kelsey Wheel Co. of Detroit, Mich. Blanks for these screws are delivered to Cleveland ⅞-inch Model B automatics which are employed to cut a right-hand Acme thread at one end and a left-hand Acme thread at the opposite end of the work, two operations being required to complete this threading. It will be seen that magazine *B* is held on a horizontal rod *C* carried by special brackets *D* that are bolted to the tops of the bed arms that support the camshaft.

As in the case of the mechanism for handling Northway pistons illustrated in Figs. 6 and 7, there is a special transfer slide mounted at the rear of the cross-slide and arranged to carry successive blanks forward from the magazine *B* to a position in line with the center of the chuck. Referring to the plan and side elevation of the magazine in Fig. 10, it will be seen that it consists of two strips of metal having grooves planed to two depths down their inner sides, to form a channel that receives the enlarged portion at the center of the work and the stem at each side of the head. At the edges there are lugs *E* through which bolts are passed to hold the two members of the magazine together.

As each successive piece of work reaches the bottom of the magazine, it drops into a cradle and is then carried over into line with the chuck, so that a push-rod on the milling slide can transfer it from the cradle to enable chuck *F* to grip the work by the stem at its left-hand end. The arrangement of the plunger on the milling slide and of the transfer mechanism have been worked out along different lines from the arrangement shown in preceding illustrations. In the present case, it is required to use a die *G* to thread the work, and as this tool is rather bulky it was necessary to mount plunger *H* and the mechanism which it actuates so that it would clear the threading die.

On the transfer mechanism, there is a slide that moves against the tension of a compression spring *I*. This slide carries a projecting arm *J* which engages plunger *H* on the milling slide, when the transfer slide under the magazine has carried a blank forward into line with the chuck. After plunger *H* has come into engagement with arm *J*, this plunger moves the transfer slide over against the tension of spring *I*, and a plunger *K* carried by the slide engages the screw blank that has just been taken from the magazine and pushes it into place in chuck *F*. Spring *L* supports the thrust of plunger *H* and compensates for slight differences in the lengths of the screw blanks. The camming of the cross-slide which carries the main transfer mechanism and of the milling slide is so arranged that after the blank has been placed in the chuck, the milling slide recedes and the cross-slide withdraws the transfer mechanism back into its initial position under the magazine, thus disengaging plunger *H* from arm *J*. Then the milling slide is once more advanced to enable die *G* to cut the required thread on one end of the screw. The finished piece of work is ejected from the chuck by a push-rod *M*, which is actuated from the regular bar feed mechanism by means of positive cams.

As shown in the front view of the mechanism, at the lower left-hand corner of Fig. 10, two V-blocks *N* and *O* hold the screw blank by the ends of its shank. It will be seen that V-block *N* is made in the form of a plunger, supported by spring *P*, while V-block *O* is carried at one end of a pivoted horizontal arm, the opposite end of which engages a compression spring *Q*. When plunger *K* pushes screw blank *A* into chuck *F*, the inclined right-hand side of V-block *N* is engaged by plunger *K*, and the block is pushed downward against the tension of spring *P*. Similarly, the hexagon head at the center of the screw blank, engages the inclined side of V-block *O* and pushes it downward by swinging the horizontal arm about its pivot, against the tension of spring *Q*. When the milling slide is withdrawn, V-blocks *N* and *O* are returned to their initial positions by the action of springs *P* and *Q*. After the threading operation, die *G* recedes and the cross-slide carries another blank forward to repeat the cycle of operations.

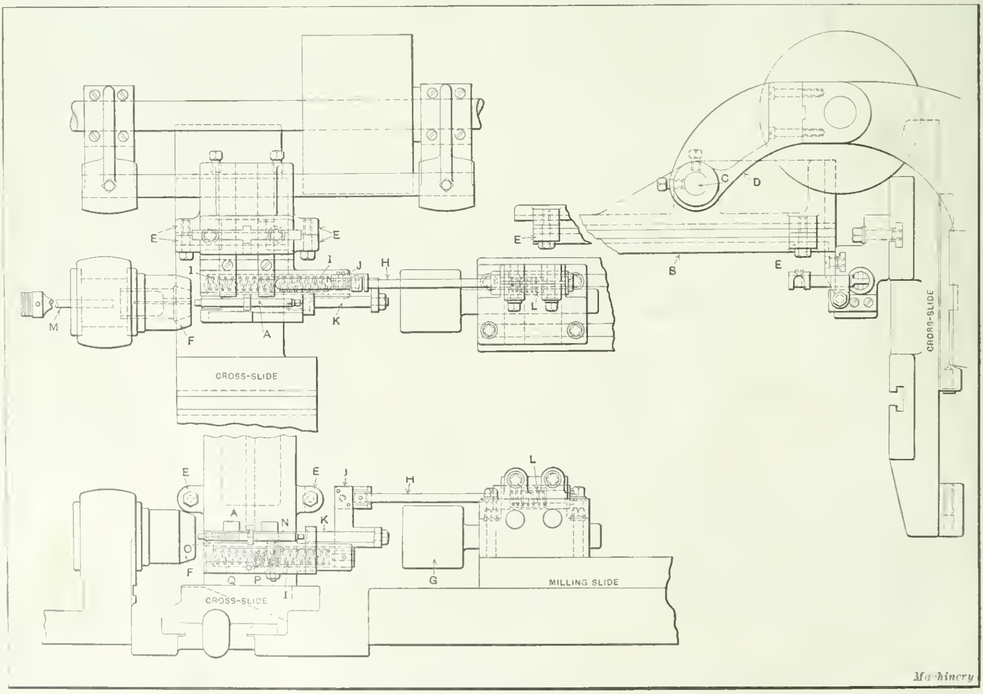

Fig. 10. Arrangement of Mechanism of the Feeding Magazine shown in Place on the Machine in Fig. 8

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Common Causes of Errors in Machine Design

Frictional Losses—Unbalanced Parts—Manufacturing Operations—Assembly—Disassembly—Safety

Third of a Series of Articles

By R. H. McMINN

IN the first two installments of this series of articles, that were published in the January and February numbers of MACHINERY, several important factors that must be considered in machine design in order to prevent errors were discussed. The present article takes up additional points governing the design of a machine, such as frictional losses, provision for lubrication, balancing of parts, manufacturing considerations, assembly, erection, disassembly, and safety requirements.

Frictional Losses

It is not strange that loss of power due to friction in a machine is often overlooked by designers. In mechanical problems, the only definite relation between the force applied at one point in a mechanism and the resistance overcome at another point depends upon the relative distance moved by these points. The friction loss is a greatly varying quantity. In a large number of problems illustrating the laws of mechanics, students are told to ignore friction. The habit is thus acquired, and the geometrical relationships of a drawing do not suggest its consideration. However, there is a friction loss between any two surfaces having either sliding or rolling contact.

The loss in friction in a long train of mechanism including cast-tooth gearing may be 50 per cent or more. A machine having 50 per cent loss thus requires double the power to drive that a frictionless machine would need. The members through which the power is first applied must likewise resist a stress twice as great as in a frictionless machine, and must be increased correspondingly in strength. The efficiency of a single worm and gear may be as low as 50 per cent unless properly designed, machined, and lubricated. It should also be noted that the friction of starting is much higher than running friction, and must be given special consideration for any machine which must start under full load. There is likewise a friction loss in the movement of liquids or gases, such as water or air, in pipes.

Provision for Lubrication

The provision of methods of lubricating surfaces in contact between which there is relative motion and which require lubrication is sometimes overlooked by designers. Some shops do not insist that the location of oil-holes and oil-grooves be indicated on drawings of the parts that require them, but the shop men use their own judgment in this matter. This is bad practice for a number of reasons, but the principal one affecting the designer is that it may get him out of the habit of considering the necessity for lubrication. While the shop can provide means of lubrication in simple cases after the castings and other parts are made, the selection of a proper means of lubrication in some cases radically influences the design of a machine, as, for instance, where the splash method is used or gears run in oil. A designer should therefore always consider the means to be employed in lubricating all necessary parts as soon as possible during design.

Unbalanced Parts

All rapidly revolving elements like disks, wheels, pulleys, drums or cranks should be designed so that their center of gravity coincides with their axis of revolution. If the center of gravity is not so located, centrifugal action will produce a force, constantly changing in direction, acting upon the shaft and bearings of the revolving part, thereby producing additional stresses and vibration. Unbalanced weight in a rolling wheel causes variations in pressure on the track on which it rolls, and transmits shocks to the track.

If the center of gravity coincides with the axis of revolution, the part will have static balance, but it may not have balance while rotating unless it be a thin disk. The condition of running balance is met if the masses in each plane at right angles to the axis balance each other, so that the effect is the same as if a series of perfectly balanced thin disks were centered side by side on a shaft. If the design prevents this condition from being realized, as in a crankshaft, the crankpins and arms should be so spaced along the axis that the moment of force which the unbalanced mass in any plane imparts to the shaft during rotation is balanced by the moments of force which the other masses impart. There will then be no unbalanced pressure on the bearings due to centrifugal force, and hence no vibration from this source. Because of lack of homogeneity of metal or the inaccessibility of certain parts for finishing, each part needing to be balanced should also be balanced by trial after being made, by the removal or addition of metal at the required points.

Reciprocating masses, such as a piston and connecting-rod, also produce an unbalancing effect due to the variations, throughout their stroke, in the force necessary to accelerate them. A vibration is thus produced in the direction parallel to the center line of the engine cylinder. This effect may be altered by adding a weight to the engine crankshaft, so that the vibration in the original direction is eliminated, but there will then be a disturbing force acting at right angles to this direction; or, sufficient weight may be added to the crank so that the effect of vibration will be divided between the directions parallel and at right angles to the center line of the cylinder. Unbalanced reciprocating masses, however, can only be properly balanced by other reciprocating masses suitably arranged. The four-cylinder gas engine has cranks arranged to balance both rotating and reciprocating masses. For the most perfect balancing, the fact that the piston does not have true harmonic motion must be taken into account.

Manufacturing Operations

The designer must constantly keep in mind while designing a machine all the manufacturing processes that must be employed in building it. He may be restricted in the size of casting which can be molded in the foundry where the castings must be made. This may require that a member be made in two parts instead of one. Long cast-iron cylinders are sometimes made in more than one piece, because of the limitations imposed by the equipment of a certain foundry on this class of work. The thickness of material in some parts may have to be made greater than dictated by strength alone, in order to cast the parts properly. The minimum thickness that may be cast without undue care depends to some extent on what class of work a foundry usually handles. This minimum thickness may be one-quarter inch, or as little as one-eighth inch, or even less, being partly dependent upon the material, size, and proportions of the casting.

The shape of certain parts and the manner of finishing them may necessitate their being cast or forged with special lugs or bosses for clamping, chucking, or centering, but which perform no function in the completed machine. Piston-rings of smaller sizes are cut from a cylinder having lugs or a flange on one end for chucking, a number of rings being cut from each cylinder. On some castings a piece may be cast on to prevent warping or to preserve rigidity while being machined, which is afterward sawed or machined off. In Fig. 5 is shown the expanding ring for a clutch, which is cast as a complete cylinder, the dotted portion being cut out after the rest of the machine work is completed.

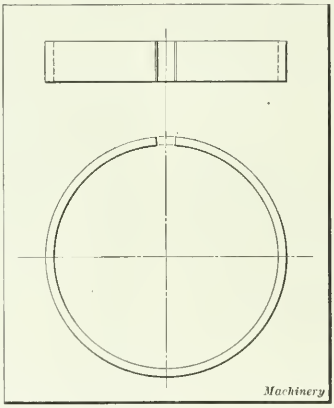


Fig. 5. Class of Work which is first cast as a Solid Continuous Ring and then cut after machining

The minimum size of bolt to use in any place may depend on the minimum diameter that can be satisfactorily cored through a certain thickness of metal. The thicker the metal and the higher its melting temperature, the larger the core that is required to prevent its being burned and thereby making an imperfect hole.

Limitations in size and form of parts which are forged, planed, turned, milled, ground, or finished by any other process must be given careful consideration during design. A limitation may be imposed upon the design of a part, not because it is impossible to make, but because the manufacturer has no machine of a proper size or type by which it may be finished. The bed of a new machine might be first designed with a bracket projecting on one side to support a motor. If it is noted that the largest planer possessed by the manufacturer by whom the casting must be planed is too narrow between the housings to handle this casting with the bracket cast on, probably a pad can be cast on the side to which a separate bracket can be bolted.

If it appears that the contemplated design of any part cannot be modified to meet the restrictions imposed by the manufacturer's equipment, the part can possibly be made elsewhere. If the designer develops a part which has a form apparently essential, and yet does not know from his own experience definite and reasonable methods by which it can be made, he should make no assumptions in the matter, but should take the question up with the manufacturing department.

Method of Assembling—Erection

Assembly is sometimes considered as the collecting of single parts into logical groups, such as the headstock, tailstock, or carriage of a lathe; and erection is taken to mean the assembly of all such groups on a frame or bed to form a complete machine. Assembly will here be treated as the combining of either single parts into groups or groups into a machine, and the term erection will be considered as referring to the assembly of a machine or structure in its final location.

Unless attention is given to how the parts of a machine are to be assembled, serious difficulties may arise. There must not only be proper clearance for all parts of a machine after they are arranged in their intended location, but there must also be sufficient clearance to get them in this location. This clearance should exist not only at one time during assembly but if possible at a logical time. If a small part like a bolt must be put in its place long before the part which it supports, the assembler may overlook placing it at the proper time. If it is a heavy part that must be put in the interior of a machine long before there is anything there to support it, this may interfere with the ready assembly of other parts. When a part is subject to wear, it should be noted that if it requires early assembly to get into place it will probably be difficult to remove and replace it when this becomes necessary.

Small parts are sometimes made so that they must be turned in a special manner in order to obtain sufficient clearance to move them to their intended position during assembly. It is well to avoid the necessity for manipulating a heavy part in a peculiar manner to get it into position. If a part is so heavy that it has to be handled by a crane or other mechanical lifting means during assembly, one should consider whether its shape will permit a hook or chain sling to be attached readily and securely. If not, special holes, lugs, or loops should be provided. Some motors have one or more lifting eyes on the top of the frame. Manholes must often be provided so as to make the inside of a hollow member, such as a boiler, accessible for assembly and other purposes. Hand-holes must be provided in the web of a box-girder (which is hollow) in order to put bolts in any part which must be bolted to the outside of the web after completion of the girder. Sufficient room must be allowed for the application and manipulation of wrenches in tightening all nuts on the machine.

If a machine or structure is being designed especially for a certain purchaser, consideration should be given to whether there may be any modification in design required to insure the easiest erection in its final location. It is difficult to say what the limitations should be on the weight of any single part in relation to the ability to erect it, since the capacity of equipment for handling heavy weights keeps pace with the constantly increasing sizes of machines in general. It is probable that any shipping unit which does not exceed the limits in weight imposed by transportation by rail can be erected by available means.

The portable equipment used by one large Chicago erecting company for its heaviest work has a capacity of 125 tons through a lift of about fifty feet. It consists of two uprights with a cross-member at the top to which the upper rope block is attached, and a winch that can be manually or motor operated. Such rigs are called shear-legs. If the purchase price of a machine includes erection by the manufacturer, the latter should know prior to taking the order whether there is a crane of sufficient capacity serving the space where the machine must be erected, or whether he will have to go to the expense of transporting and returning special erecting equipment.

It would not be economical to request that a manufacturer modify the design of some classes of standardized machines like lathes or drilling machines to suit a space of a certain size or shape in which a concern wished to use a machine of this kind; but other classes such as cranes, conveying machinery, air-hoists, elevators, foundry cupolas, and core ovens are constantly modified to suit the requirements of a particular location. If a furnace or machine is being erected in a position where there will be small clearance between the ceiling or the walls and the machine, special attention must be given to seeing that all parts can be placed in their proper position before that position is made inaccessible to an erector by lack of clearance. If possible to avoid, no member likely to need replacement should be placed where there is so little clearance that its removal will require a radical dismantling of the machine. It should also be noted that the amount of overhead clearance may affect the permissible methods of erecting a machine and therefore, possibly, its design.

Likewise, if it be required to erect any equipment such as an elevator and guides in an enclosure like a brick well, no vertical member must be so long that it cannot enter the opening in the well and be brought to position. It is evident that a knowledge of erecting conditions is necessary in order to be sure to meet erecting requirements.

Designing for Safety

A machine should be made as safe as possible for the operator or any others who may come in proximity to it. Safety requirements should be anticipated by the manufacturer when possible instead of having a state factory inspector demand the addition of safeguards. Sometimes designs are submitted to the state inspection department before a machine is built. Projecting revolving parts are dangerous because the clothes of the operator may be caught on them. Any parts to which the operator is exposed which have a variable clearance between them, as between a punch and die during operation, may be a source of danger, and if so should be guarded, if it is in reason to accomplish this. All gears on power-driven machines by whose teeth an operator or anyone coming close to a machine might be caught should be covered, at least on the periphery, and preferably all over.

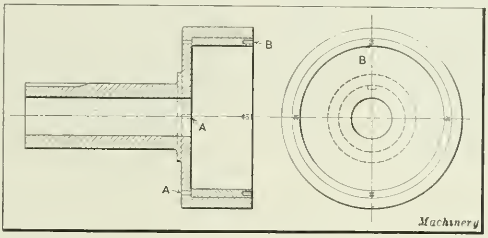


Fig. 6. Design showing Provision for Removal of Bushing

The possibility of accidentally starting a machine by a hand, foot, or weight of the body when another member is in a dangerous position should be guarded against if possible. Protection should be provided against the operator's slipping, falling and grasping a moving part, and having his hand drawn between two parts, such as a belt and pulley or chain and sprocket. An analysis of what would happen if any part of a machine were to become loose or be broken would suggest the necessity for other safety devices.

Provisions for Disassembly

Attention should be given to the disassembly of some parts of a machine which may be difficult to remove because of the method by which they are fastened to or associated with other parts. It is legitimate to rivet together the structural parts forming a crane girder, or to weld parts forming one-half of a gear-case, because the units composing the larger parts will not, as far as can be foreseen, have to be removed singly. However, when a part may have to be separated from another in the future for any reason, the two should not be welded or riveted together.

If the head of a bolt is not accessible during the tightening of the nut it is a good plan to have at least one side of the bolt head come against a shoulder. This is a convenience in the original tightening, but is particularly valuable if the threads become somewhat rusty after use, since it keeps the bolt from turning when attempting to loosen the nut. A plain countersunk-head bolt cannot be held in this manner. Unless the head can be held with a chisel, the nut may have to be cut off to remove it.

Frequently a gear is mounted on a shaft with its hub running against a solid bearing, and sometimes the gear must be removed from the shaft before the latter can be slid out of the bearing. If a taper key is used in the gear, the key must have a gib head in order to pull it from the hub, as the attempt to force the gear off the shaft will tighten it on the key. If a bushing is driven into a hole which has a solid bottom, special means are often provided to assist in removing the bushing from the hole. A projecting shoulder around the top of the bushing is best, if permissible. Sometimes small holes are provided beneath the bottom of the bushing, so it may be driven out, as at *A* in the expanding ring clutch shell shown in Fig. 6. Other times tapped holes are provided around the outside edge of the bushing into which small screws may be inserted to pull the bushing out as at *B*. Unless thought is given to how the parts of a machine can be disassembled, a difficulty may arise at a most unexpected place.

The fourth installment of this series, which will appear in the April number of MACHINERY, will treat of the following points to which a designer should give attention: Manufacturing cost; transportation of machines; and compactness and appearance of machines.

* * *

A valuable addition to the regular courses has been made at the Sheffield Scientific School of Mechanical Engineering at Yale University; the new course, initiated this year as part of the four-year curriculum in the engineering school, is intended to familiarize the student with engineering as a profession, the object being to give him a comprehensive perspective of the work for which he is fitting himself. The course explains in detail the character of the work in which civil, electrical, mechanical, and mining engineers may expect to engage, and serves the purpose of showing the student that the subjects contained in the prescribed engineering course are basic and essential to his development and success as an engineer, and of immediate use to him in the more advanced courses that he is later to pursue. This is a commendable departure in engineering education. In the past, all education has been based on the general principle that the student should accept what he is taught, and study without question the course selected for him. By giving the student a comprehensive view of the whole course at the beginning and showing him the interrelation of the different subjects to the actual work that he will perform later in the industrial and commercial activities for which he is fitting himself, his interest will be enlisted and he will also be better able to grasp the requirements of an engineer in practice.

* * *

The scarcity of coal in Europe has added interest to the development of the coal resources at Spitzbergen. Swedish and Norwegian companies are interested in coal mining in these northern islands, and while the output as yet is comparatively small, it is expected that from the mines worked by the Swedish company alone, 72,000 tons will be shipped during the present year. If no new coal resources are discovered in Europe, it will be necessary for Europe to obtain from the United States a large portion of its coal supply.

Dies for Electrical Terminals and Connectors

By JOHN A. HONEGGER

THE dies shown in the accompanying illustrations are employed in the manufacture of connectors or terminals for the wires of electric lighting units. The follow-die in Fig. 2 is employed in the production of terminals, one of which is shown completed at *B*, Fig. 1, and at *A* as produced by the die mentioned. The stock used in making this terminal is soft strip brass, 0.035 inch thick and ⅜ inch wide. The operations are piercing, blanking, and forming, and are performed in an inclined press. The stock is fed in from the right until it strikes stop-pin *B*. On the downward stroke, piercing punch *C* pierces the 0.374-inch hole, punch *D* trims the rounded end and severs the blank from the strip, after which forming punch *E* forms the terminal to the shape shown at *A*, Fig. 1.

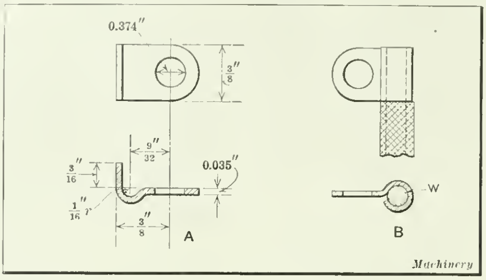


Fig. 1. Work produced by Dies shown in Figs. 2 and 3

On the return stroke, pin *F* ejects the work from both punch and die, and the part slides out at the back of the press. The die is made in two parts in order to facilitate grinding the piercing and blanking part *H* without destroying the shape of the forming portion of part *G*. The blanking punch is kept from turning by means of pin *I*, while the punch and die are kept in alignment by guide pins *J*. Sheet-steel guards *K* and *L* are fastened to the feeding side of the die to protect the operator against injury when feeding the stock to the die. The second operation, that of curling and clinching piece *A*, Fig. 1, over the wire as shown at *B*, is performed by the die shown in Fig. 3, which is mounted on a foot-press. A terminal is placed over pin *B*, after which a wire *W* is put in the terminal, where it is located endwise by stop *C*. On the downward stroke, the upright portion of the terminal follows the outline of punch *D* and is therefore curled over and clinched as at *B*, Fig. 1. Two terminals are clinched on each wire.

Piercing, Trimming, and Forming Die for Connector

In Fig. 5 is shown the first of a series of three dies used in the production of the finished connector shown in the

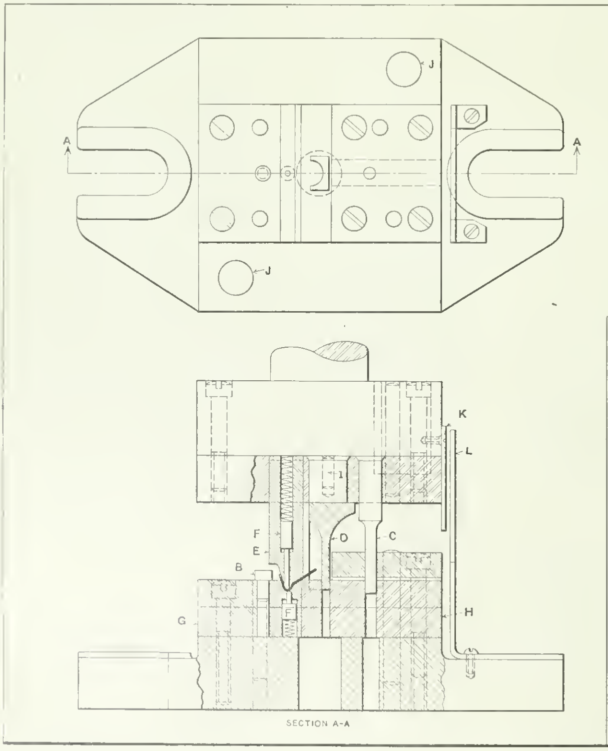


Fig. 2. Piercing, Cutting-off, and Forming Die for Work shown in Fig. 1

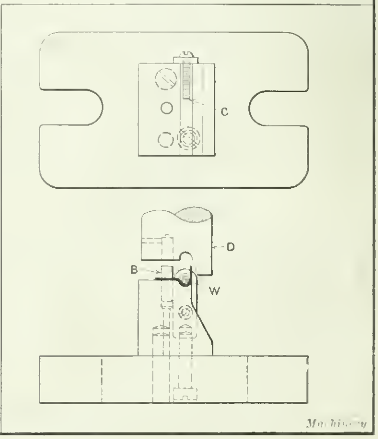


Fig. 3. Curling and Clinching Die

upper right-hand corner of Fig. 6. The stock is 0.032- by 13/16-inch soft strip brass. The operations performed by the die shown in Fig. 5 produce the part as shown in the upper right-hand corner of this illustration. The die pierces the 3/32-inch hole, cuts the two 1/16- by 9/16-inch slots, trims the end of the blank, severs the part from the strip, and forms it to the shape shown. The operations are performed in an inclined press, the stock being fed from the right until it strikes stop *D*. On the downward stroke, punch *E* pierces the 3/32-inch hole and the two 1/16- by 9/16-inch slots, which are blanked out when the end is trimmed. Punch *F* severs the stock and trims the end, after which punch *G* forms the connector to the shape shown in the enlarged view. On the ascending stroke, knock-out *H* ejects the part from the die. Should the parts stick to the punch, the tongue on gage *D*, acting as a stripper, will remove the piece so that it will slide out at the back of the press. The punches are kept in their proper positions by pins *J*, while the punch and die are kept in alignment by guide pins *K*. Sheet-steel guards *R* and *S* are placed on the feeding side of the die.

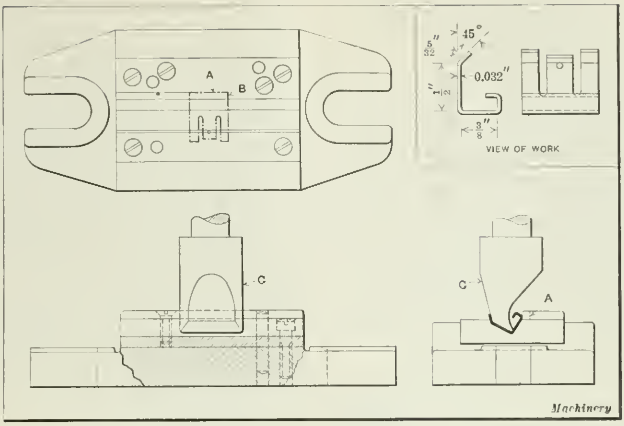


Fig. 4. Die for Second Forming Operation on Connector

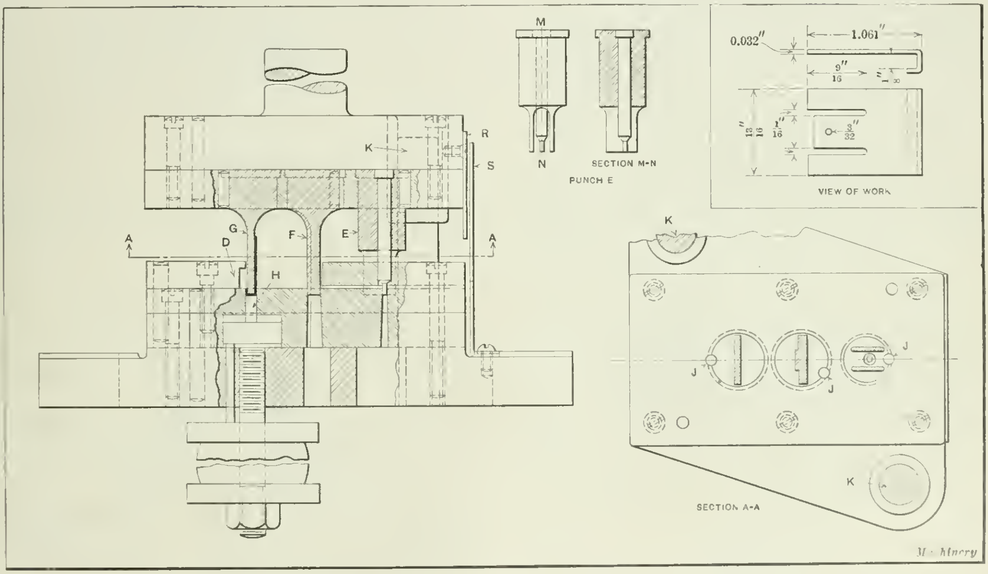


Fig. 5. Die for piercing, cutting off and forming Connector shown completed in Fig. 6

In Fig. 4 is shown the die used for the second forming operation on the connector. This operation is performed in a foot press. The double-bend portion of the blank is placed in recess *A* and against edge *B* as indicated by the dot-and-dash lines. Punch *C* forms a blank to the shape shown in the enlarged view. In Fig. 6 is shown the die that performs the third and final operation on the connector. This die is

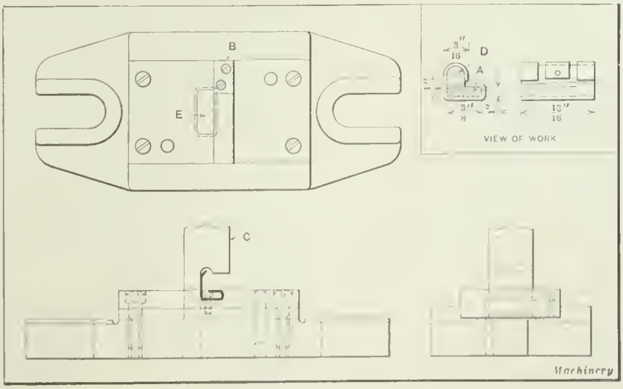


Fig. 6. Die for curling and clamping Connectors

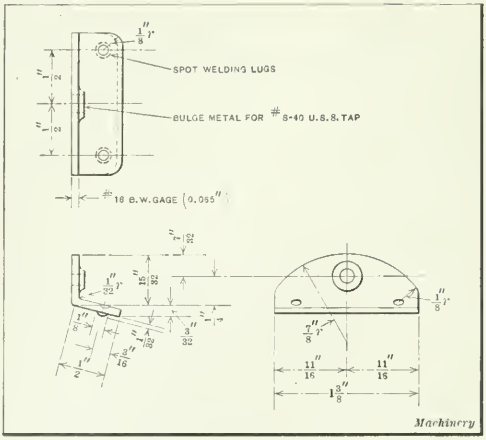


Fig. 7. Band Clamp End made from Cold-rolled Steel

also mounted on a foot press. A rectangular piece of conductive material *A*, as shown in the enlarged view, is inserted in the oblong space, and the blank is then set into the recess *E*, against stop *B*. Another piece of conductive material *D* is placed in the upper part of the connector after which punch *C* curls the end of the connector over piece *D*.

Dies for Making Band Clamp Ends

The first of a series of three dies for producing the band clamp end shown in Fig. 7 is illustrated in Fig. 8. The stock used for these clamps is 0.065 inch thick medium hard cold-rolled strip steel 1⅜ inches wide. The die embosses two spot-welding lugs; pierces a hole; trims the front end; severs the blank from the strip; and curls up metal for the boss. The operation is performed in an inclined press, the stock being fed in from the right until it strikes the first finger-stop *B*. Punches *C* emboss the two spot-welding lugs; punch *D* pierces the hole; and punch *E* partially trims the front end. After these operations have been performed, stop *B* is released, and the second finger-stop *F* is pushed in; the stock is then fed forward until it strikes stop *F*. Punches *C*, *D*, and *E*, then perform the same operations on the second blank. Stop *F* is next released, and the stock fed forward again until it strikes against stop *G*. The front end of the blank is then completely trimmed and severed from the strip by punch *H*, the piece being pushed down into die *K* until it is forced over the spreading punch *L*. Spring-actuated pilot *M* locates the blank so that the hole is kept central over the spreading punch *L*, and at the same time insures the accurate cutting off of the blanks. On the ascending stroke, knock-out *N* forces the blank from die *K*, while the ejector *O* forces the blank from punch *H* should it become stuck in the upper member. The blank slides out at the back of the press. This die is also furnished with sheet-steel guards as shown.

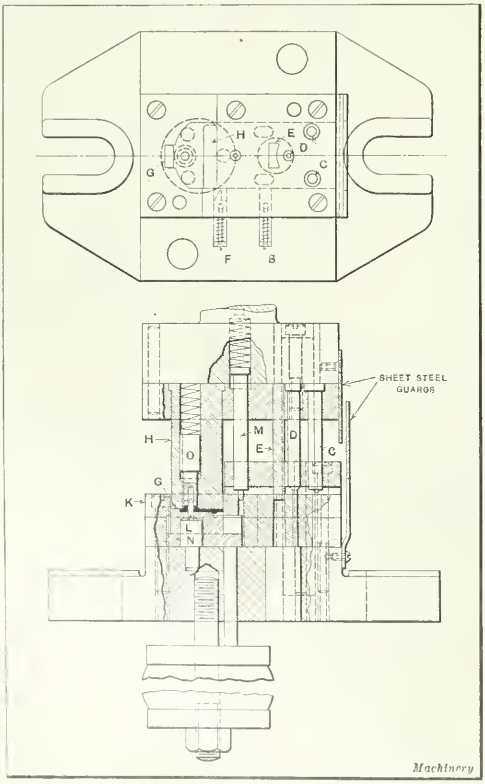


Fig. 8. Embossing, Piercing and Severing Die

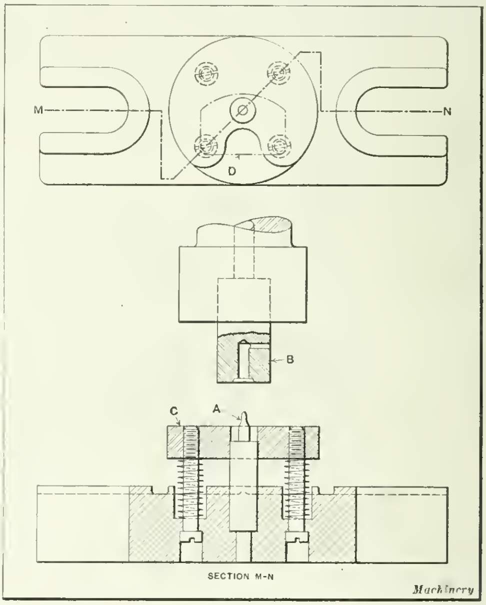


Fig. 9. Die for sizing Hole and swaging Boss

In the illustration Fig. 9 is shown the die that is used for performing the second operation on the band clamp. This operation is performed in a straight-back power press. The blank is placed over pin *A*, and as the ram descends, punch *B* forces the blank over pin *A*, thus accurately sizing the hole. The boss is swaged to shape against the shoulder on this pin and the formed recess in punch *B*. Stripper *C* strips the blank from pin *A* on the ascending stroke of the ram. It will be noticed that the stripper is cut away at *D* to facilitate removing the piece.

In Fig. 10 is shown the die employed for the third operation on the band clamp, which is performed in a foot press. The blank is placed in the recess of gage *A*, and on the descending stroke punch *B* bends the clamp to the shape shown at *E*. The die is relieved at *C* to form a clearance for the spot-welding lugs, while the punch is relieved at *D*

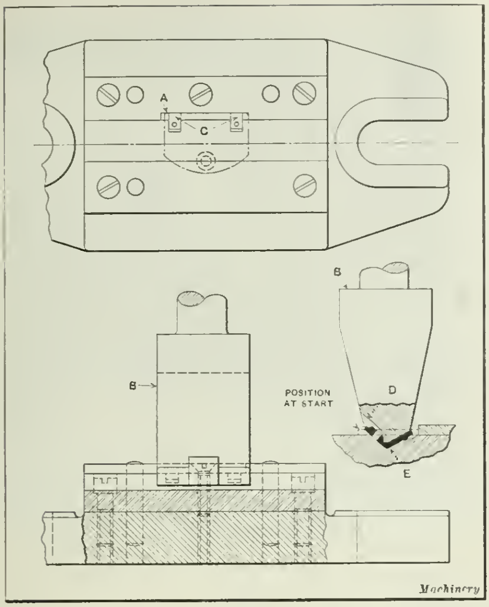


Fig. 10. Die for making Bend in Band Clamp End

in order to clear the boss. The working end of the punch presents a continuous surface, so that no irregularities or nicks are noticeable in the apex of the bend when the blank is formed.

* * *

ACETYLENE-DRIVEN AUTOMOBILES

Experiments were made with acetylene for driving automobiles in Switzerland several years ago, but the trials do not appear to have been satisfactory under normal conditions, according to an article recently published in *Engineering*, as when Zurich was visited in the autumn of 1919, not one acetylene-driven automobile could be found. However, Professor F. Haber, at the request of the German Government, has been experimenting with acetylene for driving a four-horsepower stationary motor and a twenty-horsepower Fiat automobile. He has found that it is difficult to get the maximum power with pure acetylene, because a third of the air is not really required for the combustion, so that it is dragged as ballast through the engine, and, therefore, the admixture of some other fuel is advisable. The fuel is then less ready to ignite, so that preignition is eliminated and, in addition, the fuel gives more heat per unit of time. By using a throttle mixer, the quantity of fuel mixture is varied, while the percentage of acetylene is kept constant. Since the adoption of this device, the automobile used in the experiments has run well on acetylene fuel.

* * *

HUGE BRONZE CASTING IN CHINA

In a recent lecture on the industry and progress of China, given by John R. Freeman, past-president of the American Society of Mechanical Engineers, and now connected with the Massachusetts Institute of Technology, mention was made of a mammoth hollow bronze statue 40 feet high and 20 feet wide which stands in a small town in the southern part of China. A casting of this size is believed to be beyond the capacity of any foundry today. The exact method followed in pouring it is unknown, but it is thought that the mold was built up in sections on the actual site of the statue, each section being added as the pouring progressed.

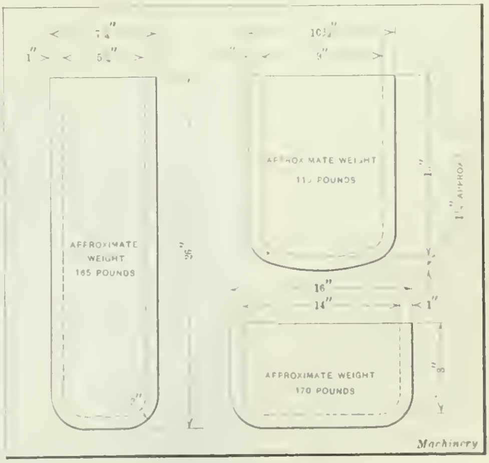
MANUFACTURE OF SEAMLESS STEEL TEMPERING POTS

To secure the required tempers in the manufacture of drills, saws, files, cutters, and other tools and fine mechanical parts, it is often necessary to bring the steel to the required temperature in molten lead, previous to immersion in the quenching fluids. The lead is usually contained in strong metallic cups known as tempering pots. These are generally made of open-hearth steel by a process of hot-punching and drawing, or by employing hydraulic machines especially designed for such work. Tempering pots made of cast iron or cast steel are not used where uniform results are the absolute requirement or where the workman's safety is fully considered. Pots made of wrought steel have supplanted the older types of pots because of the efficiency, economy, and safety which they represent.

In manufacturing a "Shelby" seamless steel tempering pot, a flat plate of open-hearth steel is trimmed to the shape of a disk and put in a furnace, where it is raised to a suitable temperature for pressing. At the proper heat it is withdrawn and placed in a heavy hydraulic press where a plunger, working in connection with a die, punches or forms the flat plate into the shape of a rough shallow cup. In this operation, the walls of the cup are left in a thick, somewhat irregular condition, and the bottom is not smoothly rounded at the corners.

To correct these features and to give the cup or pot its proper length, shape, and wall thickness, it is reheated, and when at suitable temperature it is pushed through another die, which gives the dimensions and finish required. The volume of metal, size of plungers, dies, etc., are so calculated as to give a slightly greater wall thickness at the bottom of the cup where the heaviest duty is required than at other points of the wall. The dimensions of three seamless steel tempering pots, as regularly manufactured by the National Tube Co., Pittsburg, Pa., are shown in the illustration.

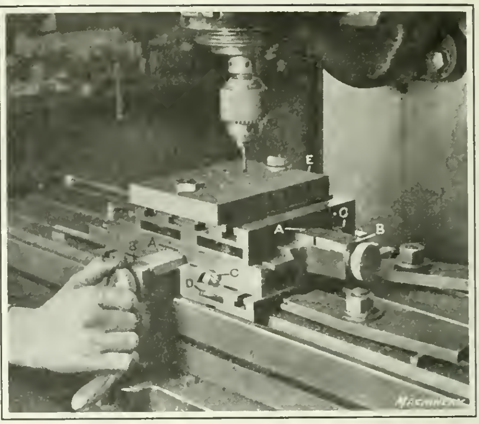
Seamless steel tempering pots, being made of homogeneous steel plates and formed under tremendous hydraulic pressure, are free from the blow-holes or sand defects sometimes found in castings. The service, therefore, is not only longer but more efficient than that given by pots of non-uniform material. The walls, being of uniform thickness and relatively thin for the strength involved, permit uniform distribution and quick transmission of heat to the substance placed in the pots. These pots are strong, yet relatively light, due to minimum cross-sectional wall area which is permissible because of the physical properties of the steel used.



Approximate Proportions of Commercially Manufactured Tempering Pots for Lead Furnaces

Using Compound Slide in Jig and Die Making

How the Johansson Compound Slide is Used in Tool-room Work, Especially in the Laying out of Accurately Spaced Holes



IN locating holes in master plates, dies, and jigs, there are various ways of doing the work, prominent among which is the familiar button method. The button method, however, which, when accurately applied, will produce the desired results, is at best slow and susceptible of cumulative errors. In addition, for work of this kind, the toolmaker must be a man of experience and should possess something more than mere toolmaking skill, for he must be patient and extremely careful; otherwise, the likelihood of error is great and the results correspondingly costly. The button method, therefore, has been to a large degree supplemented by the gage-block method of spacing holes. This method is recognized as both accurate and rapid. By the gage-block method is meant the practice of using parallels carefully adjusted at right angles on the faceplate of a lathe or machine table to locate the work from a previously finished side, and building up by means of standard gage-blocks.

This procedure is a somewhat awkward one, for it is necessary to unclamp and clamp the work with each shift of position; and this fact probably accounts for the size-block method not being generally adopted. But this method was the forerunner of a device for using gage-blocks in conjunction with two accurately machined slides, located at 90 degrees to each other, the combination of these two slides being known as a compound slide.

Construction of the Johansson Compound Slide

The compound slide, made by C. E. Johansson, Inc., Poughkeepsie, N. Y., is a ruggedly constructed precision tool, having a substantial base, which may be attached conveniently to the machine table or faceplate of a lathe and which supports two accurately machined slides. These slides are each operated by a knurled adjusting screw for sliding them on the dovetail slides of their respective supporting members. The construction may be seen in the heading illustration, which shows the slides positioned by means of suitable stacks of gage-blocks located between hardened steel buttons *A* and suitable rest pads *B* against which the slides are drawn by the operating screws. When in use, the position of the work is held fixed by locking the slides by means of screws *C*.

T-slots and clamping bolts are employed for clamping work to the top slide. In the base of the tool are gashes such as shown at *D* for convenience in securing the base to the machine. Each slide has a range of 3½ inches. The top plane is 7½ inches square, and the distance from its top surface to the under surface of the base is 3½ inches. The weight of the fixture is 55 pounds.

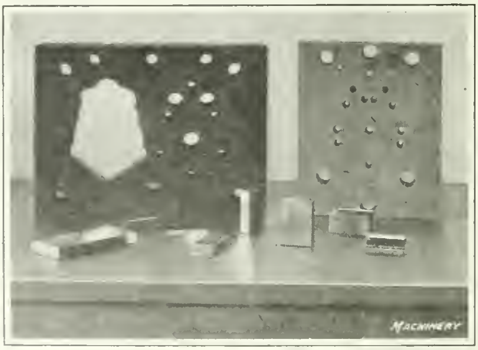


Fig. 1. Master Plate and Die produced from it

Uses of the Slide

In cases where the holes bear a certain relation to a finished side of the work, the button method must, of course, be resorted to in locating the first hole; but in the majority of cases this is not the condition, for the holes are usually spaced in accurate relation to each other rather than from a finished side. When it is necessary to locate the first hole from a finished side, the hole is laid out, drilled, and the button attached, as shown in Fig. 2; the button is then indicated preparatory to boring the hole to size. In this illustration, the slide is shown mounted on the table of a Van Norman duplex milling machine with the work secured to the upper slide and a "Last Word" indicator, made by H. A. Lowe, Cleveland, Ohio, carried in the drill chuck, as when truing up the button.

After this has been done, gage-blocks are laid in between the pad and button on each slide, and the position is secured by means of the previously mentioned locking screws. All other holes in the work can then be located directly and without the further use of cut-and-try methods. The location of the remaining holes in the work is accomplished by simply changing the over-all dimension of the stacks of blocks so that the slides may be located against them and locked in their new positions.

Frequently, the location of holes is indicated on the drawing by the use of dimensions and angles, in which case a simple trigonometric calculation must be made to determine the movements necessary to bring the work to the desired location. In Fig. 3 a Van Norman milling machine is shown equipped with a Marvin & Casler offset boring head and a twin-screw drill chuck for holding the single-point boring tool used in finishing the drilled hole, by means of which the button was formerly attached. Another application of the compound slide is shown in Fig. 4, with the tool clamped to the faceplate of a lathe. The possibilities of the tool for accurately locating work which is to be drilled or

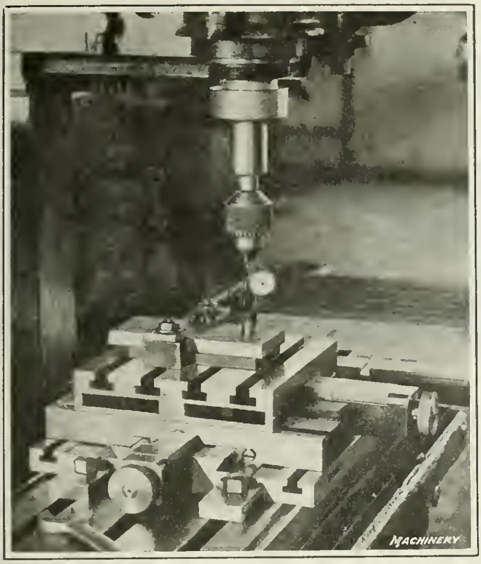


Fig. 2. Using Indicator for truing up a Button before boring the First Hole

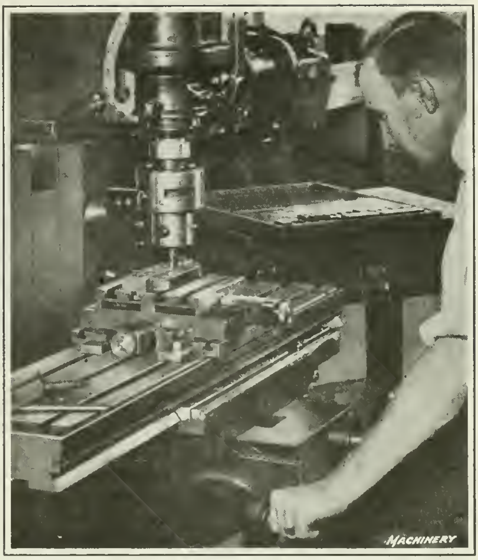


Fig. 3. Boring Holes on a Vertical Milling Machine, using the Compound Slide

bored with the aid of the lathe tailstock should be apparent, in view of the preceding description of its use on a vertical machine. In cases where a milling machine is not available for use, or in shops where work of this kind is regularly done in a lathe, the same degree of precision can be realized as in the case of the milling machine. The only precaution that should be taken in this connection is to see that the faceplate is of sufficient diameter to accommodate the slide so that it will not interfere in its rotation with the clearance space between it and the ways of the lathe.

Master plate work in the making of jigs, fixtures, and dies is usually conceived of as a class of work that must be performed by high-priced and skilled toolmakers. Without the use of fool-proof means for obtaining the accurate location of the work relative to the tool, this is true, but with the Johansson compound slide an economy in labor can be effected. Any ordinary mechanic can produce work with a much higher degree of accuracy and in less time by the use of the slide than a skilled toolmaker could under any of the commonly used locating methods. There is eliminated by the use of this tool the possibility of misreading graduations, the likelihood of errors resulting from play in the lead-screw, or the development of lost motion from other causes.

It is evident that in cases where the holes can be drilled without regard to their location from the finished surfaces of the work, all that is necessary is to establish approximately the location of the first hole, bore it, and then proceed directly to adjust the slides to correspond with the dimensions on the drawings. There are cases where the use of the button method is not feasible owing to lack of space or other conditions peculiar to the design of the work, and in such work the compound slide is invaluable.

Making Master Plates for Dies

The heading illustration and Fig. 1 show, respectively, the use of the slide and the appearance of the work produced on it in the plant of the Star Tool & Mfg. Co., Chicago, Ill. The heading illustration shows the slide set up on a Kempsmith universal milling machine with a master plate *E* attached to the top slide, and the boring tool used in machining the holes. This master plate was used in making a die employed in the manufacture of a lubricating pump of this company's manufacture. The master plate is used to locate all the holes, and irregular openings in the work. In Fig. 1 there is shown at the right a master plate, and at the left a die made from it. The time required to make the master plate, including locating, drilling, and boring the holes was six hours, and it is stated that the holes were located to within limits of plus and minus 0.0001 inch. It is believed that this degree of accuracy could not have been maintained if the compound slide had not been used, and also that it would have taken about twenty hours to have performed the work even with a less degree of accuracy. In this case, a machinist not only performed the usual high-grade work of laying out the holes, which ordinarily would have been done by a first-class toolmaker, but he also drilled the holes in the work all at one setting, thereby resulting in a considerable saving both in time consumed and in wages per hour.

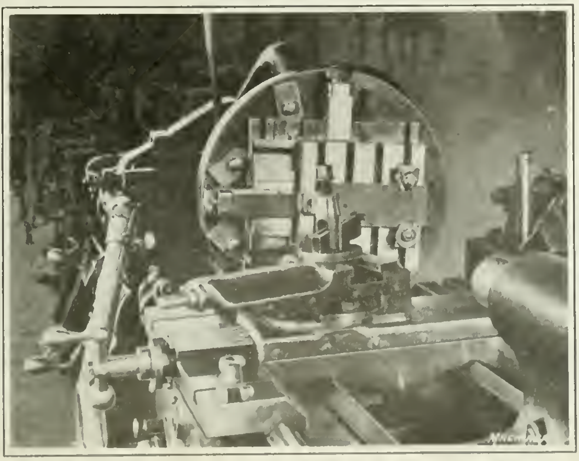
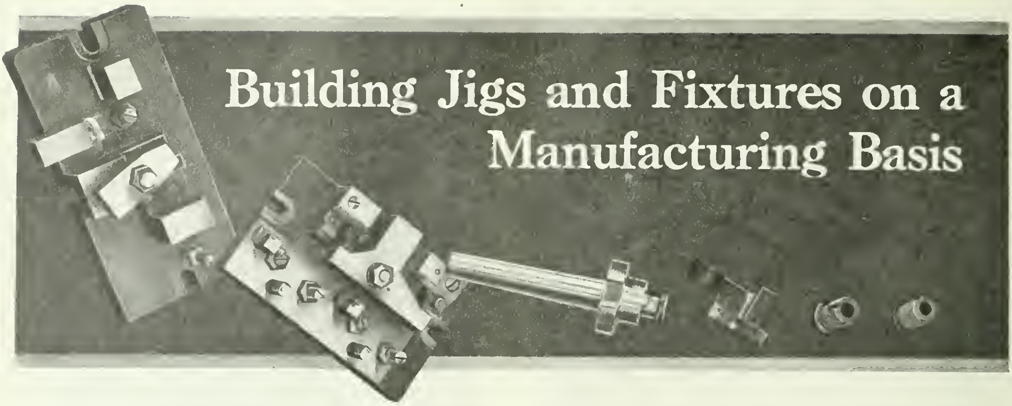


Fig. 4 Compound Slide used on a Lathe by attaching it to the Faceplate



Building Jigs and Fixtures on a Manufacturing Basis

Standardizing Various Details to Permit of their Production in Quantity at a Reduced Cost

By W. H. VOCKELL and H. C. UIHLEIN, The Cincinnati Engineering Tool Co., Cincinnati, Ohio

THE usual method of making the details entering into the construction of special tooling equipment is to design and machine each detail in the same manner as the more important parts of the equipment. That this is extremely wasteful and costly, on account of the high wages paid to labor at present, will be apparent from the facts presented in the following article, which describes the practice of the Cincinnati Engineering Tool Co., Cincinnati, Ohio. This concern has eliminated a large amount of the unnecessary time customarily involved in the design and building of jigs, fixtures, and similar equipment, by standardizing the more common details, manufacturing them in large lots, and withdrawing them from stock when required in the assembly of a jig or special fixture. While only milling fixtures are considered in this article, the principles laid down have also been applied to other equipment.

Example of Saving Effected by the Separate Manufacture of Common Details

Before deciding upon employing the method of manufacturing certain details in lots, a considerable amount of research work and calculations of machining costs were made, in order to determine whether the labor and money saved by the method would warrant the development of a line of standard details that would be applicable to various types of equipment. The following facts were revealed by this investigation and study: First, that, in general, 60 per cent of the details entering into the construction of a jig or fixture can be standardized; therefore, this percentage of parts can be machined in manufacturing lots and kept in stock for use as required. Second, that the average part can be machined in manufacturing lots at about 10 per cent of the labor cost involved when it is machined special for a job. Third, that to machine the main parts of an equipment takes only about 25 per cent of the total machining time required when all of the parts are made special for a job.

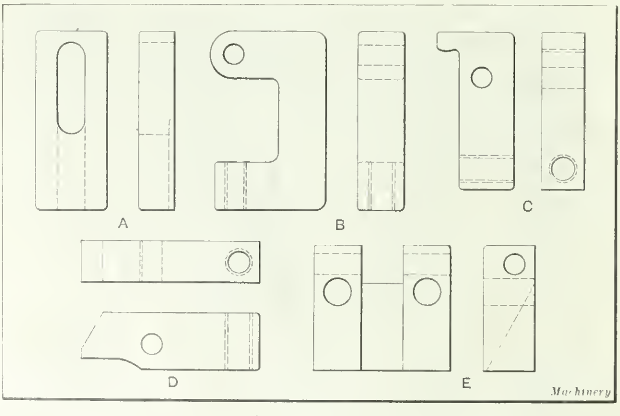


Fig. 1. Various Styles of Clamping Dogs applicable to Many Types of Tooling Equipment

The investigation did not include a consideration of the assembling time of an equipment, as it appeared that this factor would remain approximately the same for both methods of manufacture. However, actual results have proved that the assembling time is also shortened when certain details are standardized and manufactured in lots, this advantage being due to the fact that the parts are usually machined more accurately and that the workmen acquire greater skill by the repeated handling of identical parts. In order that an idea may be obtained of the saving in money corresponding to the saving in labor made according to the foregoing analysis, let it be assumed that the total labor cost of machining a complete fixture by the generally used manufacturing method is $500. A calculation can now be readily made of the amount of money saved when the majority of the details employed in such an equipment have been standardized and are manufactured in lots.

The third fact presented in the analysis is that 25 per cent of the total labor cost involved in the making of a jig or fixture may be charged to the machining operations on the main parts of the equipment. Thus, the cost of making the details by the method usually employed, that is, making each part special to suit the fixture, would be 75 per cent of $500 or $375. Next, according to the first fact, about 40 per cent of the details cannot be standardized, and 40 per cent of $375 equals $150. Subtracting this amount from $375 leaves $225, as the amount which the details that can be standardized would cost if made special for the job. The second fact in the analysis is that the cost of

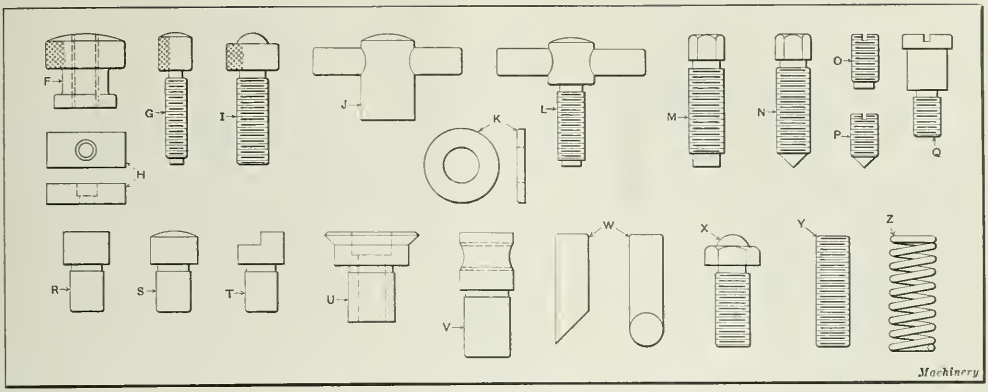


Fig. 2. Standardized Details made on a Manufacturing Basis for Use on Jigs and Fixtures

making standard details is only 10 per cent of the cost involved in making them special. Thus, 10 per cent of $225 is $22.50, which is the cost of producing the standard details in large quantities. Hence the saving in money on the $500 fixture resulting from standardizing the majority of details and then producing them in large quantities is equal to $225 minus $22.50, or $202.50.

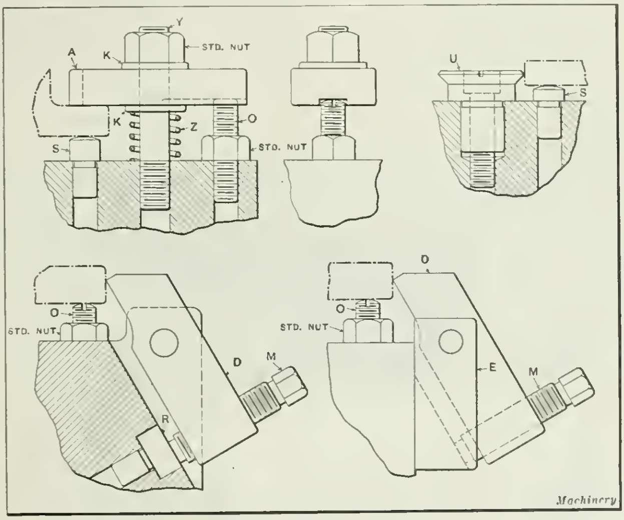


Fig. 3. Units developed from Standard Details which greatly reduce the Time spent in the Design and Detailing of Equipment

In Fig. 1 are shown a number of styles of clamping dogs commonly used in jig and fixture construction, and which are considered as standard detail parts, while Fig. 2 shows a large variety of other standard detail parts. All the parts in both illustrations are made in large quantities and used as the occasion demands. Various types are given different stock numbers, and each one is carried in a sufficient number of sizes to cover the entire field for which it is intended.

The advantages derived by manufacturing standard details in large quantities are actually greater than shown in the cost figures presented. The saving in the designing time has been entirely ignored, but, as a matter of fact, this saving is worthy of consideration. Standard units can sometimes be made up from the standard details, each unit being developed to perform a function common to most types of fixtures, such as for instance, a clamping arrangement. A number of such units are shown in Fig. 3 in which the reference letters refer to the standard details illustrated in Figs. 1 and 2. This illustration shows clearly the purposes for which some of the standard details are intended. Usually at least one of these standard units is applicable to the construction of an equipment, the result being a saving of all the time that would otherwise be expended in working up a device suitable for performing the function that is satisfactorily taken care of by the standard unit.

Another item that greatly reduces the cost of a fixture is the elimination of the necessity of making a drawing for

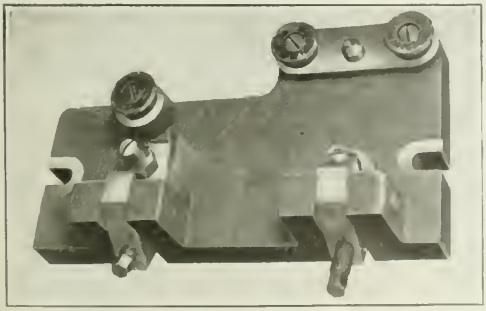


Fig. 4. Fixture on which practically all the Details are Standard and have been taken from Stock

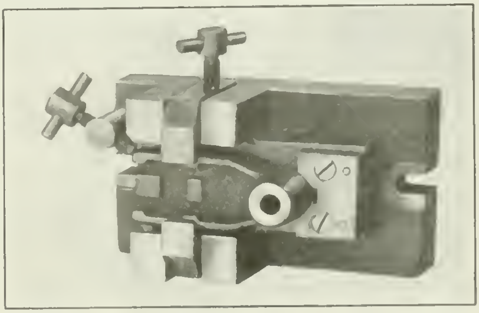


Fig. 5. Milling Fixture with Work in Place, illustrating the Use of Clamping Dogs C, Fig. 1

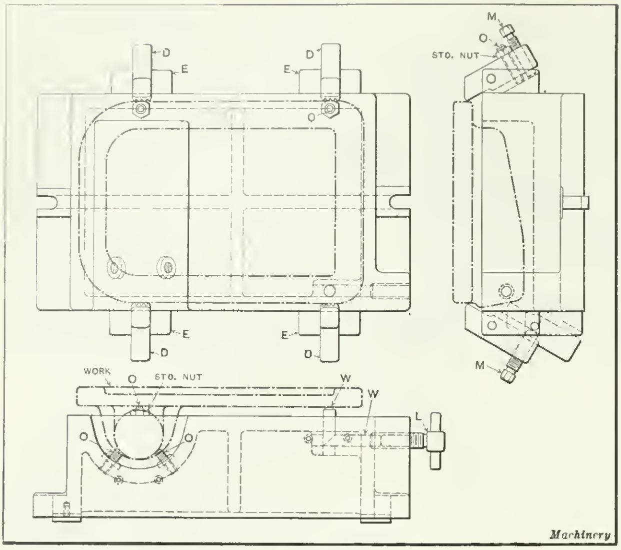


Fig. 6. Preliminary Drawing of a Milling Fixture developed for a Customer, in which Standard Details are used

each individual detail. After the preliminary design of an equipment has been developed, it is only necessary to detail the main parts entering into the construction, and those particular details which are not standardized, as all the standard parts may be called for on the preliminary drawing by the use of designated part or tool numbers. Continued study directed toward improving the various standard details also tends to improve the general design of an equipment, and in this way such designs are worked out to a finer degree than is probable when all the details are developed special for each job. The advantages of such a possibility will at once be apparent to toolmakers.

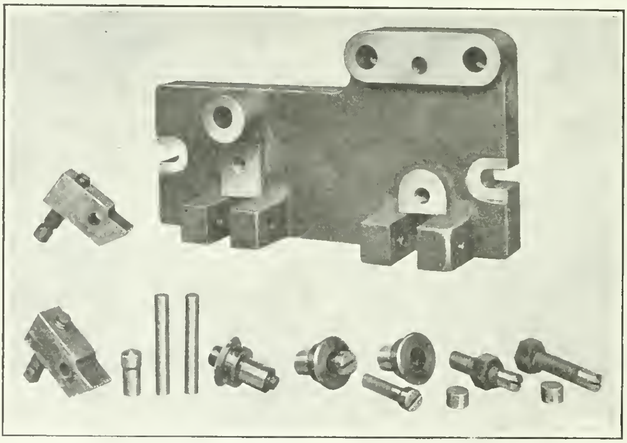


Fig. 7. Disassembled View of Parts of Fixture shown assembled in Fig. 4, the Standard Details being shown in the Foreground

A final point that is greatly in favor of developing standard details and machining them on a manufacturing basis is the delivery factor. An expeditious delivery of tooling equipment is usually desired and, as a consequence, the capacity of the toolmaking department of a plant is frequently overtaxed through the endeavor to rush the work through. By carrying a line of standard details in stock, quick delivery is possible. In the use of jigs and fixtures, the item of repair is of great importance, as production in a plant is often retarded because some detail on the tool, such as a broken clamp, bushing, etc., must be replaced. In the event of such occurrence, the interference with production is, of course, greatly lessened if the broken part is of a standard design that can readily be replaced from stock.

Supplying Standard Details to Customers

The results obtained by investigation and experience warranted the standardization of certain details and their manufacture in large quantities, but the difficult problem was to make prospective customers realize this fact so that concerns who wished to design tooling equipment and make the main parts themselves, and those details which could not be standardized, would be able to take advantage of the standard details made by the Cincinnati Engineering Tool Co. At first the attempt was made to have such customers refer to lists of the standard parts when designing their equipment, but this method did not prove successful, as considerable experience is required in the use of standard details before maximum efficiency in their employment can be obtained.

It was then decided that the following methods, which are now in use, would be the most satisfactory means of rendering service to customers: First, upon the receipt of an order, a preliminary design of the equipment is laid out, notations being made on the drawing of the standard details applicable to the jig or fixture. The stock parts and the preliminary design are then sent to the customer, so that he is in a position to complete the design and build the equipment, using the supplied stock parts in its assembling. Second, the design of the equipment is fully developed, together with the detail parts not contained on the standard lists. All the drawings and the suitable stock parts are then sent to the customer for use in building the equipment. Third, the design and necessary detail drawings are fully developed and the complete equipment built and shipped to the customer. The drawings are also furnished for use in replacing special details.

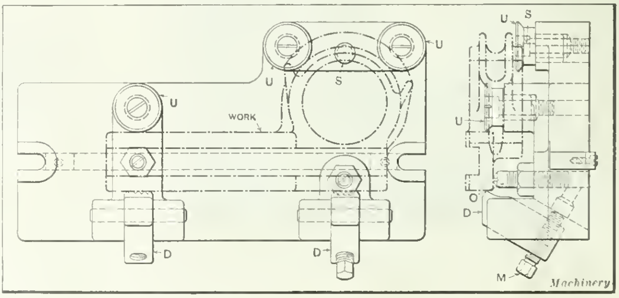


Fig. 8. View of Fixture shown in Fig. 4, with Work in Place

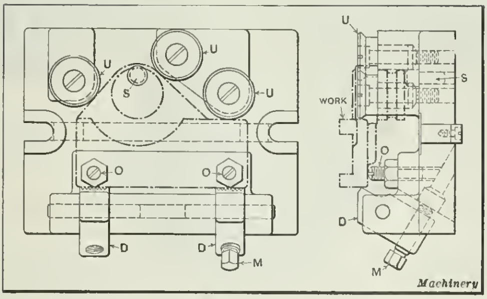


Fig. 9. Fixture employing Standard Details, Similar to that shown in Fig. 8

Fixtures to which Standard Details are Applicable

Fig. 6 shows the preliminary design of a milling fixture made for a customer under the first of the three methods outlined in the foregoing. In this illustration and successive ones, the various standard details are noted by the same letters as in Figs. 1 and 2. Upon receipt of such a design it is a comparatively easy matter for the customer to complete the essential detail drawings. In this case it was only necessary to fill in the required dimensions. This fixture is intended for use on a milling machine of the vertical type, and is employed to hold the work securely in place while a milling operation is being performed on the flange by a shell end-mill. When the casting is placed in this fixture, it first rests on four screws *O*, which are adjusted for the first operation on a lot of castings and are not touched during the completion of the order.

Pins *W* are then adjusted until the vertical one touches the bottom of the casting, the adjustment being made by advancing screw *L* into the tapped hole in which it is contained. This movement causes the wedging surface of the horizontal pin to bear against a similar surface on the vertical pin so that the latter is raised an amount depending upon the movement of screw *L*. After the vertical pin *W* has been set in place the screws of the two clamping dogs *D* at the front of the fixture are tightened by adjusting screws *M;* the two dogs at the rear are then tightened slightly in the same way. Screws *O* are provided on the two dogs at the rear so that although screws *M* on these dogs are loosened and tightened when work is removed or placed in the fixture, the positions of the two dogs will be approximately the same for each casting because the settings of screws *O* remain unchanged. The four dogs cause the casting to be brought firmly down on the supports provided and hold the casting securely during the milling operation.

A fixture designed for holding a rack bearing while a milling operation is being performed on the part is shown in Fig. 4. Nearly all the details and units on this fixture are standard, the only part made special for the job being the main casting. The same fixture is shown disassembled in Fig. 7, the various standard details and units being arranged below the main casting. An assembly view of this fixture is shown in Fig. 8, in which the position of the work when placed in the fixture is indicated by heavy dot-and-dash lines. It will be seen that the casting rests upon plug *S* and two screws *O*, the latter being used instead of plain plugs so that the height of these supports may be adjusted to suit the casting and plug *S*. The work is properly located by being forced against stops *U* when the clamping dogs *D* are brought to bear against the front side of the work, this action being accomplished by turning screws *M*. The large amount of time saved in making a fixture of this type when the majority of the parts can be taken directly from stock will at once be appreciated. Another milling fixture that is quite similar in design to that just described is shown in Fig. 9, the work being again supported by a plug *S* and two screws *O*, and forced against three stops *U* by means of two clamping dogs *D* held in lugs at the front of the fixture.

In Fig. 5 an assembled milling fixture is shown with the work clamped in place, use being made in this design of clamping dogs of the style shown at *C*, Fig. 1. An assembly view of this fixture which clearly shows all the details of its construction is presented in Fig. 10, in which the position of the work in the fixture is again indicated by heavy dot-and-dash lines. The left end of the work rests on two plugs *S*, while the right end is supported by a single plug *R*. The work is properly located through the use of the clamping screw *L* at the left rear corner of the fixture, which forces the boss at the right end of the work into the vee of a hardened block especially made for this fixture. The clamping screw also forces the front side of the left end of the work against a plug *S* placed in a horizontal position in one of the lugs supporting the dog *C* at the front of the fixture.

A fixture employed for holding short connecting-rods during the performance of milling operations is shown in Fig. 11. The work is supported on three plugs *S* in a similar manner to that employed in the fixtures previously dealt with, and is correctly located by being forced against three stops *U*. This action is made possible by the employment of a single clamping dog *D*, which is placed in a diagonal position at one end of the fixture.

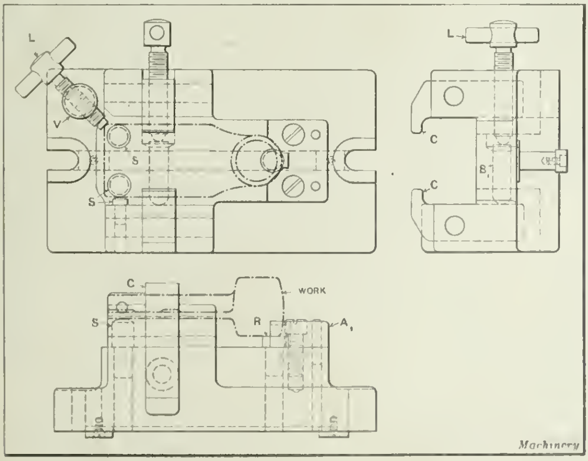


Fig. 10 Assembly View of Fixture shown in Fig. 5

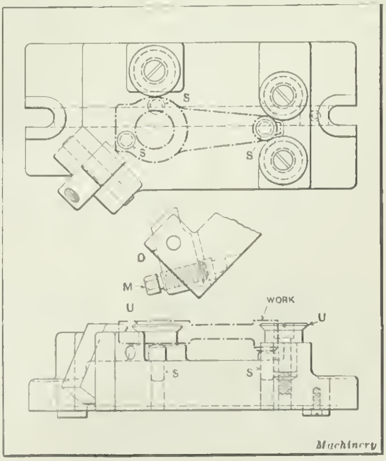


Fig. 11. Fixture that holds Work by One Clamping Unit

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PRINTERS' WAGES INCREASED

While the cost of living in New York has fallen 14.9 per cent during the last half of 1920, according to the Bureau of Labor statistics, the wages of printers have been increased during the same period 11 per cent, the second increase in 1920.

These two increases in the labor cost of MACHINERY'S mechanical department equal the annual rent of five floors of the building shown above, totaling 50,000 square feet.

No wonder that publishers and employing printers want to move from New York.

* * *

KNOWLEDGE OF COSTS A PRIME NECESSITY

Manufacturers have never so urgently needed an accurate knowledge of costs as in these difficult days of readjustment, when all industries must be piloted through the troubled waters of changing economic conditions. In most industries prices must be readjusted on the basis of actual costs and a narrow margin of profit, and unless costs are definitely known, grave mistakes may be made. Price reductions are dangerous to the manufacturer who lacks an accurate knowledge of his costs. In the machine tool building field there has been a considerable amount of guesswork about costs, and the National Machine Tool Builders' Association is making determined efforts to impress on the industry the importance of this matter.

If an accurate knowledge of costs is to become general, some common standards must be established, defining and determining the items of outlay which constitute cost. The mere installation of a cost system is only the first step; that has been tried for years with indifferent success. There should be some concerted action to establish governing cost principles and to standardize cost system practices, and it is believed that the time is opportune for a nation-wide movement of manufacturers generally, to accomplish these objects. To promote this movement, the Industrial Cost Association has been organized, which many of the leading machine building plants in the country have already joined. The work of this association, of which M. F. Simmons, of the General Electric Co., Schenectady, N. Y., is president, is to be commended, and it is to the interest of all manufacturers to familiarize themselves with its aims.

* * *

RAILROAD SHOP CONTROL AND MECHANICAL EFFICIENCY

During the period of federal control of American railways, an agreement was made between the United States Railroad Administration and the men represented by the Railway Employes' Department of the American Federation of Labor and its affiliated organizations, which deprived the railroad machine shop foremen of authority to discharge or lay off men under their charge; and by making all promotions and other benefits received by the men contingent upon their seniority of appointment, a condition resulted which limits the progress and stunts the ambition of every such employe.

It has recently been suggested to the United States Railway Labor Wage Board that the provisions of the so-called "National Agreement on Working Conditions" should be abrogated or at least greatly modified. The changes suggested would eliminate many features which operate against the best interests of both the railways and their employes. Also, they would correct a condition which is unfair to the great majority of the public which is affected by diminished efficiency in railroad operation.

Lack of space precludes entering into a detailed discussion of many other features of this agreement which are equally objectionable; but to designers and builders of machine tools used by the railroads, there is one other point which naturally follows a consideration of these conditions of employment. During recent years, the skill and energy of machine designers and manufacturers have resulted in remarkable improvements in many types of shop equipment, with a view to improving the quality of workmanship and decreasing the cost of work incident to the maintenance of railway rolling stock in efficient operating condition. But it is futile to expect that such mechanical developments can offset the influence of a condition in the shops which prevents the development of men along broad lines of progress, and which hampers the proper direction of their efforts by those officials who are held responsible for results. The best interests of the railway shop employes, the railways and the public would be served by having the far-reaching and undesirable terms of this national agreement terminated as soon as possible.

* * *

CONCISE BUSINESS LETTERS

During the period of depression through which we are passing, one line of manufacture that appears to be quite busy is the typewriter industry. One manufacturer smilingly said the reason for this is that so few people know how to write concise business letters, and therefore twice the necessary number of typewriters are required to keep a business going.

There is much truth in this statement. Long and rambling letters are unfortunately too common. A letter using many more words than are necessary to express the writer's meaning is a waste not only of his time, but of the recipient's, and is likely to be misunderstood. The meaning of concise, to-the-point letters, free from repetition, is more easily grasped; and the reply, if one is required, is likely to be of a similar character. The lengthy circular letter, particularly, should be consigned to the waste basket. It has little value as a selling proposition, because it is seldom read.

The natural ability to set down their thoughts simply and clearly on paper is rare among business men, who have many other things to think of and seldom have received literary training; but it can be acquired by practice, and is well worth working for.

Quality Versus First Cost in Machine Tools

By A. H. INGLE, President, Betts Machine Co., Rochester, N. Y.

In this article, Mr. Ingle points out that with machine tools, as with everything else, it is not possible to get something for nothing. The purchaser who wants to buy quality in machine tools must be prepared to pay for it. Quality in a machine tool means better and more expensive materials, a higher grade of skilled labor in the manufacture, and more painstaking and time-consuming processes in the assembling and inspection. Hence, there may be a considerable difference in quality between two machine tools that are of the same size and general type, and it is not reasonable for the purchaser to expect that the two can be sold at the same price.

THERE is many a purchasing agent who expects to buy machine tools on much the same basis as he buys rails or pig iron—on a tonnage basis. He may not actually figure on the weight of the machine tool and expect that it should be priced accordingly, as has so often been done in the past, but when he is given the choice between, say, two lathes of the same size and type, he will often decide on the cheaper of the two, basing his decision on price only.

Now, in buying rails this may be all right. Rails made by different mills must meet certain standard specifications applying to all rails of a given size, and price becomes the only consideration. The same is true of pig iron, and of a great many materials as well as finished products that are ordinarily bought by purchasing agents for large corporations. But it is not true of machine tools, as everyone familiar with shop work knows. Yet the purchasing agents of some of our big railroad systems are not as familiar with this point as they ought to be, and often decide in favor of a cheaper machine without investigating whether the quality of the cheaper machine does not make it the most expensive in the end. The operator's wages and the cost of power and floor space and other fixed charges are substantially the same whether the machine is a highly productive one or not. The floor space occupied by a machine that does not produce sufficiently, particularly with present building costs, is an item of expense that absorbs a great deal more than the slight increase in the first cost of the right kind of equipment.

In Buying Machine Tools the Purchaser should Look to Production, not to Price

When buying a machine tool the purchaser is not really buying so many pounds of mechanism to place in his shop. What he is buying is production. The question in his mind should not be: "How cheap can I get this machine?" but "How cheap can I turn out the work for which I am buying this machine?" The difference in price of two machine tools of the same size and general type is seldom more than 20 per cent—more often it is not greater than 10 per cent. Yet, in ten or fifteen years the higher priced machine may easily turn out several times as much work as the cheaper machine. It is generally provided with better materials for its gears, and the quality and area of its wearing surfaces are better, and the proportions throughout more liberal. It will require less repairs and will stand idle fewer hours because of breakdowns. It will have steel gears where a cheaper machine may have cast-iron gears, and the teeth of the gears are not likely to be stripped. It will maintain its accuracy longer because its bearings are of better quality and more carefully designed and adjusted—briefly, it will last longer and give better service—so much so that the 10 or 20 per cent additional first cost applied in the purchase of such equipment would result in decreasing the ultimate cost of the product in many cases as much as 50 per cent, as compared with the cost if cheaper equipment had been used.

Every effort should be made to impress upon the buyer of machine tools who is not in close contact with the actual production of the shop that it is economical to buy on a basis of quality rather than on a basis of price. Price reductions often mean quality reductions, and in machine tools the best is usually the cheapest in the end. A machine tool is not bought for immediate consumption. It will stand in the shop year after year, and it will keep on producing according to the original quality in the machine. It is the length of its useful life that counts, not the first cost.

Building an Organization versus Buying Machine Tools

It is a curious fact that many an executive of a large corporation who has proved his ability by building up an excellent organization of capable men seems unable to realize that when it comes to the buying of machines, quality is as important in order that the right results may be achieved as it is in the hiring of men. He did not build up his organization by hiring the cheapest engineers, accountants, superintendents, and foremen that he could find. On the contrary, he built up his organization by trying to locate the very best men in each class; but when he comes to the buying of machine tools the procedure is different. He calls for bids from various manufacturers and whoever bids lowest often gets the order. He forgets entirely the question of quality, and thinks in terms of price only. As a result he fills his shop with mediocre machines incapable of turning out the full quantity of work for a sufficient length of time without repairs or breakdown; yet he doubtless considers himself a capable and shrewd business man because of being so clever a buyer.

Many a time the mechanical executives of large corporations have recommended to the purchasing agent the acquiring of equipment known to be of the highest quality, but the purchasing agent, finding that the machines specified by the mechanical heads are higher priced than some other machines that appear to him to be equal in size and appearance, buys the cheaper kind. If the mechanical executive is qualified to recommend the right equipment for the work, his judgment should prevail. If he is not capable and his judgment considered unsound, then he should be replaced by someone in whom confidence can be placed. An able mechanical executive's recommendations should be followed, because he would make them only after considerable time and effort had been spent in investigation.

To Maintain Quality should be the Slogan of the American Machine Tool Builders

In order to maintain quality with present cost of manufacture we must maintain prices, and we must try to impress upon the purchaser that it is good business to buy on quality rather than on price. The effort of American machine tool builders should be to produce the best machine tools possible, irrespective of cost, and then to make the purchaser realize that it is to his advantage to pay the higher price necessary in order to obtain a superior machine.

In small shops there is little difficulty in persuading the proprietor that it is to his advantage to buy good machinery, because he is usually a mechanic himself, or he is at least so close in touch with the shop and the productive end of the business that he knows that it is not the first cost but the ultimate cost that counts. It is in the case of large corporations, and more especially in the case of railroads that the difference between machines of similar size and type is not thoroughly appreciated. The mechanical heads should have more to say about the selection of machines than they usually have, for they know that the better machine will produce more and will be cheaper in the end.

It is especially important in the selection of large machine tools that the question of results in production rather than first cost be the deciding factor, because of the large investment involved, the large space occupied, and the fact that many of the smaller machines are dependent on the output of a few large ones. Hence, the total production of the shop may be either accelerated or retarded according to the efficiency of a few big machines, and the small difference in first cost is the least important item to be considered.

Designers of machine tool equipment would be able to contribute more to the advance of efficiency in machine shop practice if they had greater freedom to design the best and most efficient machines, at all times, without any restrictions to meet the demand of the buyer who looks at price first and results second. The difference in first cost between a really good machine and one second in quality is soon recovered if the better machine is installed; whereas, if the cheaper machine is bought it will continuously hamper the output of the shop and act as a reminder that saving in first cost is often the cause of a continuous increase in production costs.

The many purchasing agents who investigate quality as well as price, and exercise the courage of their convictions in buying, are laying a foundation for substantial recognition of ability in their field, and the soundness of their judgment will become evident in no uncertain manner as the results show themselves in the form of greater production in the shop.

* * *

HOW LABOR AGREEMENTS COMPEL RAILROADS TO PAY FOR WORK NOT DONE

Following are two of the many instances cited in the hearings before the U. S. Railroad Labor Board in Chicago to show how the "National Agreements and Rules Working Conditions" brought into existence under federal control compel the railroads to pay large sums for time not spent by workmen in productive labor:

On the Cincinnati, Indianapolis & Western Railroad a mechanic was required to make a trip to an outside terminal for work which required about one hour's time. The man slept at the terminal all night, but upon his return to his home station claimed time and a half and double time for the period covered by his absence, causing the railroad company to pay him *$34.84 for one hour's actual work.*

On the Chicago, Great Western Railroad, a wrecking crew arriving back at its home station two days after it had left to clean up a wreck, put in claims for time and a half and double time during the night periods when they were not working, and notwithstanding the fact that the wrecking outfit was equipped with sleeping and dining facilities and the men were free to rest, sleep or eat from 9 P. M. to 7 A. M., they claimed and were *paid a total of 18 hours and 30 minutes pay, representing time while they were performing no work.*

These examples illustrate the practical workings of Rule No. 6 of Labor Agreements which the railroads are seeking to have abrogated. This rule provides: "All over-time outside of bulletin hours, up to and inclding the sixteenth hour of service in any one 24-hour period, computed from the starting time of the employe's regular shift, shall be paid for at the rate of time and one-half, and thereafter at the rate of double time, up to the starting time of the employes regular shift."

BILLS IN CONGRESS TO INTRODUCE METRIC SYSTEM

Bills have been introduced in Congress by Senator Frelinghuysen of New Jersey, and Congressman Britten of Illinois, proposing to fix the metric system of weights and measures as the single standard for weights and measures. These bills provide briefly that "from and after ten years no person shall do or offer to attempt to do any of the following acts, by weights and measures, in or according to any other system than the metric system of weights and measures, namely: Sell any goods, wares, or merchandise except for export as provided in section 12; charge or collect for the carriage or transportation of any goods, wares, or merchandise; charge or collect from or pay or reimburse any other person for work or labor which has been or is to be performed or done . . ."

It is further provided that "from and after four years no person shall manufacture or make for himself for use, or purchase for use any weight or measure or weighing device constructed, marked, or graduated in any other system than the metric system of weights and measures; that from and after ten years no person shall use or attempt to use any other system than the metric system of weights and measures; that from and after two years no person shall manufacture or pack, offer for sale or sell any goods in package form, which are required by law to be marked in terms of weights and measures, unless they be marked in or according to the metric system of weights and measures; that not later than ten years all postage excises, duties and customs charged or collected by weights or measure shall be charged or collected in or according to the metric system of weights and measures; that rules and regulations for the enforcement of this act shall be made and promulgated by the Secretary of Commerce."

In this connection it is of importance to note that a great many organizations have taken formal action in opposition to the compulsory use of the metric system in the United States. The resolutions which these organizations have passed are on record in the office of the American Institute of Weights and Measures, 115 Broadway, New York.

* * *

FINANCING FOREIGN TRADE

The Foreign Trade Financing Corporation, 66 Broadway, New York City, has been organized under the Edge Act for the purpose of assisting in the maintenance and further developments of the foreign trade of the United States. It is expected that the corporation will have a fully subscribed capital of $100,000,000 with a surplus of $5,000,000. Under the law the corporation may extend long- and short-term credits, invest in securities, purchase bills of exchange, engage in foreign banking, and in every lawful way aid in financing foreign trade.

It is expected that the corporation will furnish a much needed machinery for carrying on foreign trade requiring long-term financing. The proposal to organize the corporation arose out of the existing needs of industry and commerce for greater facilities for financing the purchase of American-made products by foreign customers. Many foreign buyers, even those most advantageously situated financially, suffered from the effects of the exhausting war, and are unable to pay immediately for adequate quantities of American-made products unless long-time credits are arranged for.

It is expected that the industries of the United States will aid in financing the corporation by the purchase of stock, and an invitation to subscribe is extended to all organizations and individuals representing agricultural, manufacturing, financial, labor and other interests throughout the United States. Further information may be obtained by communicating with the Committee on Organization, 66 Broadway, New York City.

Taxation and the Industries

By THEO. H. PRICE, Publisher "Commerce and Finance," New York

In his article "The Business Outlook for the Coming Year," that was published in the January number of MACHINERY, A. W. Henn, president of the National Acme Co., Cleveland, dealt briefly with the question of taxation and called attention to the method of taxation proposed by Theo. H. Price, publisher of "Commerce and Finance," which Mr. Henn stated appears to be free from most of the objections that have been raised to other proposed systems of taxation and which, in addition, seems to have many advantages. In the present article the method proposed by Mr. Price is outlined in greater detail. Manufacturers will be interested in this proposal, because the development of the industries depends very largely upon the methods of taxation.

EVEN though it be thought that the present taxes are against the public interests, it must be admitted that it is politically impossible to get them changed at once. It is probable that the excess profits tax will be repealed. It is possible that some reduction in the income super-taxes may be secured. It has also been suggested that the tax on earned incomes should be revoked, leaving "unearned" incomes alone subject to taxation. The unwisdom of attempting to discriminate between earned and unearned incomes will probably become apparent as the proposition is considered. It would drive capital into tax-exempt securities, penalize thrift, and encourage people to spend their earnings instead of saving them.

The Consumption, Sales, or Turnover Tax

The most favorably received suggestion thus far made for a substitute for the present excess profits tax is that of a consumption tax or a "turnover" tax. It is estimated that the agricultural, mineral, and industrial production of the United States is now worth an aggregate of about seventy billion dollars a year, and that in its passage from producer to consumer it generates a trade or commerce which involves a turnover of about five hundred billion dollars annually. A tax of one per cent upon this turnover would yield a revenue of five billions a year, which is nearly twice as much as we are likely to need in the future; a tax of one-half of one per cent would be sufficient and would not be felt appreciably by the individual consumer, so why not levy it and be done with it? It would collect itself, for it would only be necessary to require that everyone should send on the first of each month a statement of his sales, and a check for his taxes to the Treasury Department, and the buyer would hardly know that he was paying the tax, because it would be hidden in the price and absorbed in the seller's overhead charges.

Objections to the General Sales Tax

It all looks very simple, but let us examine it. Would it be politically possible to get Congress to pass a law taxing the farmer on what he receives for his crops? It is very doubtful. Would it be physically possible to compel the newsboy to pay a tax on the papers that he sells or the peanut vendor to make a monthly statement and send a check? Does the bootblack sell a "shine" or his labor, and would the latter be taxable? Is it freight room or service that we buy from the railroads and should either be subject to the consumption tax? Should the banker who sells hundreds of millions of securities be subject to a "turnover" tax that would break him, or be given an exemption that Congress would never grant?

These are just a few of the questions that suggest themselves, but they make it plain that the problem is one of infinite complexity. When the turnover tax was first proposed, it impressed me so favorably that I advocated its adoption; but when I came to think about a practical plan for its collection, I found that it would have to include innumerable exceptions, and that each exception made would inspire a demand that another class be exempted, until there would be nobody left to tax. I have therefore given it up, and my mind, still seeking some practical method of taxation that would be less injurious to the industries, has gradually turned toward a tax that would be levied on the total amount of wages and salaries paid by employers of labor. I believe that this is the nearest approximation to an equitably distributed consumption tax that we can obtain.

Taxation on Total Wages Paid

All that we consume and all wealth is the product of work. The banker's profit and the bootblack's pennies are alike the result of work. Speculation and judgment, the willingness to take risks, and the ability to select and limit them intelligently affect the reward that different men receive for doing the same amount of physical work, but these are elements that, being intangible, exempt themselves from taxation.

By and large, the great mass of things that mankind consumes is the product of work—on the farm and in the mines, in the factories and in the offices. Therefore, if the labor cost of these things were taxed we should approximate an equitably distributed consumption tax, and if it were supplemented by a reasonable income tax plus moderate surtaxes, we would, it seems to me, be getting about as near as we can to a fairly apportioned tax.

I am fully aware that there are a great many exceptions that would have to be made or would, so to speak, make themselves, in the application of this theory. The men and women who employed no household servants, as well as those who sold the product of their individual labor directly to the public, would be exempt, but I am inclined to think that this is desirable, for it would stimulate personal economy and industry.

Application of the Tax on the Payroll

The employers' payroll tax, while it would be paid directly by the farmer, the manufacturer, and the merchant, would be immediately passed on by a microscopic addition to the price of the article produced. It would therefore be almost invisible, it would be nearly painless and it would be promptly paid in small installments from day to day, or month to month.

A manufacturer or merchant whose monthly disbursements for wages, salaries, or piece-work totaled $100,000, would at the end of the month send a statement to Washington with a check for the amount of his tax. If the tax were 5 per cent, his check would be $5000, which he would include in his overhead charges and add to the selling price of his product.

The price paid by the manufacturer of an entirely finished or marketable product for the raw or partially finished material that he used would have been correspondingly increased by the employer's tax upon the wages paid to those employed in its production, and thus the price at which the article was sold for consumption would include all the employer's taxes that it had to bear in its progress from the first producer to the ultimate buyer.

The Fiscal Point of View

As to the aggregate of the wages paid in this country, which would be the principal sum upon which such a tax could be levied, no definite figures are available. Roughly speaking, there are probably fifty million men, women, and children in the United States who sell their labor directly or indirectly. If they earn on an average $2 a day and work 300 days a year, the labor income of the country is thirty billions a year. This is hardly more than a guess, but if it is anywhere nearly correct, a tax on total wages paid that would equal 7 per cent on the total payroll would probably provide all the revenue we need to offset the reduction in the excess profits and income supertaxes for which we hope.

A Tax that would be Equitably Distributed

Such a tax would be paid directly by the employers and for the most part by the large employers. Where the work paid for produced the things that the people consume, the tax would be passed on in the prices charged; and in the case of those who employed others to lessen their own toil or minister to their comfort, luxury or extravagance, the tax could not be passed on and would act as a deterrent to unproductive expenditure.

I submit the suggestion for consideration. I realize that it is only out of the conflict of opinion that truth is evolved. There may be a great many objections to the proposed tax that I cannot see. Constant study of a single subject is apt to impair the vision. All that I hope or can expect to accomplish is to stimulate thought upon what is our most important domestic problem, and I am certain that a satisfactory solution can be found if the energies of the collective American mind are concentrated upon the subject.

* * *

TESTING MERITS OF HIGH-SPEED STEEL

By THOMAS FISH

President, Ready Tool Co., Bridgeport, Conn.

The writer's attention has been called a number of times, to the fact that there seem to be no facilities in this country for testing, *in a scientific way*, the merits of the various makes of high-speed steel. The writer has in mind some place where it would be possible to continue the work as laid out by the late Frederick W. Taylor, at the works of the Midvale Steel Co.

If some technical school, like the Massachusetts Institute of Technology would take hold of this, or if the American Society of Mechanical Engineers could provide facilities for the proper testing of high-speed steel, I believe that it would be invaluable to the large users of high-speed steel.

The Ready Tool Co., as a manufacturer of tool-holders, selling large quantities of extra cutters or tool bits in various forms, squares, flats, double bevels, and special shapes for threading tools is, of course, always interested in knowing of, and using, the best steel. We have the representatives of the large steel companies calling on us continually, stating the various tests they have made in different plants, and how their steel "did more work than any of the other twelve or twenty-four brands that the test was being run against"; but when you come to examine the report of the test, you find that no attempt was made to analyze the work that was being machined, no stated form of tool was used or maintained; and various ways of determining the value of the steels were used by different manufacturers.

One will take a sample piece of high-speed steel, and run it just as long as he can at a *very high speed*, which speed may be entirely impractical, as far as its use is concerned, but his theory is that if he can show on one grade of work that he ran two inches, where another high-speed steel only ran one inch at this high speed, then the one that ran two inches is double in value to the one that only ran one inch, regardless of Taylor's proof shown in his book, "On the Art of Cutting Metals," that this is in no way a proper test.

Other manufacturers will take high-speed steel at a *slow speed*, and run it *for days at a time* without sharpening; and if one high-speed steel will run three days, and another will run six, then, it is his opinion that the one that runs six days is worth twice as much as the one that runs three. In other words, there is not only no place for properly testing high-speed steel, but there is no standard being used for determining the results.

Taylor gave us an accurate report of his tests, showing that the average economical time that should be used for a tool was an hour and twenty minutes, before breaking down, but that for his test, he did not want to take up this amount of time, and that a twenty minute run was nearly enough correct to determine values in high-speed steel.

Of course, there is, in addition to this, another very important factor, that is, the heat-treatment of high-speed steel. In the writer's travels all over the country he has run across some peculiar methods of treating high-speed steel; there is no standard, and even the manufacturers vary considerably in their instructions for the heat-treatment of their own particular brand. It would seem that if the American Society of Mechanical Engineers, or some technical school, could take advantage of this opportunity, the benefits derived would be very valuable.

A proper size of lathe should be used, and properly annealed and analyzed cast iron and steel should be employed for the purpose of the test. Then, with proper equipment, and with correctly formed hardened and ground tools made from various makes of high-speed steel, tests could be run at predetermined feeds and speeds, and compared with other makes of steel, giving an accurate report of value.

It would, of course, be understood that each manufacturer having tools or steels tested would retain for his own personal use only the name of the steel he was having tested, so that no manufacturer would be injured by the report.

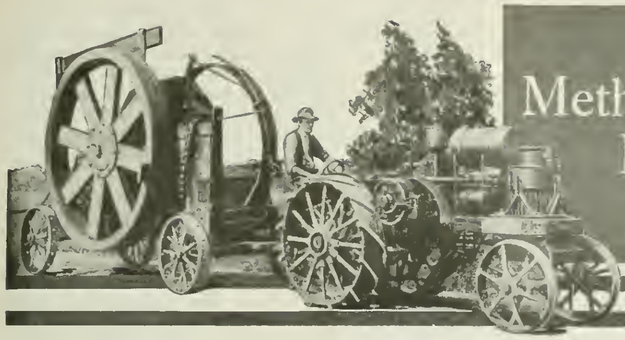
* * *

NATIONAL MACHINE TOOL BUILDERS' CONVENTION

The semi-annual convention of the National Machine Tool Builders' Association was held at the Hotel Cleveland, Cleveland, Ohio, February 24, 25, and 26. The meeting was originally scheduled to be held in May at Atlantic City, but a change in plans was made, because the executive committee had considered a number of enlarged constructive activities which might be undertaken by the association. It was in order that some of the features of this program might take immediate shape that the executive committee deemed it advisable to call an earlier meeting of the association for the purpose of discussing this enlarged program of work.

The association also had before it the consideration of the proper principles of cost accounting, this work having been carried through its preliminary stages by the firm of Scovell, Wellington & Co. It was deemed that an earlier meeting of the association than was at first contemplated would serve to crystallize association opinion concerning the value of this work, so that it might reach concrete form as soon as possible. The sessions therefore were devoted entirely to association business and no outside speakers were invited. There was no printed or formal program; but many topics of interest were presented by members for discussion, among which were the following: The present business situation and how to handle it; principles of sound financing for the machine tool industry; and how to run a machine tool shop in a time of depression.

The convention was well attended and the interest displayed by members in the new activities undertaken indicated the value of the increased activity of the association.



Methods in a Tractor Engine Plant

Machining Cylinder Liners on a Progressive Rotary Type of Boring Machine

On tractor engines built by the Avery Co., in Milwaukee, Wis., a practice is made of using what are termed "cylinder liners," namely, cylindrical shells that are fitted into the cylinder block to provide a bearing surface for each piston. The chief advantage of this form of construction is that when the interior of the cylinders becomes worn from service it is an inexpensive matter to remove these liners and substitute fresh ones in their places, thus restoring the cylinders to a new condition at a relatively small expense. For use in boring the cylindrical shells before they are assembled into the cylinder block, use is made of a special station type of boring machine which is of somewhat different design to many equipments constructed on the same general principles. This machine is shown in Fig. 1, where it will be seen to consist of a turret which carries both the boring spindles and the work-holding fixtures in which the cylinder liners are held.

Actually the term "progressive" boring machine would probably be more descriptive than the term "station type" that is generally applied to an equipment on which several pieces of work are set up and carried around a circuit from the loading station for the successive performance of the various machining operations that are required. In the regular station type of machine, the work moves intermittently, stopping under the sequence of tools, each of which performs its share of the required machining operations. While the pieces of work are at rest in their respective stations, the tools are fed down to the work. Each piece of work may also rotate independently of the main table on which the work-holding fixtures are mounted; or the work may be held stationary and the tools receive a rotary movement in addition to their reciprocating vertical feed movement. But in the case of the present equipment shown in Fig. 1, a casting is loaded at the starting point and the boring tool comes into contact with it, after which the boring operation progresses continuously as the casting is carried around the circuit; and when the work gets back to the loading station, the boring tool is withdrawn at high speed, so that the

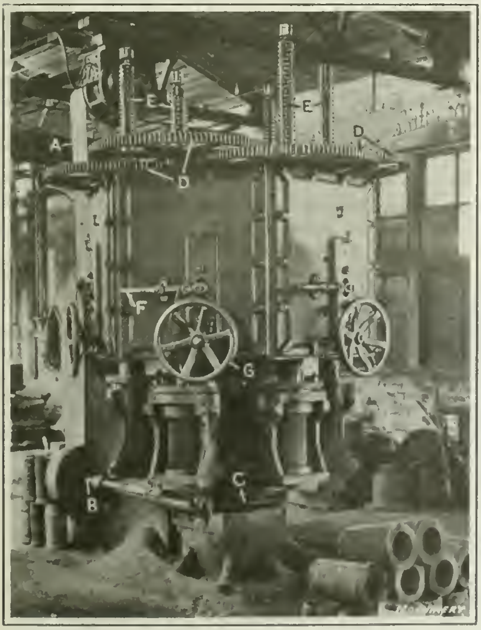


Fig. 1. Special Progressive Type of Machine used for Continuous Operation in boring Cylinder Liners for Avery Tractor Engines

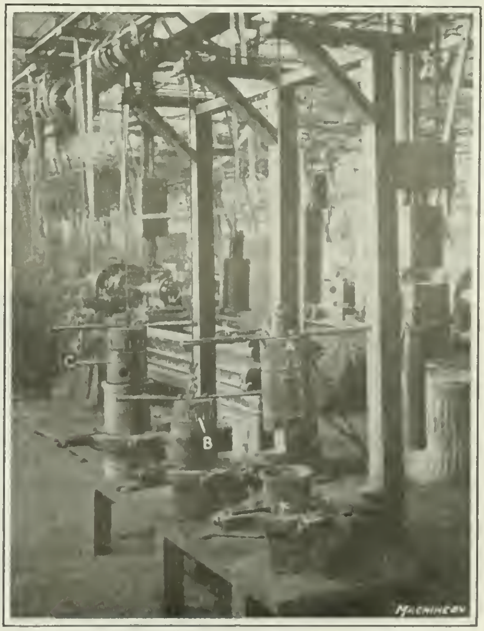


Fig. 2. Special Equipment used for chamfering Center Bearings on Tractor Engine Cylinder Liners preparatory to finish-turning

cylinder liner can be removed from the fixture and a new casting set up in its place. On this machine, the work occupies a fixed position on the rotary table and the boring tools rotate.

Mechanism of Progressive Rotary Boring Machine

With this preliminary statement concerning the characteristics of this machine, we are in a position to present a brief description of the mechanism by which the desired results are accomplished. It will be seen that power is furnished by a belt *A* from an electric motor mounted above the machine. This belt drives a pulley on horizontal shaft *B* that transmits the drive through a worm to a worm-wheel *C* secured to the base of the turret. As previously stated, this turret carries both the boring spindles and the work-holding fixtures, so it will be seen that the entire upper section of the machine rotates as a single unit.

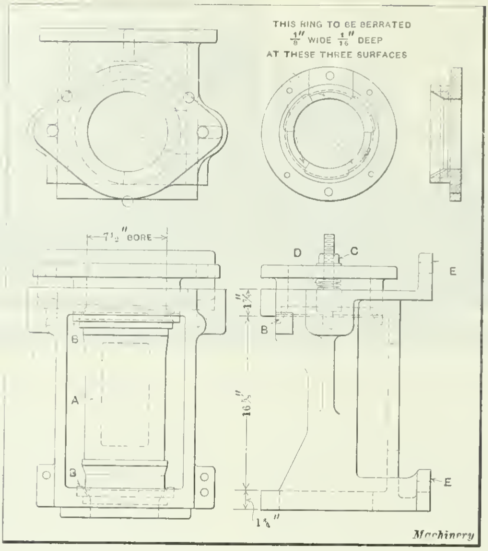


Fig. 3. Design of Work-holding Fixture used on Continuous Progressive Type of Boring Machine shown in Fig. 1

Extending up through the center of the turret, there is a vertical driving shaft which has a wide-faced spur pinion at its upper end that meshes with the large gears *D* which will be seen at the top of the turret. Each of these gears is splined to a lead-screw *E* at the upper end of one of the spindles, thus providing for rotation of the spindle and of the boring-bar that is carried at its lower end. These lead-screws also run through nuts, thus affording means of feeding the spindles downward to carry the boring-bars through the work. As the turret revolves, the work is carried around from the loading station, and the boring tool is fed downward until the operation in the cylinder liner has been completed. As each piece of work returns to the loading station, the direction of rotation of the screw *E* is reversed and the tool is backed out of the work at high speed. This result is accomplished by shifting the change-gears by means of lever *F*, which may be set in three positions to give a forward, neutral, or high-speed return movement. Wheel *G* provides for adjusting the vertical position of the spindle and boring tool by hand. Each spindle is independently controlled, and power is transmitted through an individual gear-box. In addition, there is a change-gear box that provides means for varying the speed at which the entire machine is driven.

Design of the Work-holding Fixtures

A good idea of the arrangement of the work-holding fixtures will be gathered from Fig. 1; and in Fig. 3 more detail is shown of the provision made for securing these fixtures to the machine, and for loading and clamping the cylinder liners in position for boring. In this illustration the work is shown at *A*, and it will be seen that there are serrated bell-mouthed bushings *B* at the top and bottom of the fixture, which serve the double purpose of locating the casting in a vertical position, and, by means of the serrations on these bushings, of biting into the edges of the work to prevent it from turning while the boring operation is in progress. This special boring machine was designed and built to facilitate production on the boring of cylinder liners, and bearing this fact in mind the work-holding fixtures were developed with special reference to the rapidity with which loading and unloading can be accomplished.

From Fig. 3 it will be seen that the method of procedure in setting up a piece of work for boring is to hold it in a vertical position and enter its lower end into the bell-mouthed bushing *B* at the bottom of the fixture. After this result has been accomplished, two nuts *C* are tightened down. These nuts bear against a flange located at the top of the upper bell-mouthed bushing *B* and provide for pushing it down on top of the work, sufficient force being applied on the wrench used on nuts *C* to insure having the serrations of the bell-mouthed bushings *B* bite into the work. Surrounding each of the bolts which connect the body of the fixture to the upper bell-mouthed bushing, there is a stiff compression spring *D*, and when nuts *C* are tightened down, the upper bushing slides into the fixture against the tension of these springs. Conversely, when the nuts are released, springs *D* raise the upper bell-mouthed bushing away from the work so that the bored cylinder liner may be lifted out of the fixture. The method of attaching the fixtures to the machine is quite simple. At the back there are brackets *E* through which bolt holes are drilled to provide for securing the fixtures to the faces of the turret that carries all parts of the mechanism.

Seasoning Castings after Rough-boring and Rough-turning

After the boring operation has been completed on the cylinder liner castings, they are transferred to a lathe and set up between centers to provide for the performance of a rough-turning operation on the outside diameter. The outer scale has now been removed from both the inside and outside of the work, and among men of experience in the machining of castings which are sufficiently thin so that even a moderate force might result in distorting their shape, it is a matter of quite general knowledge that the removal of the outer scale results in a readjustment of the internal strains in the metal, which may prove sufficient to cause a change of form. Particularly is this true in the case of thin castings that

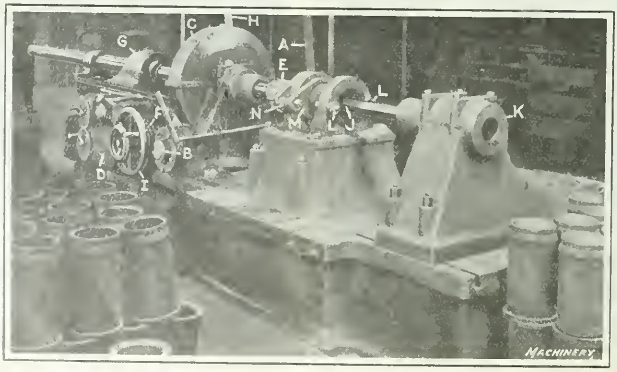


Fig. 4. Special Horizontal Machine for reaming Liners for Tractor Engines

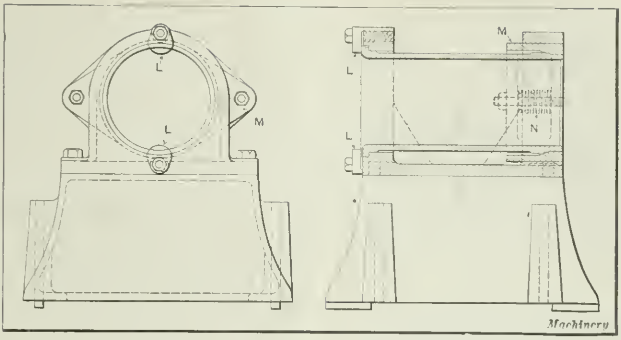


Fig. 5. Design of Work-holding Fixture used on Machine illustrated in Fig. 4

are of the same general character as the work that is at present under discussion. In order to assure the attainment of accuracy in the finished product, it is necessary to allow sufficient time for the effect of these new strains in the metal to become permanent before the finishing cuts are taken; and for that purpose, a practice is made of allowing the rough-turned castings to stand for a period of three weeks before starting the finishing operations, in order that they may be thoroughly seasoned.

Special Machine for Reaming Cylinder Liners

When the castings have stood for a sufficient time so that there is no danger of any further change in form, they are sent to a special horizontal reaming machine shown in Fig. 4, on which a finishing cut is taken on the inside of the work to assure having the bore straight and of exactly the required diameter. It will be seen that there are two belts coming down from the overhead works to provide for driving this reaming machine. Belt *A* runs over a pulley mounted at the end of a transverse shaft *B* on which there is mounted a worm meshing with a worm-wheel contained in case *C;* this worm-wheel is splined to the spindle and provides for driving it at a suitable speed of rotation.

At the back of the machine there is a horizontal belt (not shown) that transmits power to a transverse shaft that carries movement through to a feed-box *D* located at the front of the machine. This box provides for furnishing to the reamer *E* the various movements that are necessary for the performance of the required reaming operation in the cylinder liners. From the feed-box, the drive is through a worm and worm-wheel *F* to a lead-screw mounted inside the bed of the machine, which imparts movement to a sliding carriage *G* that is secured to the horizontal boring-bar. By means of gear shifts accomplished by the manipulation of the feed-box levers, provision is made for obtaining slow forward and reverse feed movements, and fast forward and reverse feed movements. There is also a neutral position for each lever on the feed-box.

At the back of the machine there will be seen a second belt *H* coming down from the overhead works. This belt runs over a pulley at the end of a transverse shaft, and provides for furnishing rapid forward and reverse traverse movements for the spindle of the machine, when it is required to quickly adjust its position. The pulley driven by belt *H* rotates continuously while the machine is in operation; and when it is required to utilize the traverse movement, this result may be accomplished by the engagement of a clutch that is manipulated by turning handwheel *I*. Then the traverse movement comes direct from belt *H* to the worm and worm-wheel *F*, and thence to the lead-screw. When the slow feed movements are required, handwheel *I* is turned to release the clutch, and the drive then comes from belt *A* through feed-box *D* to the same worm and worm-wheel *F*, and thence to the lead-screw, as previously described. The traverse and feed movements are interlocked so that conflicting movements cannot be engaged simultaneously.

Design of the Rapid-action Work-holding Fixture

Fig. 5 shows in more detail the arrangement of the work-holding fixture provided on this cylinder-liner reaming machine. As in the provision made for the holding of these castings for rough-boring, care has been taken to provide a means of accurately and rapidly setting up the work, so that production need not be unnecessarily retarded. At the time that the casting is being set up, the guiding pilot *J*, Fig. 4, at the forward end of the boring-bar has been withdrawn so that the casting may be lowered between the open end of the fixture and the inner end of the guide bushing *K*, and pushed back into the fixture. Then two small straps *L* are tightened to push the casting back, so that its inner end engages a bushing that carries a flange *M*. Tightening of straps *L* results in pushing this bushing and the work back against the resistance offered by two compression springs *N*, the tightening of the straps being continued until assurance is obtained that the back of the flange of the work is against the bottom of the counterbore in the fixture. After the reaming operation has been completed and the pilot *J* withdrawn, it is merely necessary to loosen straps *L*, and springs *N* will then push the casting out of the fixture for a sufficient distance so that the operator can take it in his hand and lift it off the machine.

Centering the Cylinder Liners for Finish-turning

In assembling the liners into a cylinder block, there are fits at each end of the liner which are seated in the block, but the main wall of the liner does not come in contact with

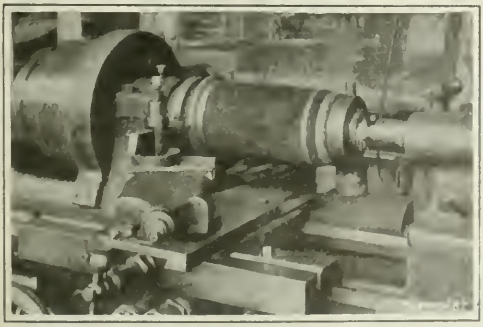


Fig. 6. Engine Lathe used for finish-turning Avery Tractor Engine Cylinder Liners

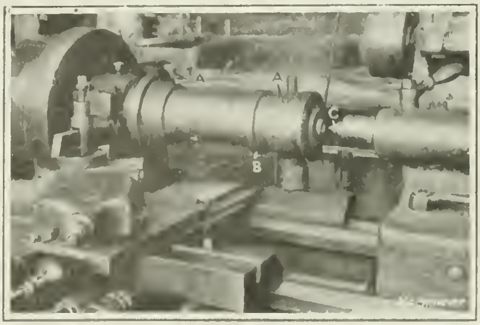


Fig. 7. Special Centers used for holding Work on the Lathe illustrated in Fig. 6

the block. Hence, it is only necessary to finish-turn the outside of the liners where they engage the cylinder block These finishing cuts are taken with the work held on centers, and it is necessary to chamfer the inside edges of the shell in order to be sure of having them properly fit the special centers used on the lathe on which the finish-turning is done. Fig. 2 shows the equipment used for the performance of these chamfering operations, and from this illustration it will be seen that while the work is done by hand, the cutters are especially supported so that not only can the work be done as rapidly as possible, but a minimum physical effort is required of the operator. The same man who operates the reaming machine shown in Fig. 4 is required to chamfer the cylinders.

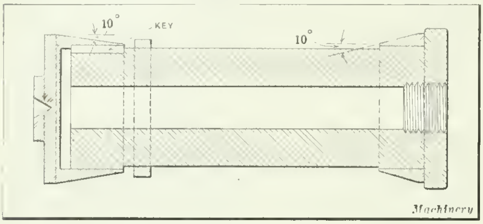


Fig. 8. Cross-sectional View showing Design of Lathe Centers illustrated on the Machine in Figs. 6 and 7

Referring to Fig. 2, it will be apparent that each of the cutters *A*, *B*, and *C*, is furnished with a guiding pilot that enters the reamed interior of the work; also, these cutters are suspended by cables which run over pulleys on a specially constructed framework, so that counterweights may be employed to balance the weight of the cutters and thus require the operator to merely apply sufficient force to overcome inertia and to turn the cutter after entering it into the work. Cutter *A* is shown suspended in its highest position, cutter *B* has been pushed down so that the pilot has fully entered the work and the blades are ready to start performing the chamfering operation, and cutter *C* is illustrated with the pilot about half way into the work. Also, it will be noticed that the castings are held by lathe steadyrests and that the castings under cutters *A* and *C* are standing in one position, while the casting under cutter *B* has been reversed end for end from that position. After each casting has been chamfered at one end, it is taken out of the chuck, reversed, and reset in order that the opposite end may be chamfered. Then the casting is ready to be sent to the lathe on which the finish-turning operation is performed.

Performance of the Finish-turning Operation

A statement has previously been made concerning the finish-turning operations which are performed at opposite ends of the cylinder liner castings, and it was explained that the reason for taking such cuts is to provide for fitting the liners into the cylinder block. Fig. 6 shows an engine lathe built by the American Tool Works Co., Cincinnati, Ohio, on which the finish-turning operation is performed, and in Figs. 7 and 8 there are shown the centers that engage the surfaces chamfered for that purpose by the tools illustrated in Fig. 2. There is one point in connection with the design of these centers which might not be understood from the illustrations without the assistance of the following description, namely, that the conical surfaces *A* which engage the chamfered inner edges of the work are solely responsible for its location and support. From the illustration it would appear that collar *B* also engages the finished bore, but actually such is not the case. However, this collar does serve as a guide to assist in pushing the reamed cylinder liner over that portion of the center to the left of collar *B* at the time the work is being set up.

After the liner has come in contact with the left-hand conical surface *A*, the right-hand cone center *A* is slipped over the outer end of the fixture and pushed up into the chamfer at the right-hand end of the bore in the work. Then the regular lathe center *C* is advanced into a center hole at the end of this right-hand cone *A*, and by tightening up the tailstock spindle against the work, provision is made for holding the casting ready for finish-turning. Obviously, the chamfered ends of the bore were accurately located relative to the reamed bore of the work by means of the piloted cutters shown in Fig. 2. Hence, with the work set up in this manner, it will be evident that the finished surfaces at the outside will be accurately located relative to the bore. Possibly a better idea of the arrangement of the centers will be gathered from Fig. 8. In addition to their use for locating the liners in the cylinder block, the seats that are finish-turned at this setting of the work are utilized as locating points for setting up the liners on a planetary grinding machine on which the final operation in the bore is performed.

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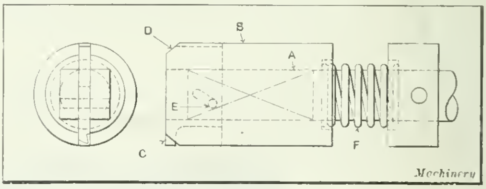
RECESSING TOOL

By HARRY MOORE

A recessing tool that can be advantageously used on turret lathes or drilling machines is shown in the illustration. In order to make its operation more readily understood, a description of its construction will first be given. Shank *A*, which is attached to the turret of a lathe, or to the spindle of a drilling machine, is milled square on that portion which enters sleeve *B*, there being a sliding fit between the two parts. If preferable, this portion of the shank could also be round and have two keyways engaging keys in the sleeve. Cutter *C* is held in a slot milled across the end of sleeve *B* to the same depth as the length of the cutter. The cutter is a sliding fit in this slot. The cutter is provided with a slight clearance to prevent marking the work and is chamfered at *D* to provide chip clearance. Sleeve *B* has a similar chamfer. The cutter is attached to the shank by means of pin *E*.

In operation, the tool is fed into the hole in which a recess is to be produced, spring *F* exerting sufficient pressure against the sleeve to insure that the cutter will be held in the position illustrated. When the bottom of the hole has been reached, as the shank continues to advance to overcome the action of the spring, the cutter is forced radially outward by pin *E*. The recess is formed by rotating either the cutter or the work as the cutter is forced outward in the manner described. In removing the tool from a finished hole, spring *F* causes the cutter to be brought back to its original position before the tool begins to be withdrawn and so prevents marring of the work. The depth of recess can be regulated by providing stops on the machine for the purpose. The sleeve should be a good fit in the hole in which a recessing operation is to be performed.



Tool used on Turret Lathes or Drilling Machines for forming a Recess at the Bottom of Holes

* * *

According to the Hartford Steam Boiler Inspection & Insurance Co., there were in 1919, 528 boiler explosions in the United States in which 530 persons were killed or injured. This was an increase in the number of explosions of 79 over the previous year, and an increase of 57 in the number of persons killed. With all the efforts that are being made to provide safety in steam plants there is yet much to be done.

Machine Shop Training for Salesmen

Methods Used by the Norton Company, in Providing a Practical Training for Grinding Machine and Grinding Wheel Salesmen

By JOHN C. SPENCE, Superintendent Grinding Machine Division, Norton Co., Worcester, Mass.

IN previous numbers of MACHINERY, the principles involved and the methods used in training operators for the shop. as based upon the practice of the Norton Co., Worcester. Mass., have been dealt with. The training department maintained by this company has a much wider scope, however, than that indicated by the former articles. In addition to the shop training course, it includes a course for training salesmen both of grinding machines and of grinding wheels and abrasives. This training course is known as the "Grinding Course," and is divided into two subdivisions—the course for the training of grinding machine salesmen and the course for grinding wheel salesmen. The careful manner in which the Norton Co. prepares the men who are to sell its product is of great interest, because there is no doubt that a salesman who is properly trained in the actual use and care of the product that he sells can be of greater service to the customer than one who lacks direct and intimate practical knowledge of the product that he handles. It is the object of the present article to outline briefly the training methods used and the scope of the training. In so doing, the subject will be divided into two parts—the training for grinding machine salesmen, and the training for grinding wheel salesmen.

Grinding Machine Training Course

The object of the grinding machine training course is primarily to prepare men for field work as service men, demonstrators, and salesmen of grinding machines. In addition, this course is open to salesmen employed by agents selling Norton grinding machines, and is intended to familiarize these salesmen with the various types and sizes of grinding machines and attachments, as well as to acquaint them thoroughly with the details of the design of the Norton Co.'s machines and to teach them the proper methods of grinding as advocated by the company. The grinding machine course is also open to men employed by customers of the Norton Co., who wish to have the users of grinding machines trained in the proper principles and practices of grinding.

Preparing the Future Demonstrators and Salesmen for the Training Course

When a candidate having the proper qualifications has been accepted for the training course, he is turned over to the training supervisor, R. J. Spence, by the educational director, Professor A. D. Butterfield. The supervisor, in a talk with the prospective demonstrator or salesman, gives him an outline of the work involved in the training course, explains to him the rules and regulations of the department, and gives him a general idea of the safety precautions applying to the various departments in which he will work. An idea of what will be expected of him in the line of personal conduct is also given. After this preliminary talk he is furnished with a competent guide and taken through the entire plant, so as to obtain a general understanding of the manufacturing operations.

In subsequent talks, the applicant is told about the origin of the company, its founders, its growth, its present officers, its products and general policies, and its standing in the industrial world. The beginner is told what alundum is in its natural state, and the processes that it passes through before it reaches the Worcester plant are briefly described. In the same way, crystolon is dealt with, together with a number of other things relating, in a general way to the abrasives used in the grinding wheels made by the Norton Co. The prospective salesman is also given a general idea of the administration of the company, and is briefly told of the functions of the various departments.

Beginning the Training Course

After these preliminary talks, the training supervisor takes the beginner to the foreman of the first department in which he is to work, previous notice of his coming having been sent to the foreman. The foreman explains in a detailed discussion the operations for which the department is responsible, and the dangers to be guarded against in the work in this department are pointed out. A competent instructor is then assigned to the student, and the training supervisor turns him over to the department; but from time to time the supervisor visits the student while he is at work, and keeps in touch with the foreman, instructor, and some reliable fellow-workman regarding his progress. The same method of introducing the student to every new department is followed.

Reports and Records

The student is required to furnish a weekly report, and at the conclusion of his assigned work in each department a complete report covering what he has learned is expected within one week of the completion of the work. On the first of each month a report on the progress of the student is sent to the president of the company, containing the impressions of each member of the training department with regard to the man. Copies of this report are also furnished to other executives directly interested in the demonstrators and salesmen.

Outline of Course

The grinding machine training course is carried on according to a carefully worked out schedule, requiring a sufficient length of time in each department to insure that the student will receive a thorough knowledge of the machines and attachments made by the Norton Co. and their operation The average length of time of training in each department is fixed, but the skill and aptitude displayed by the student is taken into account, and sometimes the course may be made either shorter or longer, according to circumstances. This is especially true of the time of training in the grinding practice departments. The total time for the training course is about ten months.

The first week is devoted to wheel manufacture, during which time the student is taught how to bush wheels, how to test them for speed, balancing, grading and wheel inspection. The general principles of packing and shipping are also taught

The student then begins on the main part of the course, devoting about four months to cylindrical grinding practice including the grinding of straight cylindrical pieces, fitting tapers, steadyrest work involving the grinding of long slender shafts, and production grinding. Later, one week each is devoted to crankshaft grinding, surface grinding, and tool and cutter grinding, and two weeks to master cam generation and cam grinding. Two weeks are devoted to operating the Norton running balance indicating machine, after which the student is transferred to the assembling department where units for Norton grinding machines are assembled. Here he spends about two months in assembling the headstocks, footstocks, aprons, power-feed mechanism, surface grinding machine units, cam-grinding attachments, speed frames, and dynamic balancing machines. Two months are then spent in the erecting shop in the assembling of plain grinding machines, double-head crank machines, and surface grinding machines.

The next step in the course is a week in the machine inspection department in the running-off of machines and countershafts; and two weeks in the engineering department, where the student will be engaged in cam lay-out and be shown general lay-outs for machine and crankshaft equipment and where he will have the theory of the design of the machines explained to him. A week is later spent in the sales engineering department, where the student is taught the general principles of the running of this department and becomes thoroughly conversant with the relation of this department to the salesmen and demonstrators. He is shown the different files, and taught how the records relating to the company's engineering work are preserved. Finally, he spends a couple of days in the sales department, during which time he is taught the sales policies of the company, and is then sent on field demonstration trial work for at least four weeks.

Throughout the course, talks on engineering principles, principles of grinding, and grinding practice, are given to the students by Charles H. Norton. In addition, every Saturday morning, lectures are given by various executive department heads, salesmen, and foremen, which are attended by the student and which cover a variety of subjects, such as sales policies and sales problems, billing and collections, packing and shipping, contracts and agreements, knowledge of product as a basis of successful sales work, deliveries, precision grinding, etc.

Training Salesmen to Write Letters

An interesting part of the course is the training in the handling of correspondence. So-called "letter problems" are put to the students, and they are taught how to handle difficult situations and to understand the company's policy under different conditions. The manner in which this is taught is quite unique; an actual letter is given to the student from the files, and he is requested to answer it in such a manner as he would deem satisfactory. The actual reply that has been made to the letter is then shown to him for comparison, and if his reply differs from the actual reply, the matter is thoroughly explained to him and reasons given to show him why the letter should be replied to in a certain way. This method of training men to write letters for which the firm becomes responsible is an exceedingly good one. One of the most serious things to any firm employing a large number of men, each of whom carries on independent correspondence with outside customers, is the difficulty of having all the correspondence conform to certain uniform rules and of getting the men trained in tactful letter writing.

Course for Training Grinding Wheel Salesmen

The course for training grinding wheel salesmen is the same in principle as the one for training grinding machine demonstrators and operators, except that it differs in the actual length of time taken in different departments. The grinding wheel salesmen, of course, are given a longer training in the wheel department and a shorter training in the machine department. They spend between two and three weeks on truing and bushing wheels and on wheel inspection, and then five weeks in the stock department, where they are expected to become thoroughly familiar with the shapes and sizes of the wheels made by the Norton Co. They are expected to commit these shapes and sizes to memory, and also to know the wheels that may be used as substitutes for other wheels, if for some reason the exact wheel recommended may not be available for immediate delivery. The student is subjected to a written examination at the end of his stay in the stock department.

The next step in the training includes a general machine shop course covering three months, during which time the student is taught bench work and the operation of lathes, milling machines, shapers, and drilling machines. Three weeks of this time are spent in the regular production department. The next training involves grinding practice—a course covering three months, similar to the one given to the grinding machine salesmen, as already outlined. Another month is spent in master cam generation and grinding and in the engineering department. Later four months are spent in the mechanical laboratories, after which about two months are spent in the various office departments. The same lectures as are outlined for the grinding machine salesmen are attended by the grinding wheel salesmen.

A Course for Office Assistants

Outside of the courses for demonstrators, salesmen, and customers' wheel and machine users, the company has inaugurated a brief course covering about five weeks for training office assistants in the different processes in the shop. It has been found that if the men in the office have an idea of the general shop routine and the shop processes, they can answer correspondence much more intelligently and know what they are writing about to customers. They also become familiar with technical and trade names, and this training is really necessary in order to have a staff that can intelligently handle the office work. This course includes a brief stay in each one of the main departments of the plant, including three weeks in the stock department with a view to becoming thoroughly acquainted with all the sizes and shapes of wheels made by the company.

Training Customers' Wheel Users, and Agents' Salesmen

It will be seen from the foregoing that the training of demonstrators and salesmen for the Norton Co.'s own staff requires something like ten months. So long a period of time is generally too long for agents' salesmen, and the course is abbreviated to fit the needs of the individual, the time usually being from three to twelve weeks. The customers' wheel and machine users receive a training that is also fitted to the needs of the individual and which may be extended from one month to one year.

It is evident that training courses such as outlined make it possible for the company to serve its customers in a more efficient manner than if salesmen and demonstrators had not been so thoroughly and systematically trained. The departure of the Norton Co. in establishing such complete educational and training departments is in accordance with the trend of the times, it being recognized that service must be rendered in connection with the product, no matter how valuable the product may be in itself.

* * *

COPPER-STEEL

In a paper read before the American Iron and Steel Institute, E. M. Buck reviews the development of copper-steel, stating that tests made by a committee of the American Society for Testing Materials with the cooperation of the United States Bureau of Standards, together with other data available, prove that by alloying from 0.15 to 0.25 per cent copper with normal open-hearth or bessemer steel the rate of corrosion of steel is very much reduced, where the products are exposed to alternate attacks of air and moisture. It is also claimed that in the investigations indications pointed to a better adherence of paint coatings on copper-steel, resulting in a more effective and longer-continued protection by the paint film. The manufacture of copper-steel has heretofore been largely confined to sheet metal, but it might be extended to other uses. In particular, steel freight cars are mentioned, especially those of the open kind, which are greatly affected by corrosion.

System for Production Control

Methods Employed in the Plant of the American Multigraph Co., for Routing and Recording the Progress of the Work. Based on an Interview with R. G. Pack, Vice-president in Charge of Production, American Multigraph Co., Cleveland, Ohio

It is a simple matter for the man who has charge of the work in a small shop to maintain close personal contact with each job and to ascertain that satisfactory progress is being made with its execution. This problem of supervision becomes increasingly difficult as the size of the plant increases, and in the case of large manufacturing establishments which are working on a product that involves the machining of a great diversity of parts, it would be impossible to attain and maintain the enormous production schedules which are required, without the use of carefully devised systems that enable the production manager to ascertain exactly what progress is being made with each part of the work.

In most lines of mechanical work, there is a very large number of parts to be produced for the assembly of each complete unit, and a shortage of any essential part would naturally hold up the production of the entire factory. It is to guard against such occurrences that the production manager must be kept constantly in touch with the progress that is being made in every step in the manufacture of each part, so that in the event of some unforeseen condition arising that would adversely affect production, steps may be taken at once to overcome the cause of the trouble. Practice varies as to the method of keeping the production manager informed in regard to the progress that is being made in the factory, and local conditions must always govern the method of procedure. However, as a general proposition, it may be stated that the system employed for this purpose should be worked out with the aim in view of attaining the maximum simplicity.

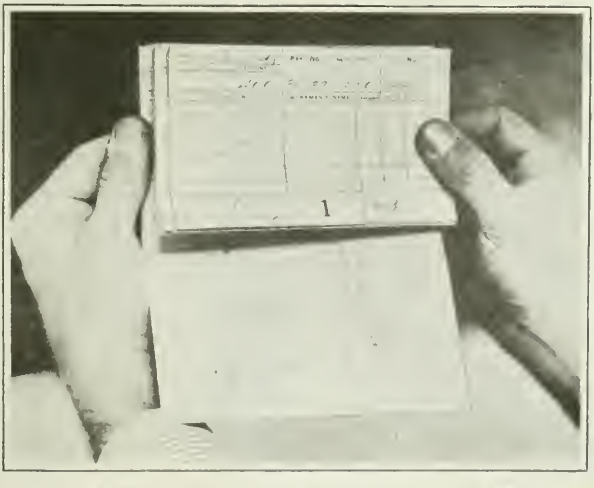


Fig. 1. Route Book Open to show how Operation Tickets are bound Ready for Use in the Plant

One frequently hears the term "production control" used by manufacturers and men employed in the production departments of industrial plants. As the expression signifies, production control is a means of assuring efficiency in the performance of manufacturing operations. Such being the case, an adequate system for the attainment of this result must go further than merely supervising the progress of work on various parts of each order that is going through the plant. It is also necessary to make sure that labor is being used efficiently and that there is not an excessive waste of material, due to the spoilage of work while it is in course of production; also, care must be taken to see that the labor cost that has to be charged against each job is not unduly high. Another important function of production control is to supervise the stock-room, with a view to making sure that there is always an adequate supply of all parts and supplies on hand to meet the requirements of the assembling department.

All of the requirements mentioned in the preceding paragraph are well looked after by a system of production control which is giving very satisfactory results at the plant of the American Multigraph Co. in Cleveland, Ohio. In addition to providing means of attaining the desired results, any system of this kind must be free from complications which would make it difficult for men in the shop to apply the system and which would consume a sufficiently large amount of time to interfere seriously with the production capacity of the plant. From the reader's standpoint, a most important feature is that this system is entirely general in its application, and could be successfully used in any machine shop engaged upon work where a considerable diversity of parts have to be machined for assembly into the final product.

How the System Works out

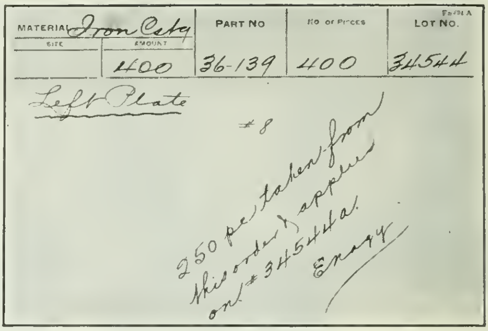
Fundamentally, the idea of this system of production control is to provide a simple and absolute means of following the progress that is made in machining all parts of each order that is going through the plant. Incidentally, although this is also most important, the system provides for obtaining reports on the labor costs that must be charged against the work; it also calls for the recording of the number of parts which are spoiled while in course of production and the reason for this spoilage; instructions are given for routing work through the plant, so that there is a minimum amount of lost motion in transferring the pieces from department to department; and provision is made for handling successive operations in the most advantageous manner.

At the plant of the American Multigraph Co., several different types of multigraphing machines are built, and there is a large number of parts in each machine. Quotas covering a definite number of each machine are given to the assembling department for each month. Parts are issued to this department from stock carried by a finished stores department on receipt of assembling orders issued by the production department. Parts are processed in the factory in quantities to maintain a sufficient supply of parts in stock to meet the quota requirements set for the assembling department and to take care of all sales orders for parts. The producing of sub-assemblies, that is, machine members composed of a number of basic parts, which are assembled and sent to the stock-room as units, where they are held pending the time when they will be required in the assembling department, is another means of saving time and reducing production costs.

Method of Procedure in Executing an Order

When an order for the manufacture of a specified number of any type of multigraphing machines is to be issued to the factory, the first step is for a clerk in the production department office to make out what is known as a "route book," as shown in Fig. 1. It consists of a number of 3- by 5-inch operation tickets, which are bound into a cover in such a way that the tickets may be removed successively by tearing along a perforated line. A part number is assigned to each part of the product, which is composed of two numbers, one of which signifies the type of machine into which the part is to be assembled, while the other denotes the specific part of the machine in question. This duplex part number is entered on each of the operation tickets that is bound into the route book.

Each route book also carries a notation as to the number of pieces of this kind which is to be produced on the order, and a so-called "lot number," which is a serial number applied to the job in question for cost-keeping purposes. In making out a route book, the clerk who handles this work in the production department office has access to files of cards which are arranged numerically by part numbers, each card showing the complete sequence of operations required and the order in which they must be performed on the part in question, in order to complete it ready for assembling. With one of these master cards as a guide, the clerk proceeds to fill out a separate operation ticket for each department to which the work must be sent, with a statement of the operation which must be performed in that department. Fig. 5 shows one of these tickets. The part number and the lot number are entered on each of the tickets, and a notation of the number of pieces to be machined on the first ticket. At the bottom of each operation ticket bound in the route book, there is a numeral which represents the number of the department; and in the lower left-hand corner, spaces are provided for the foreman or the clerk of the department to enter the date on which he forwarded the work to the next department, and the number of the department to which the work was sent. The number of the department to which it must be sent is the number shown on the next operation ticket. The first sheet in the book, Fig. 4, is a requisition for material required from the finished stores department for executing the order.



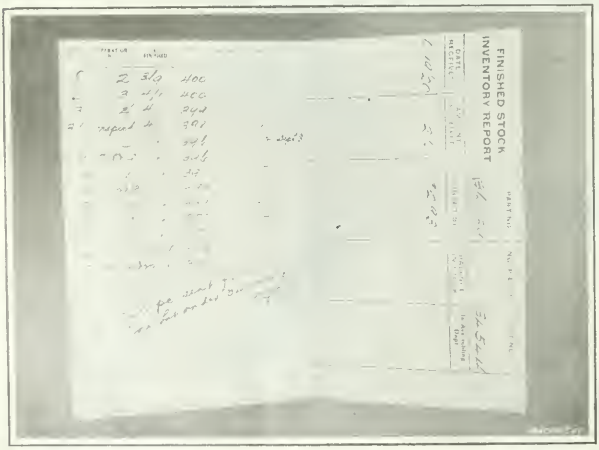
MATERIAL Iron City		PART NO	No of Pieces	LOT NO.
SIZE	AMOUNT			
	400	36-139	400	34544

Left Plate

#8

250 pc taken from this order & appears on #34544a. Emory

Fig. 3. Front Cover of the Route Book, giving Name of Part and Notation concerning Division of the Original Order



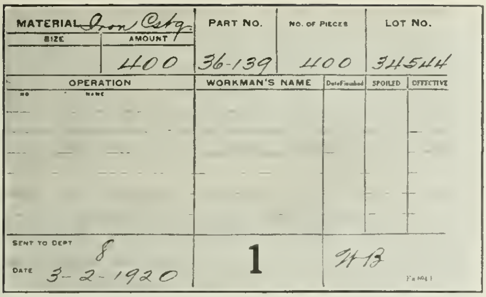
FINISHED STOCK INVENTORY REPORT

Fig. 2. Route Book with Operation Tickets removed to show Forms for Data recorded inside of the Front and Rear Covers

Recording Parts Spoiled in the Process of Manufacture

In the event of one or more pieces having been spoiled during the performance of any operation, it is the duty of the clerk of the department in which the spoilage occurred to deduct from the number of pieces called for on the original order, the number which were spoiled. For instance, on the job for which the operation tickets are here reproduced, the original order called for 400 pieces, but in department No. 3 one piece was spoiled in performing operation No. 4, as shown in Fig. 5, so that under the heading "No. of Pieces" on the operation ticket for department No. 36 to which the work is sent, 399 appears in the space for recording the No. of Pieces instead of 400. The clerk in the department where the piece was spoiled must also make out what is known as a "scrap ticket," shown in Fig. 6, on which there is entered a complete record of the spoiled piece. This scrap ticket is made out in duplicate, one copy being forwarded to the production department office, while the other is sent to the salvage department with the work. It is the duty of one of the inspectors in this department to examine both the scrap ticket and the work, in order to ascertain whether the spoilage was due to carelessness or to an accident, and also to determine whether the defective piece can be salvaged or if its discard would be more profitable.

An effort is made to utilize as many of the defective pieces as possible, but owing to the dif-



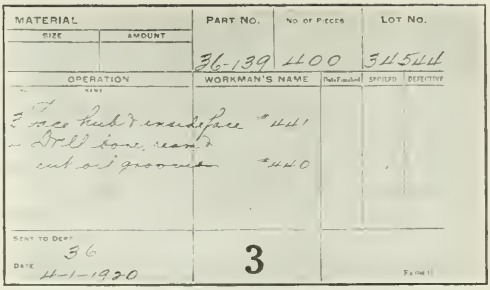
MATERIAL Iron Cstg.

SIZE	AMOUNT	PART NO.	NO. OF PIECES	LOT NO.
	400	36-139	400	34544

OPERATION NO. NAME	WORKMAN'S NAME	Date Finished	SPOILED	DEFECTIVE

SENT TO DEPT 8
DATE 3-2-1920
1
WB

Fig. 4. Operation Ticket for Department No. 1. This is a Requisition on the Stock-room for the Necessary Castings



MATERIAL

SIZE	AMOUNT	PART NO.	NO OF PIECES	LOT NO.
		36-139	400	34544

OPERATION NO. NAME	WORKMAN'S NAME	Date Finished	SPOILED	DEFECTIVE
Face hub & inside face	#441			
Drill bore, ream & cut oil groove	#440			

SENT TO DEPT 36
DATE 4-1-1920
3

Fig. 5. Operation Ticket for Work done in Department No. 3. One Piece was spoiled in performing the Fourth Operation

ficulty of successfully handling separate parts or merging them with other lots of regular production work, it is a moot question whether this department is a profitable one, except in so far as the supervision and effort to handle defective parts serves as a check to prevent an excessive number of pieces being damaged in course of production, because the foreman of a department which is showing too large an amount of spoiled pieces knows that he will be called upon for an explanation.

Reporting Progress of Work to the Production Manager

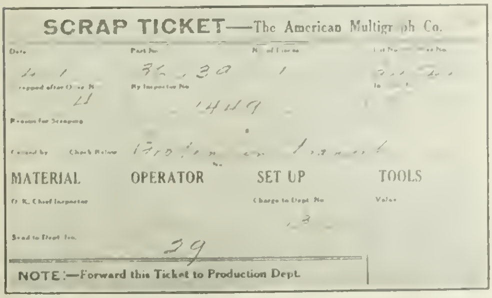
After each department of the factory finishes its work on a given lot of parts, the clerk of that department fills out the ticket that bears the number of his department, and this ticket is torn out of the route book along the perforated line and forwarded to the production department. When the proper notations have been entered on the next ticket in the book, both the partially finished pieces of work and the route book are sent on to the next department in which an operation will be performed. In this connection it is important to note that the route book is placed in a sheet-metal binder which serves to protect it from dirt and damage while passing through the plant. Before forwarding a route book and work, the clerk of the department which has just finished its operation on these pieces enters on a form printed inside of the front cover of the book, as shown in Fig. 2, the number of his department, the number of the operation which has been performed, and the date on which the work was finished, together with notations of the number of finished pieces that passed inspection and the number which were found defective. In this way one complete record of the job is kept with the work until such time as it is completed, and the operation tickets which are detached and forwarded to the production department serve as a duplicate record to be used in the follow-up system.

On the inside of the back cover of the route book, Fig. 2, a form is printed with spaces for entering the part number and lot number corresponding to similar notations on the tickets that are bound in the book; and below there are spaces for entering the date on which completed parts on this order were received in the finished stores department, the number of pieces so received, and the time clock number of the employe by whom they were counted. This route book cover is then sent to the production department where the number of pieces shown as received in the finished stores department is recorded on an inventory record card. This method of procedure constitutes a continual inventory of finished stock.

The operation tickets (Fig. 5) which are received by the production department as a lot is processed through the shop, and also scrap tickets (Fig. 6), are filed according to part numbers and lot numbers, the scrap tickets being placed in the same file with the operation tickets bearing the same part and lot number. By referring to this file, exact information as to the quantity, condition, and location of all work in process is easily and quickly obtainable; and when a route-book cover is received by the production department from the finished stores department, these operation tickets and scrap tickets are withdrawn from the files and checked against the record on the inside of the cover. The scrap tickets and cover are then sent to the cost department, the operation tickets being destroyed.

Recording Labor Charges against Each Job

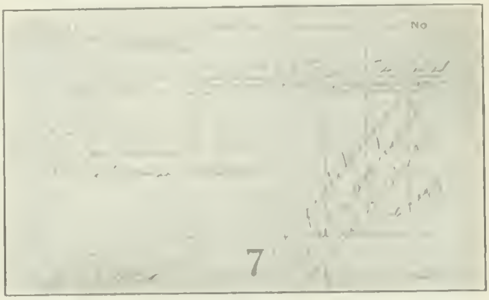
In an introductory paragraph, reference was made to the importance of maintaining accurate records of labor costs that must be charged against each job. For this purpose production cost record tickets are used (see Fig. 8). These tickets are filled out by the foreman or department clerk, showing the part number, lot number, and operation number, as appearing on the operation ticket in the route book. Each employe is required to stamp one of these cards on a time recorder, to show the time at which he started and stopped work on each operation on which he was employed during the day. An exception to this practice of stamping in and out on each job is made in cases where operators are employed on a given job at the end of the day's work. In such cases, their punching out on the regular time-clock is regarded as evidence that they were employed on this job for which a new ticket will be stamped in on the time recorder



SCRAP TICKET—The American Multigraph Co.

Date [illegible] Part No. [illegible] No. of Pieces 1 Lot No. [illegible]
By Inspector No. 1449
Reason for Scrapping
Caused by — Check Below
MATERIAL OPERATOR SET UP TOOLS
O. K. Chief Inspector
Charge to Dept. No. 3
Value
Send to Dept. No. 29
NOTE:—Forward this Ticket to Production Dept.

Fig. 6. Scrap Ticket, showing Result of Investigation conducted to ascertain Cause of spoiling One Piece in Department No. 3



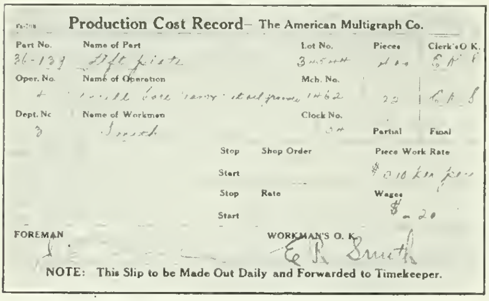
No
7

Fig. 7. Operation Ticket which carries a Notation concerning the Dividing of an Order to expedite Production

on the following morning. These production cost record tickets are sent first to the time department for payroll purposes, and then to the cost department, where they are segregated according to lot order numbers, and the labor is then recorded on the proper cost ledger sheet. The number of parts called for by the labor tickets for each operation is checked with the number of parts, as shown on the inside of the route-book cover, and if scrap has been produced the cost of the scrap parts is computed up to the point at which the spoilage occurred. As a result, an accurate cost is obtained of all O. K. parts and of scrap parts of each production order that is processed through the factory.

Maintenance of an Adequate Supply of all Necessary Parts in the Stock-room

In order for the production manager to so regulate manufacturing operations that there will always be on hand an adequate stock of all parts required in the assembling department, a careful analysis must be made of proposed production schedules for the forthcoming year, and of the requirements of the assembling department for all parts which are called for to produce the necessary number of finished units. It is also necessary to maintain in the stock-room a surplus of certain pieces for which there is a constant sale as parts; and the amount of this surplus varies according to the parts in question. A monthly report is sent to the production manager, which is arranged numerically by part numbers. This report shows the number of pieces of each part number that are on hand in finished stores and in process of production; and it also gives the order numbers of parts of each type that are in process, and the department in which each order is located. Finally, the monthly report shows the number of pieces of a given part number that are required to carry on operations according to schedule. With this record at his disposal, the production manager is able to quickly ascertain those parts for which there is urgent need, and he can then issue instructions to have special efforts made to expedite work so that their completion will be accomplished with the greatest possible dispatch.



Production Cost Record— The American Multigraph Co.

Part No.	Name of Part	Lot No.	Pieces	Clerk's O. K.
36-13[illegible]	[illegible]	34544	[illegible]	[illegible]
Oper. No.	Name of Operation	Mch. No.		
4	[illegible]	1462	22	[illegible]
Dept. No	Name of Workman	Clock No.	Partial	Final
3	Smith	[illegible]		
Stop	Shop Order		Piece Work Rate	
Start			$.010 [illegible]	
Stop	Rate		Wages	
Start			$ .20	

FOREMAN

WORKMAN'S O. K. E. R. Smith

NOTE: This Slip to be Made Out Daily and Forwarded to Timekeeper.

Fig. 8. Production Cost Record Ticket used for recording the Labor to be charged against Each Job

Dividing Orders to Expedite Production

Where an order for pieces in process of manufacture calls for the production of a large number of parts, it will sometimes be found necessary to divide an order to enable the performance of machining operations to be sufficiently expedited to provide for the completion of a smaller number of parts at an earlier date. Such a procedure is found necessary where the supply of these parts in the stock-room is running low and it is required to adopt special means to provide for the needs of the assembling department. When this plan of dividing an order is adopted, a notation concerning the number of pieces which has been taken from the original lot is written across the face of the operation ticket in the route book for the department where this division of the original order was made. Fig. 7 illustrates such a ticket, where 250 pieces have been taken from the order and applied on a special lot No. 34544A. Appending the letter A after the lot number is a signal to the foremen of departments through which this work must still pass before reaching completion, that it is a rush job which must be put through ahead of all regular production work in the plant. A similar notation to that shown in Fig. 7 is also written across the front cover of the route book, as illustrated in Fig. 3, in order to avoid confusion which might otherwise result from dividing the order.

* * *

IRON ORE RESOURCES OF THE WORLD

Recent estimates of the iron ore resources of the world have been published in the United States Commerce Reports. It is stated that the available reserve supply in the Lake Superior district of the United States, in which four-fifths of the iron ore output of this country is produced, is 2,750,000,000 tons of an average grade of 52 per cent iron; the available reserves in the southeastern district, which includes Maryland, Virginia, Tennessee, Georgia, and Alabama, are estimated at 1,750,000,000 tons of 36 per cent grade phosphoric ore; and in the northeastern states, including New York, New Jersey, and Pennsylvania, the estimated reserves are 2,500,000,000 tons of an average grade of 35 per cent iron. Thus, the total estimate of iron ore in the United States is about 7,000,000,000 tons.

The total reserves of Canada have been estimated to be only 150,000,000 tons, but with a vast unexplored section, it is probable that large amounts still remain undiscovered. Newfoundland is credited with 3,635,000,000 tons of 50 per cent iron ore, and the estimated reserve for Cuba is 3,000,000,000 tons of a 36 per cent grade. One of the greatest ore reserves of the world, and certainly the greatest amount of ore suitable for the acid Bessemer process, is situated in the province of Minas Geraes, Brazil. The grade of the ore varies, but the average iron content is over 60 per cent, and the phosphorus is generally below the Bessemer limit. The total available reserves in the Minas Geraes field are estimated to be about 3,500,000,000 tons, while the entire resources of Brazil are estimated to be about 7,500,000,000 tons of 62 per cent grade.

On the opposite side of the earth, an estimate of 3,830,000,000 tons of iron ore is made for the United Kingdom. The ore in Spain averages about 47 per cent iron, and the estimate for that country is 650,000,000 tons. The total reserves of Sweden and Norway are estimated to be 1,470,000,000 tons, which has an average iron content of 54 per cent. The available ore in the field which covers a portion of Alsace-Lorraine, Luxemburg, and Belgium, is about 5,000,000,000 tons of a 30 per cent grade. The reserve estimated for France outside of that included in the field just mentioned, is about 200,000,000 tons, while that of Germany is about 1,300,000,000 tons.

Iron ore of various types is known to exist in South and West Africa, one deposit in French West Africa having recently been found to have a reserve of 100,000,000 tons, with an iron content of over 60 per cent. High-grade ores averaging about 50 per cent iron are found on the north coast of Africa, the reserves being estimated at from 100,000,000 to 150,000,000 tons. Little is known of the iron ore reserves of Australia, except that there are many important deposits.

Summarizing the estimates for the great ore fields of Europe, America, and North Africa, the iron ore resources are as follows: High-grade low phosphorus ores, 6,740,000,000 tons; high-grade phosphoric ores, 6,460,000,000 tons; low-grade ores, 17,100,000,000 tons; total, 30,300,000,000 tons. Another 1,500,000,000 tons should be added for the smaller ore fields of Russia, Austria, Greece, Chile, Venezuela, Mexico, and Canada, making a grand total of 31,800,000,000 tons, of which the equivalent iron is about 14,310,000,000 tons. On the basis of a pig iron production of 70,000,000 tons per year, the estimated quantity of iron ore in reserve is sufficient to last over two hundred years.

Curling Die Construction

By J. BINGHAM, President, The B. J. Stamping Co., Toledo, Ohio

THE punch and die illustrated in Fig. 1 is designed to flange out the bottom of a drinking cup shell and to curl or "wire" the top. This shell is made of tin and has a side seam like all common tinware. The flange enables the bottom of the drinking cup to be double-seamed on. The operation of the die is as follows: Punch *A* carries the curling ring *B*, which is made of tool steel and is hardened and ground. When the punch is in its upper position, the shell, shown in heavy lines, is slipped over the die ring *C*, which operates over the die-block and against spring action, when the punch descends. The amount of movement of this die ring is limited by screw *D*. Springs are placed under the die ring to help feed the shell down on the steel ring *E* by which the flange is formed. By making the springs stiff enough, the work is held up during the wiring operation, or until the pressure exerted by the punch is sufficient to overcome this spring action and press the shell down on ring *E*. All parts, except the tool-steel rings *B* and *E* and screw *D*, are made of cast iron. This construction is rather different from the usual design of dies employed on work of this kind.

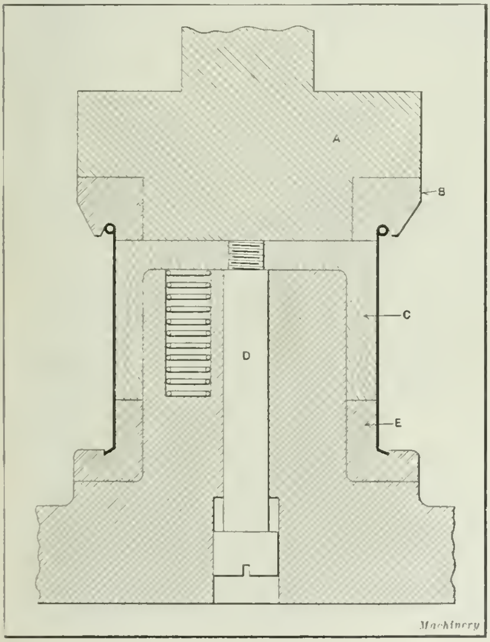


Fig. 1. Combination Curling and Flange-forming Die

Die for Wiring Both Ends of a Tin Shell

The tapered shell shown in heavy outline in Fig. 2 is wired at both ends in one operation by the punch and die illustrated. As the degree of taper is not great, the shell adheres to the sides of the die, and so an expansion punch is not required. Usually when work of this kind is done, the operation is performed on presses of special construction having a long stroke. In such cases side-arm presses are used, sometimes equipped with a sliding die that is mounted on ways on the bolster plate, and may be automatically operated to slide in and out by a mechanism provided under the press, or operated by hand.

The work is made of tin and is seamed. The shell rests in the die *B* with its lower end on the die-plate *C*, so that when punch *A* descends it will come in contact with the work and force it down until a curl of about three-fourths of a full circle is formed at the bottom. It will be noticed that the lower end of the inner surface of ring *B* has a clearance provided to permit the shell to be removed after the curling operation is completed. By the time the shell has been curled at the bottom so that it cannot be forced down any further, the wiring at the top of the shell takes place. The steel ring *D* at the top of the die serves the double purpose of supporting the wire ring during the curling operation and of ejecting the tapered shell from the die on the upward movement of the punch. This ring is operated by suitable springs (not shown in the illustration) so that as soon as the curling ring *E* has completed its work and punch *A* has started to ascend, the shell will be lifted from its seat in the die. The upper part of die *B* has a flange in which ring *D* is confined and by means of which it is guided in its movement.

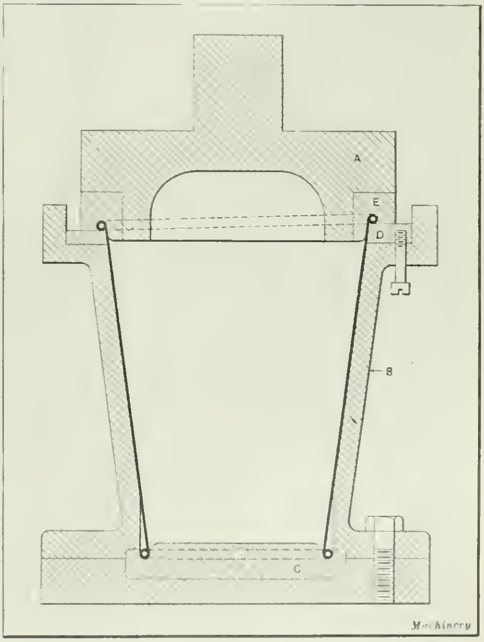


Fig. 2. Die for wiring Both Ends of a Tapered Tin Shell

Die for Forming and Wiring a Flange

The die illustrated in Fig. 3 is used for forming the flange on the cover of a bucket and for wiring this flange. As in the previous cases, the work is shown in heavy lines, and below the die will be seen the shell as formed in the first and second operations. In the first operation a combination die is employed, and in the second operation the top of the shell is cut out. The wiring dies receive the shell in the latter condition and perform the operations in the following manner:

The flange is made of No. 20 gage sheet steel and is placed on the die, on which it is located by three guides *A*. The cast-iron punch *B* carries two tool-steel rings *C* and *D*, both of which are hardened and ground. Ring *C* is the forming member, and operates against springs carried in the punch, while ring *D* is set into the punch for the purpose of curling the formed flange. As the punch descends and the ring *C* comes into contact with the work, the latter becomes partly formed under the spring pressure, and while this is in process, the center guide pad *E*, which is attached to the punch by screws, enters the hole in the shell and acts as a guide while the wiring operation is being performed. At the extreme end of the downward stroke of the press ram, the rings *C* and *D* occupy the position illustrated, ring *C* completing the forming operation after the flange has been curled. On the return stroke of the ram, ring *C*, by reason of its spring action, will eject the shell from the punch on the die so that it may be readily removed. Die *F* is made of tool steel, hardened and ground, and the die-block to which it is welded, is made of wrought iron.

Die for Curling a Flat Band

The work which is curled in the die illustrated in Fig. 4 is a flat band or ring made of No. 16 gage sheet steel, rolled up and with the seam welded. This procedure was followed to avoid drawing the shell and then cutting out the center, thereby saving considerable stock. With the dies open, that is, with the punch in its raised position, sufficient space is available so that the band may be placed in between the steel curling ring *A* and the cast-iron die *B*. There is a clearance of 0.01 inch between the band and the die, which is great enough to enable the work to be removed without much effort. The band fits snugly around the curling ring *A*, which is supported by the familiar rubber buffer construction, and is forced down on this ring during the curling operation by the tool-steel curling punch *C*, which is attached by screws to cast-iron punch *D*. After about one-fourth of this curling operation has been completed, screws *F* are brought to bear against the curling ring and push it down in the die. While the curling ring is being forced down, the remainder of the operation is in process so that the metal is curled back to the required depth, in this case ½ inch. As the punch ascends, ring *A* returns to its proper position by reason of the rubber buffer attachment, so that the curled ring may be lifted from the die, which can be easily accomplished because the metal springs sufficiently not to adhere to the ring. The clearance between the work and the interior of the die provides for this condition.

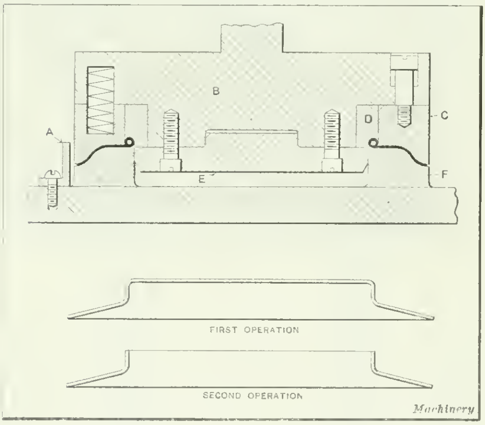


Fig. 3. Combination Forming and Wiring Die for Bucket Cover Flanges

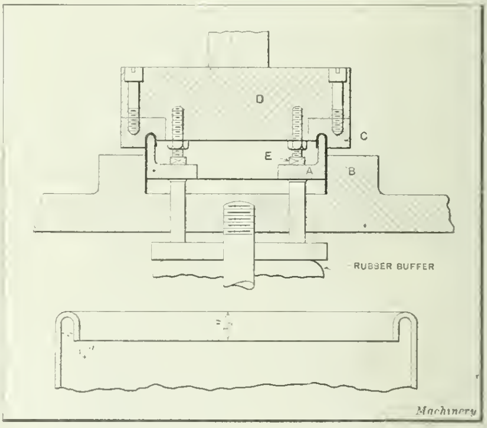


Fig. 4. Dies used for curling a Seamed Flat Band or Ring

MAGNESIUM ALLOY FOR MOTOR PISTONS

A new alloy consisting of 90 per cent magnesium is the lightest known metal adapted for commercial uses, according to an article by George Gaulois in the *Scientific American*. This alloy, which is called Dow metal, is one-quarter the weight of cast iron and one-third lighter than aluminum. The main use found for it thus far has been in the manufacture of pistons for automobiles, airplanes, and motor boats. It possesses a tensile strength ranging from 22,000 to 25,000 pounds per square inch, has no abrasive or scoring action on cast-iron cylinders, and has approximately the same coefficient of expansion as other light piston alloys. The difference between this metal and aluminum, as far as expanding under heat in a motor is concerned, is that the magnesium alloy has no permanent growth or set at these high temperatures. Recent tests have shown that with twenty-one successive heats made for two hours each, at temperatures up to 800 degrees F., the permanent growth is so minute that it cannot be detected with a micrometer.

In machining the metal, no cutting compound is necessary. Great resiliency is shown by a recent test in which a piston was placed in a vise and contracted ¼ inch. Upon being released from the vise, the piston returned to the original size, the only difference being that it was about 0.004 inch out of round. The important physical properties of the alloy are as follows: Specific gravity, 1.79; tensile strength, 22,000 to 25,000 pounds per square inch; yield point, 12,000 to 14,000 pounds per square inch; compressive strength, 45,000 pounds per square inch; elongation on a two-inch test piece, 3.5 per cent; reduction in area, 3.5 per cent; modulus of elasticity, 9,000,000; and Brinell hardness 55 to 75.

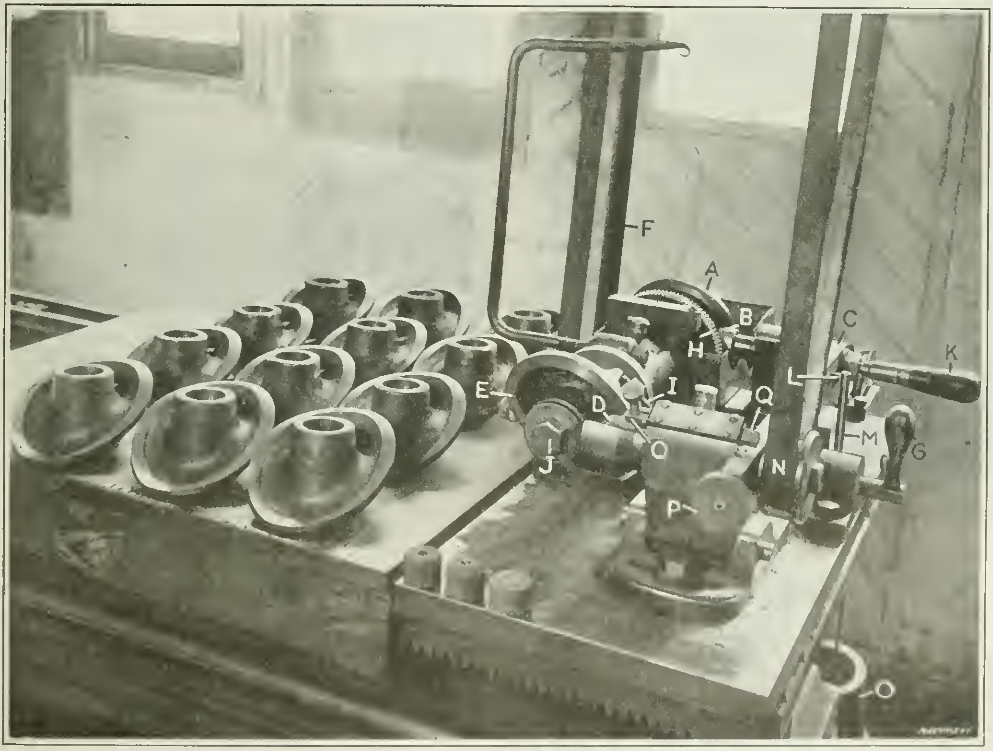
When the metal is reworked or rolled, drawn, drop-forged, or heat-treated, the tensile strength is increased by each operation. In heat-treating sand castings, the tensile strength is increased from 22,000 to 30,000 pounds per square inch without causing any appreciable change in the yield point, while the elongation and reduction in area are increased 6 per cent. In drop-forging, the tensile strength is increased to 50,000 pounds per square inch and the Brinell hardness rises to 70 or higher. An actual test of a piston made from this metal is being conducted in a light roadster, the piston having now been in constant service for over a year, during which time the automobile has traveled over 20,000 miles. This piston is still giving good service. Another test in the plant of a motor manufacturer showed that motors developed six horsepower more with the pistons made from this alloy than had been developed with any other material.

Grinding Shaper Cross-feed Cams

IN the automatic cross-feed mechanism of shapers built by the Queen City Machine Tool Co., Cincinnati, Ohio, a cam is used which is of the form shown at the left-hand side of the accompanying illustration. The illustration also shows a special grinding machine that affords a simple and rapid method of grinding the track on these cams. The principle governing its operation is that of having a master cam of the required form, which rotates in unison with the work and adjusts the position of the wheel so that the work is ground to the required contour.

In working out the details of the mechanism of this machine, provision was made for obtaining the operating conditions outlined in the preceding paragraph by the following means: Master cam *A* has a roller *B* running in contact with it; this roller is carried on a pivoted head that is secured to one end of a link *C*, which oscillates the grinding wheel *D*, the latter being carried by a similar pivoted head secured to the opposite end of link *C*. Wheel *D* grinds cam *E*. Master cam *A* and cam *E* to be ground are mounted at opposite ends of the same shaft, and they are rotated in unison by means of belt *F*. Lever *G* at the operating side of the machine provides for the engagement or disengagement of a positive-jawed clutch on the driving pulley that carries belt *F;* and the power is transmitted from this pulley through a worm and worm-wheel *H*, which reduce the speed of rotation of the master cam and the work to six revolutions per minute.

Cam *E* to be ground is first bored and faced in a Jones & Lamson flat turret lathe, equipped with a special chuck, care being taken to maintain the cam track in an accurate position. This assures performing the grinding operation in a minimum length of time. Cam *E* is slipped on the nose of the special grinding machine spindle, and its position is then adjusted by means of a thumb-screw *I*, which bears against a rib on the back of the cam, the purpose being to locate the cam that is to be ground in a position corresponding exactly with the position of the master cam *A* on the spindle by which these two pieces are carried. After this adjustment of the position of the work has been accomplished, the cam is clamped in place by means of a bolt *J*.



Special Machine used for grinding Cams for the Automatic Cross-feed Mechanism of Queen City Shapers

Hand-lever *K* makes it possible for the operator to pull both the cam-roller *B* and the grinding wheel *D* out of contact with the master cam and the work, respectively; carried on link *C* there is a pin *L*, so that when it is desired to hold the grinding wheel and cam-roller out of contact with the work and the master cam, a pin *M* carried on a sliding member can be pushed into place behind pin *L* while in its forward position, thus keeping these two pairs of contacting members disengaged. The ball-bearing grinding wheel spindle is driven at a speed of 12,000 revolutions per minute by means of an independent belt *N*. The pressure of the grinding wheel against the work, and of the roller *B* in contact with master cam *A*, is maintained by a weight *O* that is attached to the link *C* by means of a cable.

Grinding wheel *D* is fed to the work by a screw operated automatically through a mechanism of which ratchet wheel *P* is a part, that provides for shortening the distance between the points of connection of the oscillating heads (carrying grinding wheel *D* and cam-roller *B*) with the link *C*. Carried on the grinding wheel head, there is a diamond wheel truing device *Q* which is always available for use in dressing the grinding wheel. After a smooth surface has been obtained on the work and before removing it from the machine, the wheel is trued, after which a final finish-grinding operation is performed, that assures obtaining an accurate bearing between the track on the cam and the roller that runs in contact with it, when assembled in the automatic cross-feed mechanism of the Queen City shaper. Attention is also called to the fact that normally there are guards covering the master cam *A* and the worm-wheel *H*, and the grinding wheel *D* and the work *E*, as well as other running members of the mechanism; but these guards were temporarily removed, in order to more clearly illustrate the arrangement of the mechanism. This machine is of simple and compact design, and performs the cam grinding operation in about sixteen minutes.

* * *

ECONOMICAL USE OF COAL

Coal conservation by the use of the most modern appliances was urged by the director of the United States Geological Survey in a recent address. It was pointed out that the small steam plant by necessity wastes an enormous amount of the coal that is being burned, because of the impossibility of recovering more than a small percentage in actual power. The large electric generating station using modern steam turbine equipment is able to reduce this waste by a large percentage, simply because more modern appliances and bigger power units are employed. It has often been predicted that some time in the future large central power plants will be located at the coal mines, the fuel being burned directly without transportation, and electric current instead of coal being carried from these points to the industrial centers where power is required. It is obvious that in this way a twofold saving would be accomplished: First, the enormous amount of power now used merely for transporting coal would be saved; and second, the large power units possible in central stations located at the mines would be able to produce power very cheaply.

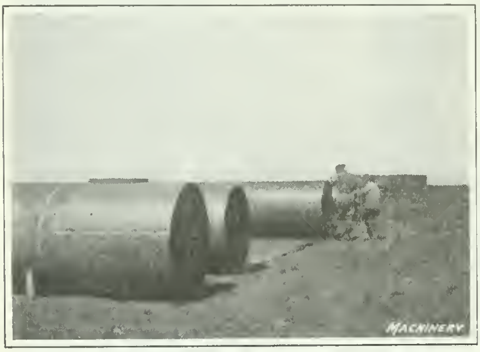


Fig. 1. Absorption Towers being welded by the Oxy-acetylene Process

* * *

The Holt Mfg. Co. of Stockton, Cal., says *Safety Engineering*, has posted a bulletin throughout the plant, pointing out to the employes what fire losses mean economically to every individual. According to this bulletin the per capita fire loss in the United States is $3.13 annually, as compared with 61 cents in England, and 49 cents in France.

OXY-ACETYLENE WELDED CONSTRUCTION OF GASOLINE PLANT

A new casing-head gasoline plant erected recently for the Charles F. Noble Oil & Gas Co., at Burk-Burnett, Texas, by the L. D. Gunn Co., Wichita Falls, Texas, is of interest because of the fact that all-welded construction is employed throughout the plant. Ordinarily this class of work would require threaded pipe, but the difficulty of obtaining this material was a serious obstacle in this instance, whereas plain-end pipe could be bought for immediate delivery and at a considerably lower cost. The previous successful experience of the Gunn Co. in using the oxy-acetylene welding process in the Oklahoma and Texas oil fields convinced the operators that a thoroughly satisfactory system, which would stand up under severe pressure test, could be constructed by welding the joints of tanks, pressure separators, etc., as well as the joints of pipe lines.

In the foreground of Fig. 1, are shown two absorption towers of all-welded construction, while in the background are shown the welders at work on a similar tower. From this illustration it will be seen that the seams or joints on the finished towers are smooth and have a substantial appearance. The casing-head gasoline tank shown in the foreground of Fig. 2, and the line of casing-head absorption towers at the rear are good examples of the heavy welded construction employed throughout the plant. In putting up pipe lines, it was found feasible to weld where special pipe fittings would ordinarily be required. It was found that right-angle turns, T-connections, and reducers, could be easily made up. By using the oxy-acetylene flame the pipe could not only be welded but could also be cut to the required length, both operations being performed by one welder.

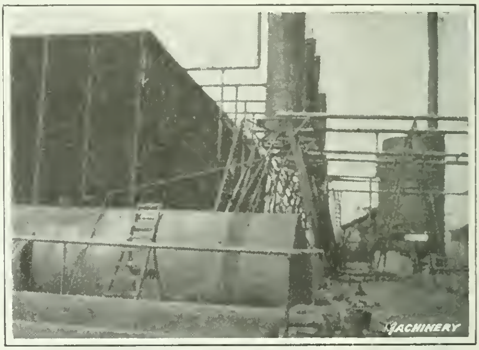


Fig. 2. Gasoline Absorption Towers and Pipe Lines of Welded Construction

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INTERNATIONAL AGREEMENT ON WAR-TIME PATENTS

An international agreement concerning the preservation or re-establishment of patent rights and property rights in designs and trademarks affected by the war has, according to *Engineering*, been signed and ratified by Great Britain, France, Germany, Poland, Sweden, Switzerland, Tunis, Czecho-Slovakia, the Netherlands, and Portugal. The arrangement provides for extensions of time for filing applications under the International Convention for the protection of industrial property, and also for extensions of time for accomplishing any act, fulfilling any formality, paying any fees, and generally satisfying any obligation prescribed by the laws or the regulations of the signatory states. The new arrangement gives the patentees the right to apply for a patent or pay an overdue tax, in cases where they had been unable to take the necessary action owing to circumstances arising out of the war.

Molding a Deep Cast-iron Hopper

By M. E. DUGGAN

THIS description concerns the molding of a deep cast-iron hopper used for receiving ashes deposited from steam boilers. These hoppers, or ash receivers, have caused much trouble both in their production in the foundry and when subsequently used under the boilers. The trouble experienced in the foundry started with the design of the part in the drafting-room.

Referring to Fig. 1, it will be noted that the hopper is wide, and quite deep through the V-section, and that the sides are parallel. The interpretation of the drawing by the patternmaker led to the making of the pattern without draft, to be molded in green sand. It was intended that the inside of the mold be lifted with the cope, the outside of the pattern being located in the drag side of the mold. It will at once be apparent that the patternmaker should have provided the customary draft, particularly in view of the depth of the casting and the method of molding. It was extremely difficult to lift the heavy body of sand out of the inside of the pattern or to withdraw the pattern from the drag, a fact which naturally reflected on the judgment of the patternmaker. When making the mold in the regular way with this pattern, a great deal of trouble was experienced in lifting the cope, because the sand on the side of the mold was sheared away. The same difficulty was also experienced in withdrawing the pattern from the drag half of the mold, which necessitated that the disturbed part of the mold be mended and slicked over.

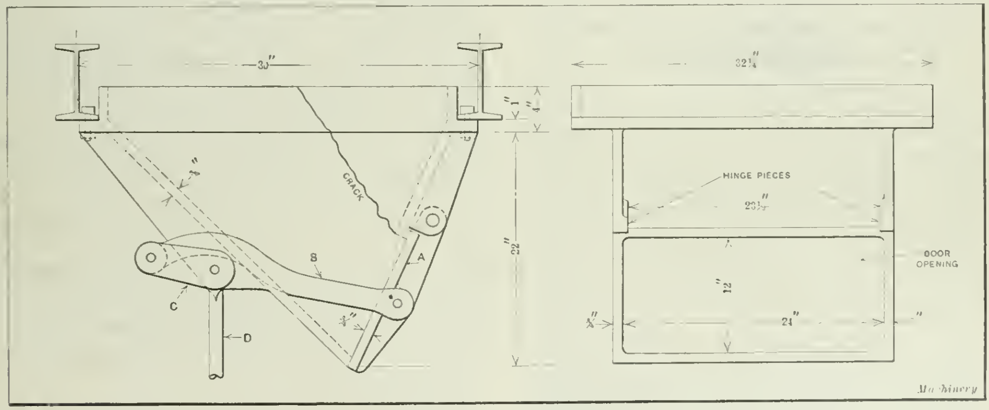


Fig. 1. View of Cast-iron Hopper showing how Inefficient Foundry Methods resulted in Failure in Service

Before considering the effect of thus repairing the mold on the quality and service of the casting, it will be well to refer to the design of the hopper itself, as indicated in Fig. 1. It will be seen that the thickness of the metal is ¾ inch, the depth 26 inches, and the width 25½ inches on the main body and 32¼ inches on the upper portion. The weight of this shell should be approximately 600 pounds, but the shearing away of the sand in making the mold and the subsequent mending and slicking resulted in an uneven increase in the thickness of the wall varying from 1 inch to 1¾ inches. It will be readily seen that this added materially to the weight of the casting, the actual weight being 775 pounds, or 175 pounds greater than was intended.

This increase in weight is objectionable, especially since it is unevenly distributed. In this connection, it is well to consider the kind of service that is required of the hopper. The casting is fastened with bolts to I-beams in the boiler-room floor (see Fig. 1). A door *A* covers the discharge opening in the hopper, and is operated by lever *B*, bellcrank *C*, and lever *D*, one such mechanism being provided on each side of the hopper. The hot ash falling into and remaining for some time in the hopper produces sufficient heat to cause the uneven walls to become red-hot in spots. The resulting expansion and distortion, augmented by the weight of the ash and of the casting, exerts a severe strain on the locking levers *B*, which is very likely to result in the hopper becoming cracked in its weakest section. A logical place to expect such a fracture is in the vicinity of the door hinge, as indicated. Sometimes this crack is large enough so that when the door is released an entire section of the casting will drop away. It will thus be seen that either through the failure of the draftsman to indicate the methods of molding properly, or through the patternmaker's error of judgment, a serious condition resulted which might easily have been prevented.

The molding problem is one which must always be handled wisely and with due consideration for the cost factor. It might even be wise to produce the casting here described and illustrated, as it actually was produced, if there were only two or possibly three castings to be made, but a great deal more labor and care would be required in molding than would otherwise be necessary and the product would at the same time be inferior. When a number of castings are to be made, as in the present case, however, the matters of design and production should be considered, and the most efficient molding scheme should then be followed.

In this connection, it is well to consider how the casting was produced in a certain foundry where an order for forty had been received. The pattern was changed to give a 2-inch draft on the sides, and provision was made for using a dry sand core in place of the green sand formerly used. A sectional view of the mold is shown in Fig. 2 from which it will be seen that the upper part is molded in the cope and that the mold is parted so as to bring the core entirely in the drag. A new pattern was, of course, required as well as a core-box. Attention is directed to the method of setting the core. It will be seen that the new pattern provides a

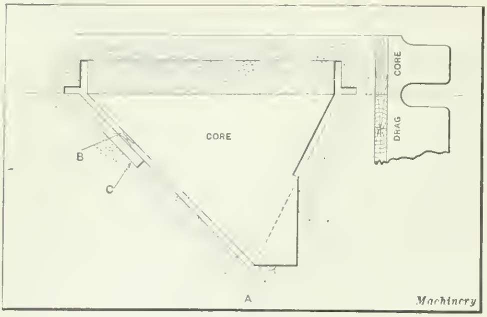


Fig. 2. Cross-section of Hopper Casting Mold using Dry Sand Core with Special Supporting Provision

foot-rest for the core. This is rather an unusual idea and is made possible by the door opening in the wall of the casting. The back of the core is supported by stud chaplets *B*, which rest on a slab core *C*. This slab core is rammed up with the mold and furnishes a substantial seat for supporting the weight of the core.

This method of molding is much quicker than the method previously mentioned, and the product is much more accurate and uniform; consequently the weight is correct. The advantage of predetermining the method of procedure in molding propositions such as this is forcefully shown in the present case.

* * *

GRINDING A KEYWAY GAGE FOR A TAPERED HOLE

By J. B. GRAY

The accompanying illustration shows a gage which is required to be replaced frequently, and which presents a rather unusual grinding problem, due to the fact that the dimensions as given in the illustration must be accurately maintained. It is especially desirable that the two radius dimensions, 0.623 inch and 0.750 inch be correct, and it is important that a means be provided whereby these dimensions can be easily tested or checked from time to time by the inspector. The keyway gage is used to gage the distance from one side of a tapered hole to the bottom of a keyway diametrically opposite, within a tolerance of 0.002 inch. Were it not for the 1/8-inch dimension which represents the depth of the keyway, the nominal diameter of the gage at the large end would be 1 1/4 inches. Allowing 0.004 inch for a drive fit, the diameter of the "Go" gage at the large end would be 1.246 inches, and the large end of the "Not Go" gage would be 1.250 inches in diameter. One-half of the "Go" gage has a dimension of 0.623 inch, as shown in the illustration. The radius dimension of the other half of the gage, including the depth of the keyway, is 0.750 inch.

Surface *A* represents the "Not Go" or full size step, while step *B* represents the "Go" or minimum dimension. Therefore, if the face of the work lies between these two steps, when the gage is inserted in the hole, it is known that the work is within the required limits of accuracy. A collar *C* provided with a handle *E*, as shown by the dotted lines, is secured to the handle of the gage by the set-screw *D*, and is used to rock the gage when grinding the taper on the short side.

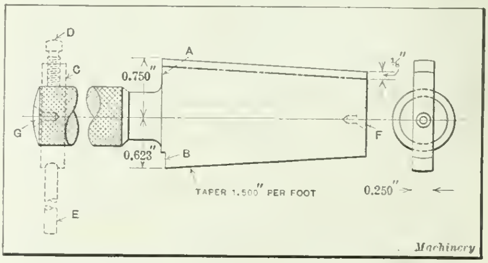
In making the gage, the first thing to consider is the production of centers at *F* and *G*. These centers must be smooth and true, and should be lapped before the gage is ground. A stop-collar should be placed on the drill when drilling the centers in order to keep them a uniform depth. The stock from which the gage is to be made, and also two auxiliary full-round pieces of stock of the same length and diameter should be centered as described.

Both the gage and the auxiliary pieces which are to be used in connection with the production of the gage, are hardened after the preliminary machining operations. The centers are next lapped, after which one of the auxiliary pieces is placed in the grinder. This piece is first ground straight and a facing cut taken over one end, in order to obtain a true surface that can be used in setting the machine to grind the required taper. Then the piece is taper-ground to nearly 1.500 inches at the larger end, after which the grinding wheel is carefully trued up, and the blank is finish-ground to the exact dimension, thus obtaining the radius 0.750 inch as indicated in the illustration.

After the grinder stop is set to this size, or the setting of the machine is noted, the blank is removed and replaced by the piece from which the gage is to be made. This piece is then ground down to the correct size, being rotated on centers, and a stop, or the graduations on the cross-feed handwheel employed to determine when the work is the required size. Next the gage and the auxiliary piece are compared by placing them in a lathe or some other machine, the centers of which have been carefully ground and tested. A dial indicator is used in making the comparison, and it will, of course, be found that the gage is still somewhat larger than the auxiliary piece, owing to the slight wear on the wheel which takes place after making the initial setting of the machine. As the indicator shows the amount of difference between the gage and the piece, it is a simple matter to replace the gage in the grinder and remove the amount of material required to bring it down to the same size as the auxiliary piece. It may be necessary to make several comparisons and take several light finishing cuts before this is accomplished.

As the side of the gage having the shorter radius cannot be ground by rotating the work, a somewhat different procedure is necessary. In grinding this side, the other auxiliary piece is ground until it measures 1.246 inches at the large end, or twice the amount of the radius, 0.623 inch, indicated in the illustration. The stop on the machine is set at this position, as in the case of the previous grinding operation, and the gage placed in the grinder. After backing out the wheel—or the work, as the case may be—the traverse feed is engaged and the work rocked by operating rod *E* with the hand, until the gage is ground down to size. The testing or comparison between the auxiliary piece and the gage is the same as that employed in grinding the gage to the 0.750-inch dimension. By keeping the two auxiliary pieces for permanent reference, the gage can be duplicated at any time, or one auxiliary piece may be used, and ground first to the larger size, and then to the smaller size; when, however, many of these keyway gages are used, two test pieces will prove advisable.

The method by which this gage was produced may be used to advantage by others having similar gage-making problems. The method of comparing the work with a full round test-piece insures accuracy and eliminates the chance for errors which are likely to occur when only the graduations on the feed-screw of the grinder are relied upon to determine the size. Another advantage of this method is that it produces a gage which can be easily checked for accuracy by the inspector.



Gage for gaging Depth of Keyway in Tapered Hole

New Precision Measuring Device

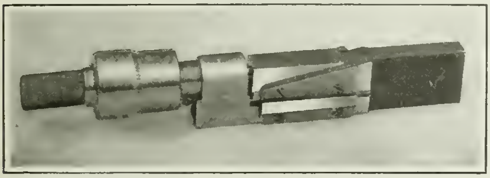


Fig. 1. Hanson Precision Measuring Device with Upright and Sliding Head removed, showing Tapered Wedge

A NEW precision measuring device which makes it possible to measure accurately to within a hundred-thousandth part of an inch by the use of only six precision measuring blocks has been designed by B. M. W. Hanson of Hartford, Conn. With this device a complete set of precision blocks becomes unnecessary, and measurements can be obtained more rapidly than by picking out a large number of blocks in order to obtain the desired combination. The device, as shown in the accompanying illustrations, Figs. 1 and 2, consists of a base in which is mounted a taper wedge actuated by a micrometer screw, and an upright. The graduated thimble of the micrometer screw is of larger diameter than on an ordinary micrometer, so that graduations indicating 0.0001 inch are approximately 1/16 inch apart, making it possible, by means of a vernier, to read variations to 0.00001 inch.

It will be seen by referring to the illustrations that the taper wedge, which is an accurately lapped block sliding upon a lapped surface on the base, may be moved forward by the micrometer screw. The angle on the taper block is so selected that as the micrometer screw moves forward one-thousandth inch, the top of the block is raised two ten-thousandths inch, and in this way very small variations in dimensions may be detected.

The device is provided with an upright, attached at the lower end to the base block, which it straddles. In the slot in the center of the upright slides a head which is used for holding and binding the upper measuring bar in any desired position; thus it is evident that when the upper measuring bar is in place, the device may be used much in the same way as a micrometer, except that it will measure with much greater accuracy. Two binding screws are provided for the sliding head; one merely provides for a good sliding fit of the head when the instrument is in use, while the other is a positive binding screw that will bind the head to the upright in any given position.

The device, as shown in the illustrations, has a measuring capacity or range from 0 to 3.200 inches, and may be employed to measure accurately any dimension within this range by the use of six Johansson measuring blocks—two 1 inch; one ½ inch; one 0.300, one 0.200, and one 0.100 inch. As the taper wedge has a lateral movement of ½ inch, its top surface has a vertical movement of 0.1 inch, so that any dimensions between 0 and 0.1 inch may be measured without an additional block. An advantage of the instrument is that it is practicable to measure extremely thin parts with it. If the movable top jaw is placed directly on the wedge, measurements beginning with 0 may be taken.

Use of the Device for Measuring Work

It is clear that when the device is to be used for measuring, the thimble is set at 0, when the top surface of the wedge and of the lower or fixed measuring jaw will be level. Then the approximate size to be measured is built up with precision blocks placed between the wedge and the upper or movable jaw, as shown in Fig. 2. The sliding head is next brought down upon the movable jaw and the horizontal clamping screw is tightened, which holds the blocks and the jaw firmly in place but still permits them and the head to slide within the upright when the taper wedge is actuated by a movement of the micrometer screw. As the size between the two jaws is now accurately known when the micrometer reads 0, it will be clearly seen that the accurate dimension of the piece to be measured may be determined by actuating the micrometer screw and thereby moving the upper measuring jaw as required.

It is evident that when a measurement is to be taken of an unknown size, it would be very difficult to obtain the measurement by the use of precision blocks alone, as the user cannot guess what combination of blocks he needs in order to make a comparison with his unknown measurement. With the device described, the user picks out blocks to make up the approximate size, and then obtains his final measurement by the adjustment of the wedge until the jaws fit over the piece being measured.

Using the Device as a Height Gage

The device may be used for obtaining the height from one surface to another, as for example in planer work or surface grinding. The height wanted is built up with a combination of the wedge and the blocks, and the planer tool may be readily set to the exact dimension required; or, if it is desired to determine the exact dimension from one planed surface to another, it is only necessary to place a parallel on the top of the upper surface, place the instrument on the lower surface, fill it with blocks until nearly the correct dimension has been obtained, and then actuate the wedge by the micrometer screw until the instrument with its blocks fits between the lower surface and the parallel resting on the upper surface. The dimension may then be read off directly from the barrel of the micrometer screw. The upper jaw may protrude beyond the lower jaw if required, and in this way the distances from one surface to another may also be easily measured. By making the end of the upper jaw into a sharp edge, so that the lower surface

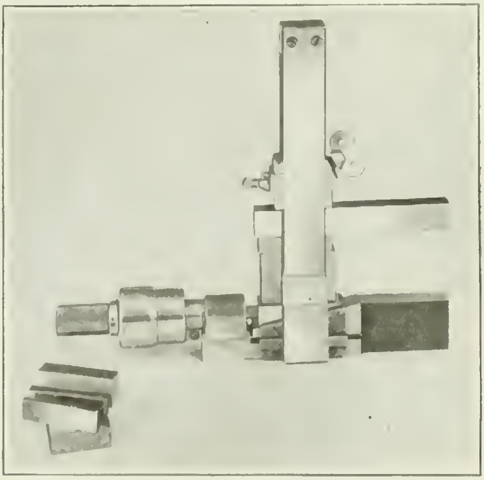


Fig. 2. Precision Measuring Device with Upright in Position Ready for taking Measurements

of the upper jaw ends in a sharp point, this point may be used for accurately scratching lines for accurate machining.

Practical Application of the Measuring Device

One of the main features in connection with the design of this measuring device is that it is intended to be a practicable measuring tool for shop use and not an instrument for laboratory application. While the instrument will measure to one-hundred-thousandth inch as accurately as any other instrument adapted for shop use, mechanics know that it is seldom or ever that it is necessary to measure to any such accuracy in shop work, and the fact that the instrument will measure with ease to an accuracy of a ten-thousandth part of an inch is really what commends it for general use.

Adjustment for Wear

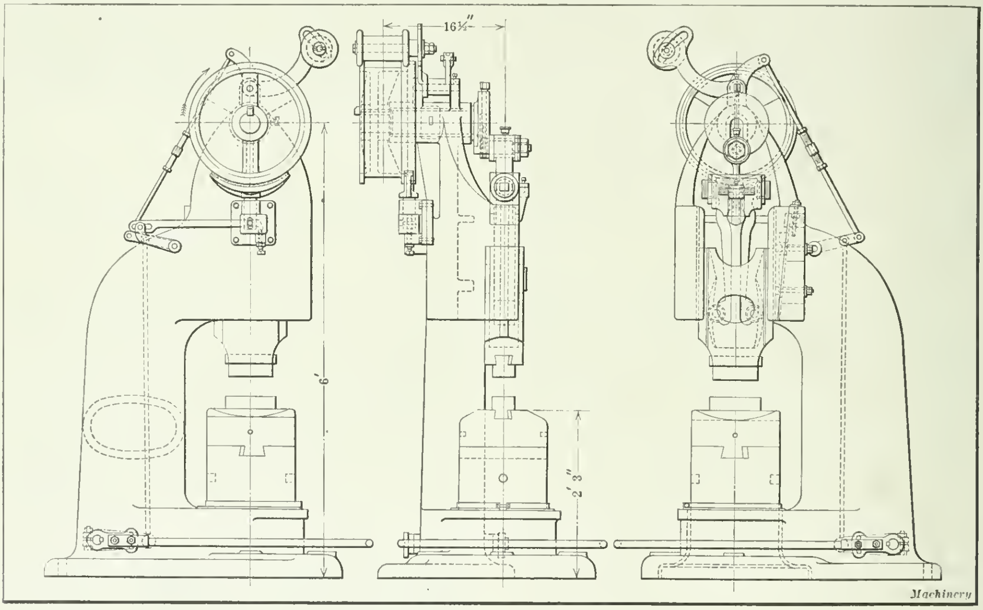
When after long use any wear occurs that affects the accuracy of the instrument, such wear may be easily compensated for. The amount of wear is detected by using for comparison a set of Johansson gages or a reliable measuring machine. The wedge is placed in a number of different positions, and measurements are taken from the top surface of the wedge to the bottom surface of the lower jaw, these measurements being compared with the graduations read off on the barrel. If the micrometer should wear slightly, the barrel can be turned around to the 0 mark in the same manner as when adjusting an ordinary micrometer. If the surfaces have been worn at the points where they are mostly used, they can be relapped; if the user of the instrument has no means for accurately lapping them, the corrections can easily be made by the maker of the instrument.

* * *

According to figures compiled by the *Iron Age*, there are nearly 400 electric furnaces in use in the iron and steel industries of the United States and Canada, and practically the same number in the non-ferrous metal industries. Fifty per cent of the electric furnaces in the steel industry are used in steel foundries, and thirty-three per cent of the furnaces in the non-ferrous metal industries are used for foundry work.

BELT-DRIVEN 200-POUND FORGING HAMMER

Among the machines shown at a recent British exhibition was a belt-driven 200-pound forging hammer built by the Bretts Patent Lifters Co., Ltd., Coventry, England. This machine is shown in the accompanying illustration and is provided with a free tup or hammer head, which permits an elastic blow to be given to the work. The belt is normally somewhat slack, but when the hammer is about to deliver a blow, it is tightened by means of a mechanism operated by a treadle in front of the anvil. The belt drives the machine through a combination pulley and flywheel, keyed to one end of a shaft at the top of the machine. An adjustable crank mounted on the opposite end of this shaft operates a short connecting-rod, at the lower end of which is a cross-head in which are housed the upper ends of two spring arms. These arms extend into the tup and have rollers at their lower ends that run on curved paths. In this way the tup is attached to the arms, but as the latter move up and down following the movements of the crank, the tup is allowed a certain elasticity of movement due to the manner in which it is connected to the arms. Adjustment is provided for the tup slides by means of a long taper shoe on one side. The combination pulley and flywheel is fitted with a brake that is applied when the treadle is released.



Belt-driven 200-pound Forging Hammer

* * *

SYSTEM OF FIT ALLOWANCES

In connection with the article published in the January number of Machinery entitled "A System of Fit Allowances," our attention has been called to the fact that the method of representing tolerances in a diagram by parabolic curves was originated and first adopted by the firm La Précision Mechanique, 11 rue Vergniaud, Paris, France, in 1912. This firm has made a special study of the question of tolerances, and is believed to have been the first one to have enunciated the parabolic law for clearances, tolerances, and fits upon which the article published in the January number was mainly based.

Production Planing in Machine Tool Plants

Methods Used in Planer-building Shops—Third of a Series of Articles

FROM preceding discussions of the classes of machining operations that are generally regarded as planer jobs, it has been made apparent that one of the most general types of work is the finishing of flat surfaces on large castings. Bearing this fact in mind, one would expect to find that planers are extensively used in plants which specialize in building planers. Naturally, the machine tool builder who is engaged in this line of work believes in the merit of his own products, and as a result one finds that planers are largely used in machining the parts of other planers. In this age of specialization, one would also be justified in expecting the methods used on these jobs to represent the most modern practice in the performance of planing operations, and such is actually the case; but in justice to other manufacturers who have made a careful study of the problems connected with the performance of their planing operations, it is only fair to add that the methods of planing that are used in planer builders' shops do not necessarily surpass in efficiency those which have been developed for use on certain other lines of work. Aside from the fact that most of these operations conform to the latest practice, much of this planer work involves the handling and setting up of large castings, and its discussion in the present article will doubtless prove of value to many who could use similar methods for handling work of this character in their own shops. In this connection, attention is called to the fact that all of these methods are of general application, and they could be successfully used with slight modifications for the planing of many different classes of work.

General statements are likely to prove misleading; but probably it is safe to state that many shop men consider it necessary to perform subsequent scraping operations in order to bring planed surfaces to a high degree of accuracy. As a matter of fact, the results obtained where the most approved methods are employed in planing have shown the fallacy of this idea, and in certain cases subsequent scraping of planed surfaces is likely to prove detrimental rather than beneficial. Admittedly, it is often considered necessary to scrape certain bearing surfaces after the preliminary work has been done on a planer; but there are other cases where the use of suitable methods of planing produces a result that fulfills all practical requirements. In this connection, especial emphasis is laid upon the desirability of completing a job by planing in all cases where interchangeability of the planed parts is required, as in the case of planer tables on their beds; also, the scraping of planed surfaces is likely to prove detrimental to the accuracy obtained in planing the fits between members of such structures as the bed, housing, and top brace of a planer. In the present article, there is presented a statement of the experiences of several planer builders in the use of machines of the type which they manufacture, and especial emphasis is laid upon the possibility of holding the dimensions of planed work within close limits.

Accuracy Attainable in Performing Planing Operations

In machine building, it is quite a general practice to scrape two planed surfaces that are required to fit perfectly and to run in contact with each other. This procedure is extensively followed in finishing such work as the slide bearings on various types of machine tools, and there is no question concerning the ability of a skillful workman to produce a satisfactory bearing through scraping two planed surfaces to a final fit. However, scraping not only requires the employment of an experienced and consequently high-priced workman, but it is also a slow and tedious operation, so that the scraping of bearings to a final fit represents no small expenditure of both time and money.

For several years, the G. A. Gray Co., Cincinnati, Ohio, has maintained that by paying more attention to the setting up of planer work and to the performance of planing operations, it would be possible to eliminate much of the scraping that is now done on surfaces which have previously been finish-planed. It is the contention of this company's engineers that practically as well as theoretically, the planer furnishes an ideal method of machining flat surfaces which are required to be straight in both longitudinal and transverse directions. Attainment of such results in the performance of planing operations, presupposes the use of an accurate planer that is in perfect adjustment; and it is also necessary for the work to be set up in such a way that it is held without producing strains resulting from either the unsupported weight of the work or from the pressure applied by the clamps that are used to hold it down on the planer table.

Last, but equally as important as the two preceding factors in the attainment of accuracy in precision planing, is the use of tools which are of the types best suited for performing their respective operations; and these tools must be properly ground to give the required clearance and rake angles, and to present a keen cutting edge to the work. Where all of these points receive the proper attention, it is not claimed that scraping can always be eliminated; but results which are regularly produced in planing parts of G. A. Gray planers have shown conclusively that in many cases the finish-planed surface is better adapted to fulfill a given set of conditions without subsequent scraping, than would be the case if a lot of time were to be spent in going over the previously machined surface with a scraping tool.

Planing V-bearings on G. A. Gray Planer Beds and Tables

The citing of a few typical examples of practice followed by the G. A. Gray Co., in planing parts of the planers of its manufacture, should serve to clear up any misunderstanding which may have been formed in reading the foregoing general discussion. Consider the work of planing the female V-bearings in a planer bed and the male bearings on the table that is to subsequently be assembled on the bed. This work has been developed to a point where users of Gray planers are able to order a new table by simply specifying the size and type of machine, and when it is delivered to the consignee's shop, a new table will fit without scraping. Tables are interchangeable on the beds, end for end. This calls for the planing of V-bearings which are perfectly straight, accurately spaced, and with their sides properly inclined to each other; and such results are produced with finish-planing tools, without depending upon the scraper to fit one of the contacting bearing surfaces to the other.

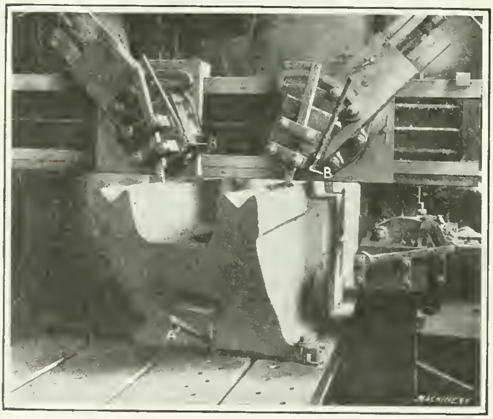


Fig. 1. Close-up View of the Tools used for simultaneously finish-planing Two Sides of the V-bearings in a Planer Bed

As a matter of fact, the V-bearings in Gray planer beds and on the tables are scraped by applying diagonal strokes of the tool, first in one direction and then in the other, with the result that the tool forms a series of diamond-shaped intersections over the work; but the purpose of this scraping is simply to remove any partially abraded particles of metal that might be adhering to the planed bearing, to harden the surfaces, and to create a condition which is more favorable to efficient lubrication. The scraping has no influence upon the fit between the bed and table bearings, as the procedure followed consists merely of going over the work with two series of diagonal strokes in the manner previously described, and a practice is not made of testing the bearing with a film of red lead and scraping down the high spots. The work of fitting the bearings is completed during the course of the finish-planing operations on the bed and table castings.

Planing Fits to Assure a Precise Angular Relationship of Machine Members

In the preceding discussion, mention has been made of the possibilities of planing as a method of obtaining accurate fits between bearing surfaces, but the possibilities of the planer for the performance of precision work are by no means confined to such operations. Another most useful application is in the finishing of surfaces that are to be assembled together, to provide a definite angular relationship between two contacting members of a machine frame or any similar structure. A typical example of this kind is in the planing of the contacting surfaces between the planer housings and bed, and between the top brace and housings.

Attention has been called to the fact that the planer produces a theoretically straight surface. Where the necessary care is taken to obtain the required angular relationship between machined surfaces on a piece of work, the members of a frame built up with planed surfaces at the joints are likely to possess their maximum possible rigidity, due to the uniform bearing that is obtained between the contacting surfaces. Also, such a frame is likely to be more accurate, owing to the ability of the planer to finish one surface at exactly the specified angle to the other surface with which it comes into contact. Scraping will give a satisfactory bearing, but there cannot be the same assurance of accuracy in the angular relationship between surfaces that have been scraped, as there is in the case of carefully planed surfaces.

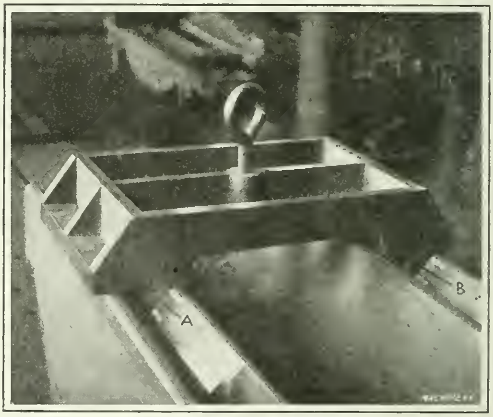


Fig. 2. Close-up View of Gage and Tissue-paper Feelers for testing the Accuracy of Planer Bed Bearings shown in Fig. 1

Setting up G. A. Gray Planer Beds for Planing

Fig. 1 illustrates a 48- by 48-inch by 30-foot Gray planer engaged upon the performance of a finish-planing operation on the V-bearings in the bed of a G. A. Gray planer. After the discussion of methods used in handling planing operations on various types of machine tools, which have been presented in earlier installments of this series of articles, there is no need to dwell upon the sequence of cuts that are taken on this particular job. Interest centers upon the precautions which are observed in setting up the work to be sure that it is free from external strains resulting from the unsupported weight of the casting. If care were not taken to avoid trouble of this kind, there would be a tendency for the casting to sag in places, and even though the bearings were straight at the time of planing, they would be sprung out of a true line after the work was removed from the planer table.

Compensating for Effect of Sagging of the Casting

To avoid such difficulties, the method of procedure followed is to first lower the casting on three blocks, two of which are under the corners at one end, while the third block is centrally located at the opposite end of the work. Three supporting points of this kind are bound to afford a solid foundation, but there is little doubt that the weight of the casting would cause it to sag at the center if dependence were to be placed upon holding it from these three points. Hence, supplementary supporting blocks are placed under the casting, using a pry *A* known as a "pinch bar," which is shown under one end of the casting, to raise it sufficiently so that these additional blocks may be pushed into place. The under side of the casting has already been planed, and small paper packings are placed on top of the blocks, the number of packings at each point being adjusted so that a uniform foundation is provided for the work.

It may be desirable to explain at this point that the pinch bar is a pry of the form shown at *A*, with a pointed end which extends into the space between the casting and the planer bed, that is provided by the supporting blocks, and a heel that constitutes a fulcrum point for the pry. When pressure is applied at the outer end of the bar, it provides for slightly raising the casting so that additional paper packings may be placed on top of the blocks or removed, according to the nature of the adjustment that is required. It will be evident that the leverage ratio from the fulcrum to the point and to the end of the handle of the pinch bar is sufficient so that application of a moderate pressure on the handle will result in slightly raising a very heavy casting at a point adjacent to the block where adjustment is being made, in order to allow paper packings to be put in place or removed as may be required.

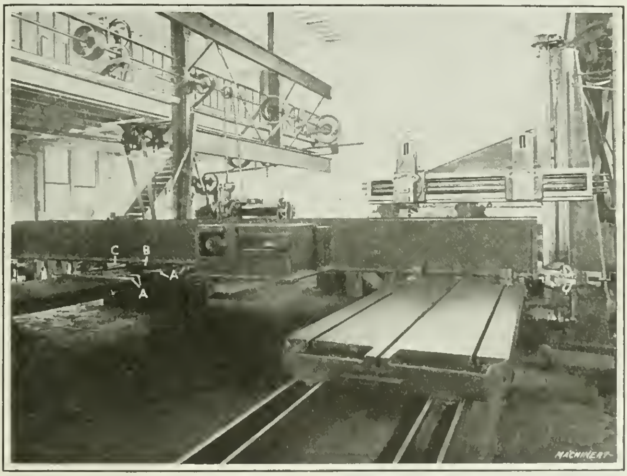


Fig. 3. Use of an Open-side Planer for facing the Ends of the Middle Section of a Three-piece Planer Bed

In using one of these bars, the object is to have the support furnished by packings under the work at each block made exactly uniform. Such being the case, the procedure of the planer hand is to just raise the work with the pinch bar and test the tightness with which the papers are held between each block and the work. The pinch bar is put under one end of the casting at the center, as shown in Fig. 1, and while the work is raised sufficiently for that purpose, the operator takes hold of the first and then the second of the packings above corresponding blocks at opposite sides of the work, and ascertains that they are both held uniformly. If any packing is found to be held too tightly, one or more sheets of paper will be removed; and, conversely, if a packing is found to be too loose, one or more sheets of paper will be added, in order to assure having this supporting point bear its full proportion of the load. With a casting set up in this manner, the operator can proceed with his planing operation with the full assurance that the degree of accuracy attained in planing will be retained when the work is removed from the planer.

At *B* in this illustration, there is shown a convenient form of "lifter" for raising the tool from the work during the return stroke. It consists of a pivoted lever secured to the apron, at the end of which there is a cam in contact with the edge of the tool box. By swinging the lever about its pivotal support, the cam raises the tool out of contact with the work by swinging the apron forward.

Another Method of Using the Pinch Bar

Sometimes it is not possible to apply a pinch bar under one end of the work, and in such cases, the method followed consists of inserting the bar successively beside each of the blocks. This calls for even better judgment than the method illustrated in Fig. 1, because the operator must raise the work at each point until he is able to test the tightness with which the paper packings are held, after which he goes to the next block and repeats the operation, depending on his remembrance of the amount of pressure required to raise the work with the pinch bar, and of the tightness with which the papers were held, to enable him to duplicate conditions at all of the points of support. Naturally, the number of blocks that are placed under a casting will depend upon both its shape and size, and upon the way in which the form of the casting is likely to add to or decrease its flexibility. Large thin castings which are likely to be quite flexible must be supported at numerous points, while in the case of castings of sufficient thickness to afford considerable resistance against flexure, a small number of supporting points will prove adequate. By looking over the illustrations presented in these articles, the reader will be able to judge the number of supporting points for the work that are provided in many different shops.

Gaging Accuracy of Planed Bearings

An idea of the degree of accuracy that is attained in planing Gray planer beds is well illustrated by the use of a gage which is shown in Fig. 2. It will be seen that this tool has two inclined faces *A* and *B* which fit against corresponding sides of the V-bearings; and the gage may be turned around so that these faces also fit against the opposite sides of the two bearings. The test consists of placing a tissue-paper feeler between the work and the upper and lower ends of each of the test points on the gage, as clearly shown in Fig. 2. Used in this way, all four papers must be held in such a manner that no one can be pulled out from between the gage and the work. After finish-planing, this test is repeated at intervals from end to end of the planer bed, and at both sides of the vees; and if there is any point at which all four of the papers are not held between the gage and the work, the finish-planing operation is repeated until the test can be conducted with satisfactory results. This indicates a degree of accuracy considerably in excess of 0.001 inch.

Planing Sectional Bed for Cleveland Open-side Planer

The Cleveland Planer Co., Cleveland, Ohio, specializes in the building of open-side planers, and in Fig. 3 there is illustrated a machine of this type engaged upon the performance of a job for which the open-side planer is well adapted. The piece that is being machined is part of a

Cleveland planer bed, which is of such length that it is required to be made in three sections. The middle section is shown in place on the planer table, and it will be seen that it is flanged at each end so that after the ends of all the sections have been planed square with the ways, they can be held together by means of bolts through the flanges. It is the planing of one end of this bed section which is shown in Fig. 3, the side-head of the planer being utilized for that purpose. This casting is 27 feet long, and it will be seen that one end is strapped down to the planer table by means of three substantial straps at each side.

Of greatest interest in connection with the performance of this planing operation is the method of providing outboard support for the work. This is accomplished by placing a planer table on blocks of sufficient height to hold it at a level about four inches lower than the table of the planer on which the work is mounted. It will be seen that four rollers *A*, made of cold-rolled shafting, have an I-beam *B* placed transversely across them. The casting to be planed is then lowered into place, with one end resting on the planer table and the other end on two pairs of wedges (one of which is shown at *C*) which are placed between the I-beam and the work, with their inclined faces in opposite directions. It will be evident that by tapping opposite ends of the two wedges in each pair, provision is made for adjusting the height of support so that the outboard end of the casting is held accurately at the level of the planer table on which its opposite end is clamped while being machined.

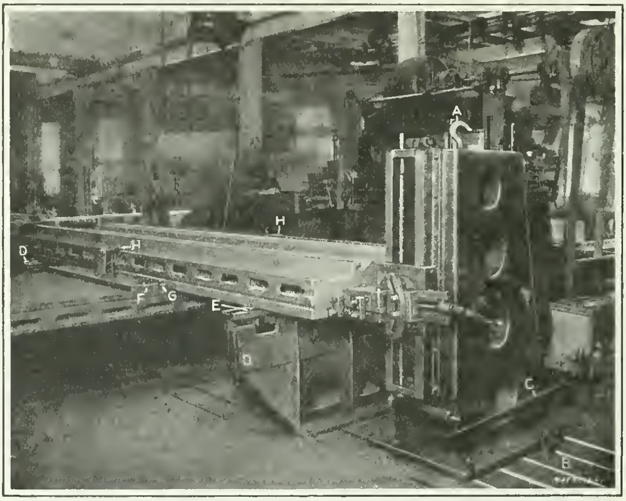


Fig. 4. Use of an Independent Housing carrying a Side-head for planing the Ends of a Sectional Planer Table. Outriggers D are used to support the Overhanging Ends of the Work

Furthermore, it will be evident that rollers *A* are for the purpose of allowing the planer table to carry the work back and forth, without any tendency for frictional resistance to disturb the setting of the end of the casting on which the planing operation is being performed. There is a saying among experienced planer-hands that a job set up is half performed, and the present example constitutes an excellent case in point. The actual planing operation is quite simple, consisting of taking a roughing cut with a round-nosed tool held by the side-head, using a feed of 1/4 inch and a cutting speed of 45 feet per minute. Then a finishing cut is taken with a broad square-nosed gooseneck tool, with a feed of 1 inch and a cutting speed of 45 feet per minute. The time required for setting up one of these castings and for performing the planing operation at each end is approximately two hours.

Planing Joints of G. A. Gray Sectional Planer Table

A description has just been given of the procedure followed in making long planer beds, where it is desirable to use two or more castings which are accurately abutted together to produce a bed of the required length. In the case of these planers of unusual length, the same general method is employed in making the table, and Fig. 4 shows the performance of the planing operation on one end of such a sectional table casting in the plant of the G. A. Gray Co., on a 48- by 72-inch by 24-foot widened pattern planer of this company's manufacture. This is another case where the work is of too great length for the capacity of a double-housing planer, and the accompanying illustration shows a substitute for the open-side type of machine. It consists of employing what is known as an "independent housing" which is furnished with a hook *A* at the top, so that it can be conveniently carried by a crane and placed beside any double housing planer in conjunction with which the independent housing is to be used. Where equipments of this kind are frequently employed, a practice is made of setting floor plates *B* transversely beneath the planer bed, so that a level foundation is provided for the independent housing; this foundation has T-slots machined in it to receive the heads of bolts that hold the independent housing in place. From the illustration it will be evident that there is a link mechanism *C*, which is connected to the regular planer feed and transmits motion to a vertical screw which feeds the head on the independent housing.

Provision for Overcoming Flexure of the Work

For holding a long casting such as the one shown placed transversely on the planer table, flexure of the work would make it impossible to plane the ends perpendicular to other previously finished faces, unless some auxiliary support were furnished to supplement that of the planer table. The means provided for this purpose consist of the use of what are known as "outriggers." Two of these devices are mounted on the floor plate, as shown at *D*, about midway between the sides of the planer table and the ends of the work. Each of these outriggers is furnished with a shoe *E* upon which the work rests, and this shoe slides on a bearing at the top of the outrigger. It will be seen that the upper member which carries the bearing for the sliding shoe is made independent of the foundation, so that adjustment is furnished to take up any twist in the casting, regardless of whether or not the foundation is absolutely level.

Previous to the planing of the end joints on this table casting, the top, bottom, and sides have been finish-planed, and one of these side faces is used as a locating point for setting up the work for performing the present operation. It will be seen that a special form of end-stop *F* is bolted to the planer table, and a parallel strip *G* is placed between this stop and the work, both the strip and the sides of the stop being carefully planed so that they are absolutely straight and parallel. Then the work is held down by a single strap *H*, and there is a similar strap at the opposite side of the work, dependence being placed upon the weight of the casting to assist in holding it down. The sequence of planing operations consists of taking a roughing cut with a round-nosed tool and a semi-finishing cut with a square-nosed tool; then one or more finishing cuts are taken until the end joint has been planed up so that tests show it to be square with the previously finished ways on the planer table.

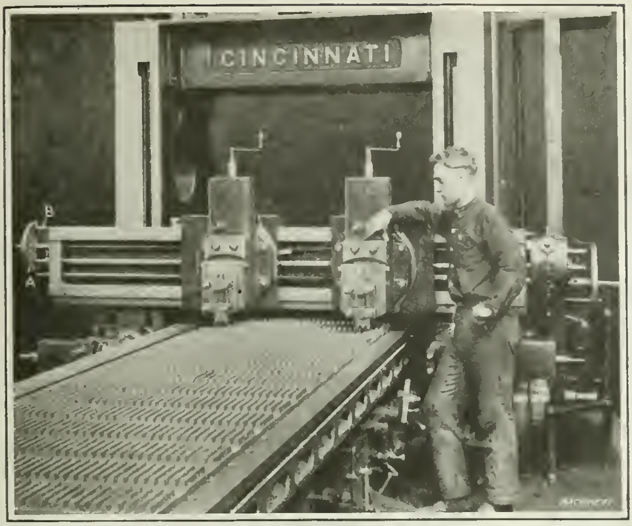


Fig. 5. Planer equipped with Multiple Tools and an Indexing Mechanism for planing the Teeth in Planer-table Driving Racks

Planing Teeth of Driving Racks for Cincinnati Planer Tables

The rack which is secured to the under side of a planer table, and meshes with the bull wheel is often made in sections. Large numbers of such racks are required by the Cincinnati Planer Co., Cincinnati, Ohio, for use on machines of its manufacture, and Fig. 5 illustrates the way in which a Cincinnati planer has been tooled up for the manufacture of these parts on a quantity production basis. From this illustration it will be apparent that the entire planer table is covered with rack blanks which have been previously planed to the desired form, with shoulders at each end which fit under clamping strips that run down both sides of the planer table. The rack blanks are lined up transversely by utilizing their previously planed side faces, the end blank being placed in contact with stops on the planer table.

It will be noticed that each of the rail-heads on the planer is provided with a multiple tool which cuts three tooth spaces at a time, and the actual operation of planing the rack teeth is quite simple. After one set of three teeth has been cut to depth by the tool on each of the two planer heads, the heads are raised and traversed over a distance equal to three times the longitudinal pitch of the rack teeth, utilizing the planer cross-feed mechanism for obtaining this index movement, after which the heads are lowered and the machine is ready for taking the next cut. It will be seen that there is an indexing dial *A* mounted on the cross-feed screw, and an index pointer is carried by a bracket *B* secured to the top of the cross-rail. With this arrangement accurate spacing of the teeth can be obtained. Equipped in this manner, a planer is able to give efficient results in the performance of rack cutting operations. The rack teeth are first roughed out six at one time with a multiple planing tool in each head. They are then finished accurately to size with formed tools fitted to special tool-blocks. The nature of the work permits the rail to be lowered extremely close to the table and creates a condition that is ideal for rigidity and securing a smooth cutting action, so very essential to work of this kind. The racks shown in process of being cut in the present illustration are 3 feet long by 7 inches face width and they have 3-pitch teeth. Twenty-two of these racks are set up on the machine at a time, and the teeth of all these racks are completely cut in twelve hours. The material is semi-steel.

Planing Knees for Cleveland Open-side Planers

An open-side planer built by the Cleveland Planer Co. is shown in operation in Fig. 6 planing a string of three knees for use in supporting the cross-rail on machines of this type. As the work comes to the machine for performing this operation, the face to which the cross-rail is to be secured has been planed, and this surface is utilized as a locating point, the work being strapped to the planer table. After the castings have been squared up and secured in place, the sequence of operations performed is as follows: The first operation consists of planing the top face *A* with a tool carried by the rail-head. Then a round-nosed tool, held in a horizontal position by the side-head, is fed vertically down face *B* until it reaches a position slightly above the top *C* of a lock bearing by which the finished knee will be secured to the face of the planer housing.

At this point, a tool-holder is substituted in the side-head, of the form shown in Fig. 6. It is held in a horizontal position and has the cutter bit projecting vertically downward, so that this tool can complete the cut down surface *B* and also down the inside vertical face of lock bearing *C*; after taking these two cuts, the tool is fed vertically down between the two side faces of the lock bearing, in order to provide for rough-planing that portion of the bottom surface which was not reached by the tool at the conclusion of the planing operations on the two vertical sides. The same tool is also used to perform a rough-planing operation on the horizontal top surface of lock bearing *C*.

Next in the order of operations comes the finish-planing of top surface *A* with a broad-nosed gooseneck tool carried by the rail-head; and a tool of similar design carried by the side-head is utilized to finish-plane surface *B*. Then the inside and bottom surfaces of the lock bearing, and its top surface *C*, are finish-planed with a broad-nosed tool, the finish-planing operations on the inside of this bearing being

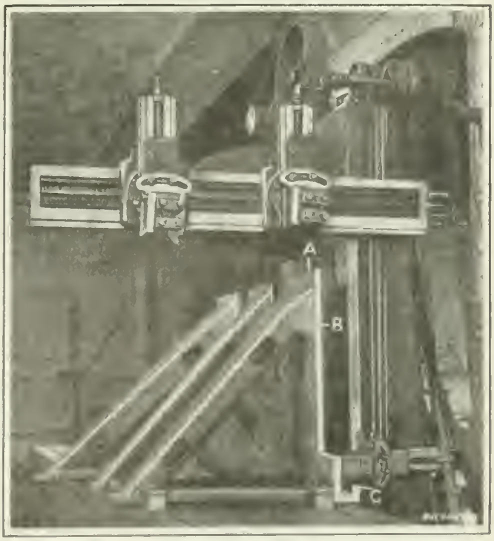


Fig. 6. Open-side Planer used for completely planing the Column Bearing in Open-side Planer Knees

continued until the width of the space has been worked out to a point where it tests up properly with a length gage used for that purpose. On this job, experience has shown that six hours are required to plane one of these knee castings and that three castings can be completely planed in twelve hours, which serves as a good example of the increased output which results from multiple set-ups for performing production planing operations.

Fixture for Planing Tapered Gibs for Sellers Planers

For use in machine tools built by William Sellers & Co., Inc., in Philadelphia, Pa., a number of the familiar form of tapered gibs are required to provide for making adjustments in the fits of various slides, etc., after the machines are placed in service. For use in planing these gibs, a fixture is employed which is illustrated in operation in Fig. 7. It will be seen to consist of a bridge *A* on which the work *B* is carried. At the time when the gib blanks are set up on this fixture for planing, all of the required machining operations have been performed with the exception of finishing the tapered side, and it is to provide the proper setting for finishing this taper that the present fixture is employed. It will be seen that the bridge *A* is supported by posts near each end, the bridge being carried at the end nearest the planer cross-rail by means of a pivot *C*, while at its outer end there is a bolt *D* that projects through the posts which are slotted to afford the necessary adjustment, so that the gib blank may be held in the proper position for performing the taper planing operation. Work *B* is held down on the bridge *A* by means of screws, which project upward through the bridge and enter tapped holes in the under side of the work.

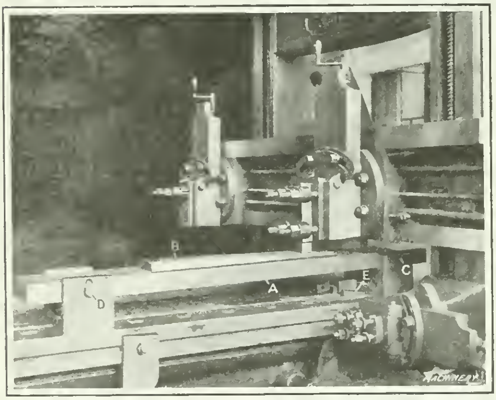


Fig. 7. Adjustable Fixture used for planing Tapered Gibs with Various Taper Angles

It will be seen that the posts which support this fixture are bolted to the planer table and that the under side of each post is grooved to receive a tongue *E* that fits into the table T-slot and provides for properly aligning the fixture with the line of table travel. Setting of the position of bridge *A* for obtaining any required taper on a gib is accomplished by means of a master gib that is first placed on the bridge. A dial test indicator is then mounted in the planer toolpost and the angular position of the bridge adjusted until a uniform reading is obtained with the plunger of the indicator in contact at various points along the master gib. Obviously the planing of gibs calls for a high degree of accuracy, and it is the practice of the Sellers plant to perform a roughing operation with the familiar round-nosed tool, after which a finishing cut is taken with a round-nosed tool that has a flat about 1/16 inch in width ground on its point. For cutting steel, the top rake of this tool is made 22 degrees.

Use of Magnetic Chucks in Planing Small Parts of Cincinnati Planers

In handling small pieces of work, and more particularly those which are of fairly regular outline and which are produced in quantities, advantageous use can be made of a magnetic chuck for holding the pieces for planing. As in all cases where magnetic chucks are used, the application of this principle of holding the work results in saving time in setting up. But or planer work, the thrust of the tools is likely to be great enough to cause trouble from shifting the endwise position of the pieces unless special precautions are taken to overcome difficulties of this kind. Fig. 8 shows the use of a magnetic chuck made by the Heald Machine Co. of Worcester, Mass., on a 30- by 30-inch by 6-foot Cincinnati planer in the Cincinnati Planer Co.'s plant, where it is employed for holding four rectangular shaped blocks, and this illustration clearly shows the means provided for preventing endwise movement of the work. It consists of providing a rail *A* at the end and at one side of the chuck which extends slightly above the face but not as high as the top surface of the work to be planed.

With an arrangement of this kind, the castings are placed in contact with the end wall which supports the thrust of the tool, and the side wall can be utilized for the double purpose of locating the work and assisting the magnetic action of the chuck in holding it in place for planing Such a double use is illustrated in Fig. 8, where it will be seen that straps *B* are held in a T-slot at the edge of the magnetic chuck and they are used to push the castings back against the wall *A*. In the present instance, their function is chiefly that of locating the work, but if additional holding power were required to supplement the magnetic action, stops could be set in the T-slot and "butters" inclined downward from the stop-screws to the sides of the work, so that they would not only push the work into contact with the side wall of the fixture, but also apply a downward component force that would assist in holding the pieces while they are being planed. The pieces shown in process of planing are saddle clamps made of cast iron. They are planed on the top, bottom, and sides, and two edges are rounded. It takes an hour and fifty minutes to set up and plane four castings.

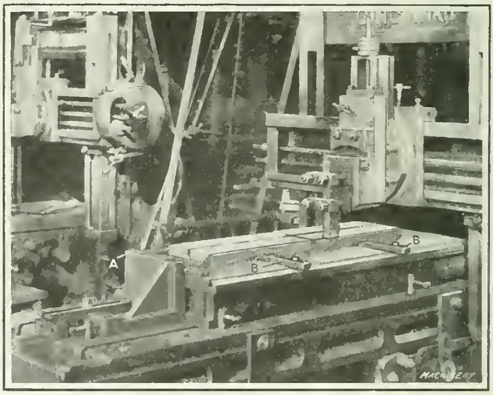


Fig. 8. Use of Magnetic Chuck for holding Small Pieces of Planer Work

* * *

Concentration of industry is the keynote of the German industrial reorganization. A typical instance is the merger of the Stinnes coal and iron trust with the Siemens-Halske Electrical Co., whereby 200,000 workers are controlled by one concern producing coal and steel and manufacturing machinery. In the field of banking a similar tendency is noted in the fusion of several large banks.

The Metric Equivalent Scheme

By FREDERICK A. HALSEY, Commissioner of the American Institute of Weights and Measures, New York City

SOONER or later most machine shop advocates of the metric system take refuge in the metric equivalent scheme, by which is meant the continued use of existing sizes measured and expressed in metric units. In MACHINERY for August, 1920, Theodore H. Miller tells us his experience with this plan in the production of De Laval separators. That there may be no doubt that the same thing is being discussed, the following quotations from various parts of this article are given here: "We simply adopted metric measurements for the machines we were already manufacturing." "Dimensions in millimeters were placed on the old drawings directly under the inch dimensions." "It is not the dimensions of the work that are changed at first, but simply the nomenclature pertaining to the sizes."

It is to be admitted at once that this procedure is physically possible, but the question before us is: Does this procedure bring about that simplification and those advantages which we are told will attend the adoption of the metric system? In what follows several questions will be asked Mr. Miller. They are asked seriously, expecting direct answers.

Drawings

In Fig. 1, supplied by L. D. Burlingame, is given an application of this plan to the spindle of a Brown & Sharpe milling machine. Will the reader endeavor to discover the advantages of the metric figures? For the benefit of those who fail, we would like to have them pointed out.

Screw Threads

In Table 1, are given some metric equivalents of English diameters and pitches of screw threads. The third column gives also the metric equivalents which, according to the previously mentioned article, are used in place of the English figures of the first column for machine parts in general. Will Mr. Miller say if he and his workmen have committed the figures of the third and fourth columns to memory and, if not, will he explain how he avoids the use of the English figures? The reader should note that the scale of sizes to be used must be carried in the mind, that the English figures are repeated for each inch and, forming a simple series, memorize themselves, while the metric equivalent list, being endless and following no law, is as impossible to memorize as a table of areas of circles.

TABLE 1. METRIC EQUIVALENTS OF ENGLISH SCREW THREADS

English Dimensions		Metric Equivalents	
Diameter, Inches	Pitch, Threads per Inch	Diameter, Millimeters	Pitch, Millimeters
1/4	20	6.35	1.27
3/8	16	9.53	1.59
1/2	13	12.7	1.96
5/8	11	15.88	2.31
3/4	10	19.05	2.54
7/8	9	22.23	2.82
1	8	25.40	3.17
1 1/4	7	31.75	3.63
1 1/2	6	38.10	4.23

Machinery

When cutting a screw of 10 threads per inch = 2.54 millimeters pitch, the lead-screw of the lathe having 4 threads per inch = 6.35 millimeters pitch, we may find the ratio of the change-gears by either of the following calculations:

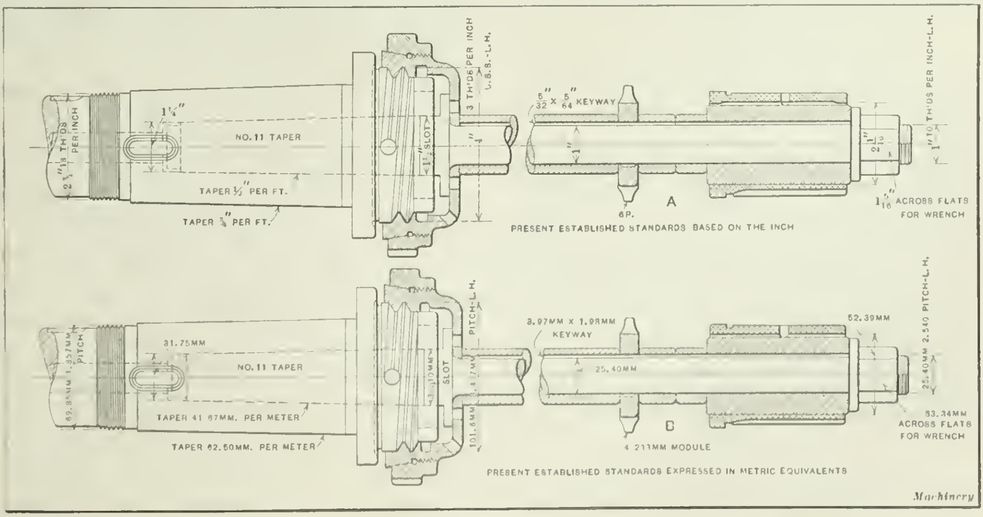
English Calculation

$$\frac{10}{4} = 2\frac{1}{2}$$

Metric Calculation

$$\begin{array}{r} 2.54)\ 6.35\ (2.5 \\ 508 \\ \hline 1270 \\ 1270 \\ \hline 000 \end{array}$$

Can anybody tell what advantage is found in the metric calculation?



The Metric Equivalent Scheme at Work

If the lathe at hand is of the older type with an index-plate, that plate will give, for the English pitches, the gears required at a glance and without calculation, while no lathe has an index-plate reading in the equivalent metric figures. When using such a lathe, is the making of the foregoing metric calculation for the ratio, followed by hunting out the gears for that ratio, preferable to taking the gears directly from the index-plate? If the lathe at hand is of the newer type an explanation will be welcome of how metric figures can be used at all.

Gear-cutting

In Table 2 are given some English diametral pitches of gears with equivalent metric modules.

TABLE 2. METRIC EQUIVALENTS OF ENGLISH DIAMETRAL PITCHES

English Diametral Pitch	Metric Equivalent Module	English Diametral Pitch	Metric Equivalent Module
4	6.350	9	2.822
5	5.080	10	2.540
6	4.233	11	2.309
7	3.628	12	2.117
8	3.175		

If we are to cut a gear of 8 pitch = 3.175 metric module, and of 6 inches = 152.4 millimeters diameter, we may find the number of teeth by either of the following calculations:

English Calculation	Metric Calculation
8 × 6 = 48	3.175) 152.40 (48 127.00 25400 25400 000

The result is identically the same gear in both cases. Are the metric modules really used in preference to the English pitches, and is the metric calculation made in preference to the English calculation?

The foregoing are but simple examples that might be multiplied indefinitely. They show what always happens when standards that have been developed in units of one system are measured in those of another. The change always results in figures which are worse than those with which we started, impossible to remember* and meaningless to those who attempt to use them, while calculations are always made more complex and time-consuming.

Draftsmen's Scales

Mr. Miller tells us that "at the present time in the De Laval plant all micrometers, scales, and other graduated instruments read in the metric system," which we are bound to understand includes draftsmen's scales. The lines on an English draftsman's scale show the sizes to be used when the English system is followed, as the lines on metric scales show the sizes to be used if the metric system is followed, but *the lines on the metric scale give no clue to the English sizes* and, moreover, except at five inches and multiples thereof, the English sizes always fall between the metric lines, and must be laid down on the drawing by estimation.

As, according to the above statement, the dimensions of the work are not to be changed, the draftsman must lay down English sizes with such a metric scale. Will the reader imagine himself a draftsman with a metric scale and attempting to lay down such dimensions as ⅝, 1¼ and 2½ inches? Do they really use metric scales in this manner and if they do, how do they locate the dimensions?

De Laval Practice

This last question becomes pertinent when we examine a copy of the De Laval catalogue No. 104 relating to the centrifugal oil purifiers manufactured by that company. This catalogue, which was given to all inquirers at the recent chemical exhibition in New York, contains two pages of tables with key diagrams of leading dimensions of the various sizes and patterns of those purifiers. The tables consist of eleven columns of figures the dimensions listed numbering 162, and every one of these dimensions is in English feet and inches and binary fractions, not one being metric. Recalling that we are told: "It is not the dimensions of the work that are changed *at first*" and also that "the change took place twelve years ago" it would be of interest to know, with especial reference to this table, how many years are meant by the expression "at first."

The table shows that the English system is still used by this company after twelve years of effort to get rid of it, and that it is still confronted with the necessity of constant conversions between the two systems, wherein is repeated the experience of every manufacturer and of every country that has attempted to adopt the metric system.

The Results

Table 3 shows what these conversions will be like, and they will be far more frequent than conversions between our present units. Things that we need in small quantities are bought by the ounce, and things needed in larger quantities by the pound. The two units are almost never mixed and conversions between them are seldom made. On the other hand, the pound and the kilogram are used for the same purposes and conversions between them will be frequent. For the same reason we will have frequent occasion to make conversions between the inch and the millimeter, the square inch and the square centimeter, the foot and yard and the meter, the square foot and square yard and the square meter, the mile and the kilometer, the square mile and the square kilometer, the quart and gallon and the liter, the bushel and the decaliter, the acre and the hectare, the pound per square inch and the kilogram per square centimeter, the bushel per acre and the decaliter per hectare, and so on to the end, and the necessity for these conversions will continue until the English units are discarded, which the De Laval catalogue shows has not been done. It is these conversions that nullify all claims for economy of time in calculations due to the metric system.

The Usual Answer

The usual answer to such questions as those that have been asked is that these equivalents will be used during the transition period only and will ultimately be discontinued —an answer that is clearly foreshadowed in the quotation given above: "It is not the dimensions of the work that are changed *at first.*"

Passing by the established fact that, after a century and a quarter of effort, France is still in the transition period, it may be asked: If these equivalents are satisfactory why should they be discontinued? If they are to be discontinued can it be for any reason except that they are not satisfactory? They must be used so long as existing standards endure, and they can be discontinued only by discarding the standards which they are, "at first," used to measure.

As an inducement to adopt the metric system we are told that we will preserve existing standards by the use of metric equivalents but, when we show how absurd they are, we are told that, sometime in the future, the equivalents will be discontinued, although that can be done only by discarding standards. That is to say, we are asked to get into this quagmire with the understanding that standards will not be changed when, in fact, the change is only to be postponed. Will it be easier to change the standards of shafting, pulleys, screw threads, pipe threads and diametral pitch gears ten years hence than now? Is it not, on the contrary, clear that the further standardization goes the greater will be the difficulty? And progress in standardization was never so rapid as now.

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*Compare the English pitches and metric modules of Table 2.

Swedish Practice

At the end of the article under discussion is given a quotation from Erik Forsberg telling us how "suddenly but fully" the metric system was adopted in Sweden.

In MACHINERY for August, 1920, page 1139, there appeared a letter from J. Christian Barth, son of Carl G. Barth, outlining his observations and experience during three and a half years' residence in Norway and Sweden. Mr. Barth explains that, having occasion to make some drawings of equipment and not being familiar with the metric system, he was told to make them in the English system and that, later, he learned that the Swedish metal industries use no less than four systems of measurement. He also states that piping, iron bars, shafting, etc., are *always* stated in English measure, and bolts, nuts, and similar articles in both English and metric measures, and he gives an instance of rivets of which the diameter was measured in inches and the length in millimeters.

In the following is given an extract from *Commerce Reports* for February 11, 1920: "According to Trade Commissioner A. X. Oxholm, lumber exported by a company in northern Sweden is cut as follows:

69% to English ft.	
7% to Danish ft.	(1 Danish ft. = 0.9711 English ft.)
8% to "Metric" ft.	(1 "Metric" ft. = 1.0936 English ft.)*
7% to Spanish ft.	(1 Spanish ft. = 1.0783 English ft.)
4% to Dutch ft.	(1 Dutch ft. = 1.0768 English ft.)
4% to German ft.	(1 German ft. = 1.0639 English ft.)
1% to decimeters	(1 decimeter = 3 15/16 inches)

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* = 1/3 meter

Clearly Mr. Forsberg overlooked the Swedish lumber industry when making his sweeping statement. And please note the various feet to which "metric" countries require lumber to be cut, not overlooking the (save the mark) *metric foot*. The time has come for the metric party to recognize that they can no longer claim that any country has discarded its old units for the new. Evidence that they have not has been accumulating for twenty years until it is mountain high and unassailable, and it is this which turns the metric case to ridicule. We are urged to adopt the metric system for the benefit of export trade, but Sweden has been compelled to keep the *old measures* for the benefit of export trade! Thus do facts confound the metricites.

New Ratios

If the new units are merely to be added to the old, as is universal in all so-called metric countries, not only will we have more units than now, but we will also have a new class of ratios—those between the English and the metric units, and of these a few examples are given in Table 3.

TABLE 3. A FEW RATIOS BETWEEN ENGLISH AND METRIC UNITS

25.4	millimeters make	1	inch
6.452	square centimeters make	1	square inch
3.281	feet make	1	meter
10.724	square feet make	1	square meter
1.609	kilometers make	1	mile
2.59	square kilometers make	1	square mile
2.205	pounds make	1	kilogram
28.35	grams make	1	ounce
2.471	acres make	1	hectare

Circular No. 47 of the Bureau of Standards on "Units of Weight and Measure" contains forty-five pages of conversion tables between English and metric units, and we are asked to add these tables to our system of weights and measures as the first step in the process of simplification. Under the plan for the use of metric equivalents for English sizes, these tables will become a part of our system of weights and measures, to endure until the English units are discarded, yet the old units are not discarded in France after a century and a quarter of effort backed by compulsory law and national pride of achievement

Belief versus Fact

The fathers of the metric system may be excused for believing that a country may change its weights and measures since they had no experience to guide them, but today the world has a century and a quarter of experience behind it. It is no longer necessary to consider anyone's belief, and still less is it necessary to consider the optimistic hopes of enthusiastic innovators. It is only necessary to consult the facts, and the facts show the attempt to adopt the metric system to be a repeated failure.

No one doubts and no one denies that, in many applications, the metric system may be used without much difficulty and, in the light of the experience of other countries, no informed man doubts or denies that in many other applications its adoption is hopeless. The problem before us is not the introduction of metric units in easy cases, but the getting rid of English units in difficult cases. The whole problem must be approached with that idea in mind.

Twenty years of investigation of this subject have shown no case of an established, developed industry that has changed its system of weights and measures. New industries have, of course, been developed in and by the metric system, but the old ones do not change. Among the industries that antedate the metric system and that are universal are lumber, building, and textiles, and we need no better illustrations of this fact. The mill units of the French silk industry are the pre-metric French units, while French builders require their lumber to be sawed to the inch. The watch industry in Switzerland still employs the ancient units.

An application wherein old units everywhere refuse to budge is to the measurement of land. Of this we have at home two perfect examples in the use of the French arpent in Louisiana and the Spanish vara in Texas, the latter being universal and the former very common. The first settlements in Canada were made by the French, and in French Canada to-day land is measured by the old French non-metric units although in other parts the English units are universal. It is commonly said and believed that the metric system is universal in chemistry, and it is substantially so in the chemical laboratory, but out of twenty reports received from American manufacturers of chemicals nineteen of them use nothing but English units in the operation of their factories.

The people everywhere do not like the metric system. Nowhere do they use it except to the extent required by law, and in many countries the law is a by-word and a farce. The approving opinion of a few individuals is lost in the disapproving chorus of the peoples and the nations.

The Real Issue

Wherever the inquiry has gone, and it has covered pretty nearly the entire world, the result is uniformly to find a mixture of systems. The old discussion of the English versus the metric system has thus become an idle diversion. The only subject worth discussing is the English versus a mixture of the English and metric systems, and what we object to is not the metric system *per se* but the mixture of systems that is everywhere the result of the attempt to adopt the metric system.

We must compare what we have with what we will get, not with what the metric advocates hope we will get, and we will get what others have got—a mixed system that will have more, not fewer, units; more and worse, not fewer and better, ratios; in which calculations will be more, not less, complex; of which school children will have more, not less, to learn, and by reason of which every claim and argument made for the metric system is, like these, not only destroyed but inverted.

The persistence of old units in all so-called metric countries is the skeleton in the metric closet.

Tools and Methods for Manufacturing Precision Bench Lathes

Practice of the S. A. Potter Tool & Machine Works, New York City, in the Manufacture of Bench Lathes—First of Two Articles

By FRED R. DANIELS

AUTOMATIC single-purpose machines, elaborate jigs, indexing and other fixtures, carefully worked out inspection methods, all of which entail a high first cost, readily find a place in the shop of large manufacturers. There is, however, a class of machine-tool builders whose volume of business does not always warrant the utilization of such elaborate and expensive equipment. The manufacturer whose output requires the machining of large quantities of duplicate parts, finds his single-purpose machine and his standardized equipment an economical investment. His volume of business justifies the heavy first cost involved. On the other hand, the smaller manufacturer is at a great disadvantage when it comes to constructing or purchasing special automatic machinery, because he must carefully consider whether or not the expenditure involved will be covered within a reasonable length of time by the increased profits resulting from its use.

The S. A. Potter Tool & Machine Works, in manufacturing precision bench lathes, has adopted only such methods and devices as the volume of its business has shown to be judicious. Whenever a manufacturing problem involving costs arises in this shop, the selection of the proper machine or tool is carefully considered. If the length of time necessary to recover the proposed expenditure extends over a number of years, the investment is considered questionable, and other means are devised that are simpler and cheaper but none the less effective. The fact that the Potter precision lathe is successfully manufactured on such a basis is proof that this is good manufacturing procedure. This article describes a number of operations in which rather unusual methods are used or in which time-saving and inexpensive equipment has been employed.

Finishing the Lathe Beds

For convenience in describing certain operations on the lathe units, the sectional view, Fig. 1, of the headstock, mounted on the end of the lathe bed will be referred to. The lathe bed *A* is machined by milling and grinding the top bearing surfaces. The practice of milling, while not general, is quite commonly followed in machining beds of lighter machine tools. The practice of planing castings of this type is also quite common, and in the case of the heavier machine

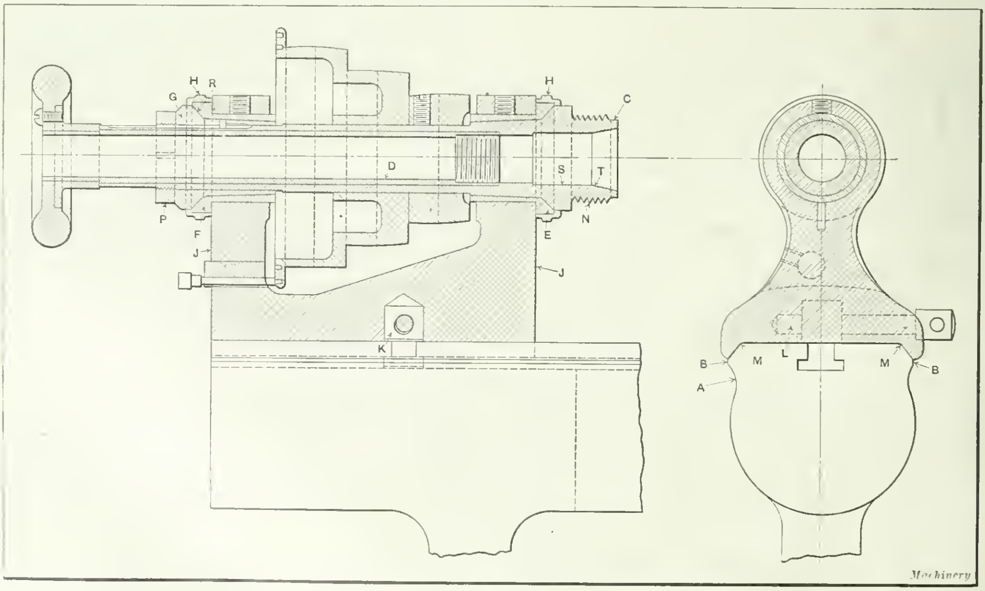


Fig. 1. Sectional View of the Assembled Headstock, showing Relation of the Various Parts

tools is almost generally followed. In Fig. 2, the set-up of a Brown & Sharpe milling machine is shown, in which a gang of seven cutters is employed to mill the top bearing surfaces for the headstock and tailstock, and the straight sides of the T-slot in the bed (see Fig. 1). The gang consists of two side milling cutters for surfaces *B;* two angle cutters for the angular surfaces; two face cutters for the top bearing surface; and one side milling cutter for the slot. The cutters and arbor form an assembled tool which is always kept intact for this job.

The casting is supported on the ends by V-blocks *A*, Fig. 2, located outside of the legs, and two slotted clamps *B* are employed to secure the work to the table. The slotting of the clamps permits the work to be quickly released or clamped in place. Rigidity in holding the work is much more vital in the case of milling operations than it is in planing, and this is suitably cared for in the present case. The practice of milling rather than planing is also a means of increasing the production rate of this preliminary machining operation. The production time, floor to floor, is twelve minutes per casting.

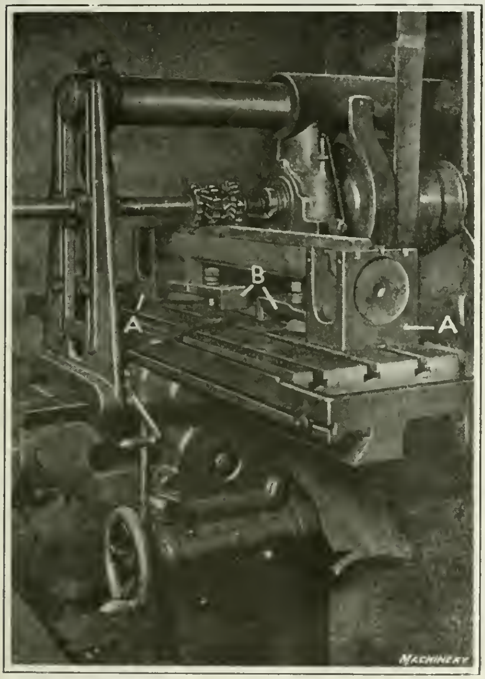


Fig. 2. Set-up for milling the Top Bearing Surface of the Lathe Bed

Inasmuch as the T-slot in the bed must be accurately located with respect to the top finished surface, this surface is used for locating the work during the T-slotting operation. Two angle-plates *A*, Fig. 4, attached to the milling machine table, are machined with elongated slots *B* of sufficient width to permit the passage of the T-cutter, and of sufficient length so that the work may be clamped to the angle-plates and at the same time leave an opening sufficient to allow clearance for the cutter at the beginning and end of the cut. The rate of production is one casting every eight minutes.

The grinding operation is not in itself especially interesting, but the substitution of this method for scraping the bearing surfaces is a distinctly novel feature in lathe manufacture. The grinding operation is performed on the Pratt & Whitney vertical surface grinding machine illustrated in Fig. 5. With this set-up, the angular surfaces of the bed are ground. Grinding, as a means of finishing these surfaces, may be criticized on the ground that there is a likelihood of the lathe bed being charged with abrasive, like a lap, and such a condition would be a decidedly undesirable one. This, however, has not proved to be the case, for the effect of the coarse wheel used is not analogous to that of the fine flour emery employed in charging a lap, and it has been found that the coarse abrasive of the wheel used has a tendency to fly off the surfaces rather than to embed itself in them. It requires thirty minutes to perform this grinding operation, including loading and unloading the work.

Another advantage derived from the employment of this means of finishing is the time saved over the scraping method and the subsequent economy realized. The human element also enters into the question, as operators are more averse to performing scraping operations than they are to operating a grinding machine. Scraping is a tedious job, and the results are not, to say the least, better than those realized by grinding. Referring to the illustration, it will be seen that these angular surfaces are ground to gage limits. In inspecting the surfaces of the work, a finished seat on the fixture is the registry surface employed. The accuracy of these surfaces is of vital importance, for by means of them the headstock and tailstock, and all other parts mounted on the bed are fitted.

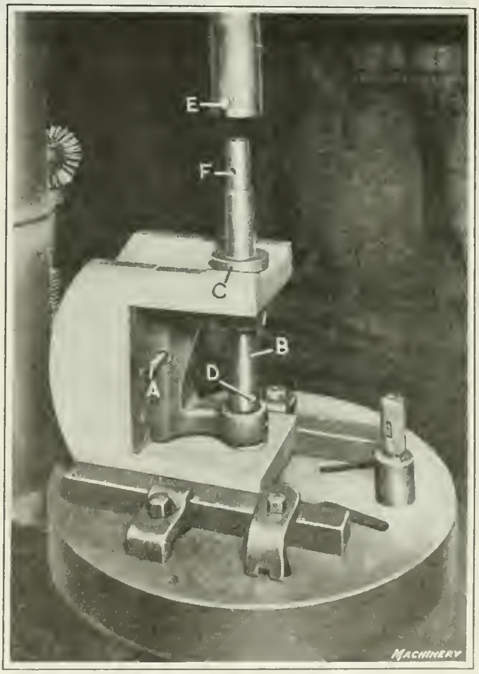


Fig. 3. Fixture used in boring the Bearing Holes in the Headstock Casting

The composite bearing surfaces of the bed are reproduced on master gage-blocks, and a quantity of these is always kept in stock for use in connection with jigs and fixtures employed during subsequent operations on the headstocks and tailstocks. By using these duplicate master locating blocks, the problem of establishing interchangeable manufacturing conditions is greatly reduced, since all fitted parts of the lathe bed are located from a common composite surface. However, this fact does not eliminate the inspection methods, which are fully as complete as would be the case if other means of locating were employed.

Machining the Headstock

The headstock casting is the unit that establishes the degree of accuracy of the lathe, not only in regard to the fit on the lathe bed, but also in regard to the machining of the spindle bearing holes and the maintenance of perfect parallelism between the spindle and the lathe bed. In the longitudinal section through the headstock, Fig. 1, *C* is the spindle; *D* the draw-in sleeve, in the threaded end of which the spring collet is screwed; *E* and *F* the front and rear spindle bearings, respectively; and *G* the cone for the rear bearing. The draw-in sleeve is operated by a handwheel at the end, and the spindle bearings are protected by brass caps *H* against the entrance of all foreign material.

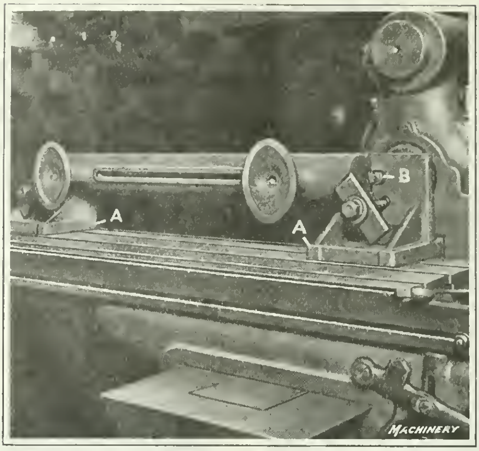


Fig. 4. Work located from the Previously Finished Top Surface and clamped to Two Angle-plates for T-slotting Operation

The operations required in machining this casting are as follows: Rough-mill the bearing surfaces of the base; face-mill the ends *J*; straddle-mill the inside of the spindle bearing hubs; finish-mill the bearing surfaces of the base; bore holes *K* and *L* for the locking cam and binder bolt; scrape, rough- and finish-bore the spindle hole; line-ream the spindle hole; and grind the ends. For the milling operations on the base of the casting, the work is mounted in an inverted position on the table of a No. 2½ heavy-duty Le Blond milling machine, as shown in Fig. 6; this illustration shows the finish-milling operation and the gage *A* used in connection with this operation. The work is held by means of a V-fixture, as the surface of the casting is sufficiently uniform for use as a locating point.

Three cutters are employed on this operation, one wide face-milling cutter *B* and two angle cutters *C* of slightly greater diameter than the facing cutter. This provides the required under-cut at points *M*, Fig. 1, for subsequently finishing these bearing surfaces. The remaining milling operations are performed with the work located on this finish-milled surface by means of master blocks, as mentioned in an earlier paragraph and as clearly shown in Fig. 7 at *A*. The production time for finish-milling the headstock base is eight minutes, floor to floor.

In milling the ends, two fixtures are used, enabling the operator to load one while the cut on the other is being taken. An inserted-tooth face-milling cutter is employed as shown in Fig. 7. It will be seen that the simple method of locating the work consists of a master block *A* with a tongue, indicated at *B* fitting the table slots, and a stop *C*. This machine is of the same make as that employed in the previous illustration, and the time required is two minutes per casting. The operation of milling the inside of the hubs is simply a straddle-milling operation. The grinding of the ends of the casting is done on a Pratt & Whitney vertical grinder, with the work located on hardened and ground master blocks, such as employed in milling the ends.

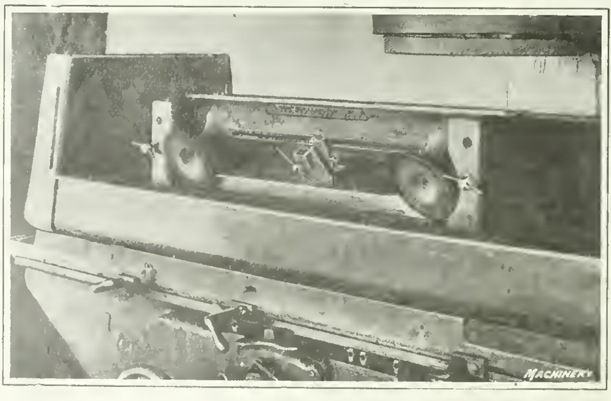


Fig. 5. Grinding the Angular Surface of the Lathe Bed on a Vertical Surface Grinder

The binder bolt hole *K*, Fig. 1, through the base of the casting, and the hole *L* for the locking cam by means of which it is secured on the lathe bed, are next bored. These holes are later employed for holding the casting during the boring operation on the spindle hole. The bearing surface is next scraped, sufficient metal for which was left in the finish-milling operation by undercutting the angular sides of the fitting surface. Obviously, the bearing surface cannot be ground in this case owing to the angle, for it will be at once evident that the wear of a special grinding wheel on the edge would result in producing inaccuracies which would require correcting by scraping. Furthermore, the surface is a short one and can be scraped much more satisfactorily than could the long bed surface.

Fig. 3 shows a Sibley drilling machine and the jig used in the finish-boring operation of the spindle bearing holes. These holes are cored and are first rough-bored, using a counterbore and plain fixture, after which they are located in the fixture shown in the illustration. As in previous operations, the work is located in the fixture on a master block and is secured by a clamping bolt extending through the jig from the rear and entering the regular binder bolt hole *K*, Fig. 1. Pin *A*, Fig. 3, is inserted in the regular locking cam hole, passing through a hole in the clamping bolt, so that when the bolt is tightened, the casting is firmly held in place. This is the identical method by which the headstock is secured to the lathe bed, as was stated in the previous paragraph. The method of performing the boring operation is of interest.

An ordinary boring-bar *B* is used, but on account of the distance between the front and rear spindle bearings of the headstock casting and the necessity of using a pilot for the boring operation, it requires, according to the usual method of drilling machine operation, a movement of about 14 inches for the drilling machine spindle. As this is not possible, the hole is finish-bored by inserting the boring-bar in the hole of the jig in which bushing *C* is a fit, until the cutter *D* contacts with the casting. The taper shank of the boring-bar is drilled through as shown at *F*, for a driving pin, and the spindle sleeve of the machine is correspondingly drilled so that the jig may be slid under the spindle, which is then lowered to encompass the projecting shank of the boring-bar, and the driving pin *E* inserted. As the boring proceeds, bushing *C* will, of course, slip down into the fixed bushing and form a guide.

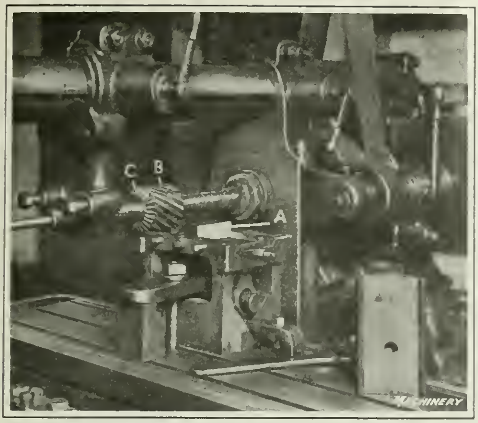


Fig. 6. Milling Bottom Surface of Headstock Casting

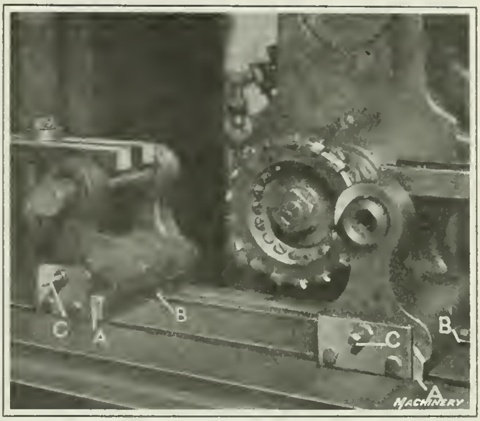


Fig. 7. Face-milling the Ends of the Headstock Castings

By this means, the accuracy of the drilling machine table is not depended upon to finish the hole parallel with the base, and by this method the desired accuracy in the hole is obtained. The connection of the shank and spindle provides a floating movement of approximately 1/32 inch between the boring-bar and the spindle center so that the boring-bar may be thrown out of alignment without destroying the relation of the hole to the base of the casting. In other words, the drilling machine spindle simply transmits power to the boring-bar without regard to the condition of the machine. This fixture and method are also employed in finish-boring the tailstock casting. The holes in the headstock and tailstock after being finish-bored, are line-reamed by hand, using a long pilot reamer. No tolerance is provided in machining these holes, since the goal strived for is absolute precision. In a later paragraph more will be said in this connection. The floor-to-floor production time for rough-boring is five minutes; for finish-boring ten minutes.

Carburizing and Casehardening

The vital parts of the headstock, in addition to the casting, are the two spindle bearings *E* and *F*, Fig. 1, the taper cone *G* for the rear bearing, the spring collet chuck, and the spindle *C*. These parts are all made of 0.25 per cent carbon machine steel, carburized and casehardened. There is no alloy or tool steel used in the manufacture of the Potter lathe, and this is regarded as rather unusual. It has been found, however, that with a soft core and a glass-hard case, the particular service required of the spindle and related parts is more satisfactorily met than would be the case if a material, such as tool steel, were employed. In addition to this, the expense is materially less and the length of service at least equal to that of the more expensive steel.

Another economical factor in this connection relates to the carburizing equipment. Instead of using cast-iron or steel carburizing pots or any of the specially manufactured alloy steel receptacles, a pot made of 3/4-inch thick boiler plate is used. Five pieces of this plate are welded together in the form of a box, and by this means it is possible to obtain pots of a suitable size and shape which can be made up in a very short time. The plates are welded, and usually twenty-four hours is sufficient notice for the welder to produce the pots on time. The cost of boiler plate is about 5 cents a pound, from which it will be seen that these boxes can be made economically, there being no other expense except the cost of welding. The cost of patterns necessary in the production of cast pots is of course eliminated, and as compared with cast iron, the boiler plate is superior in that the boxes do not warp. The cost of the pots is about 20 per cent more than that of cast-iron pots, but it is stated that the boiler-plate pots have double the life of the cast-iron pots and last about the same length of time as the cast-steel pots. A commercial carburizing material is used to pack the spindles and other machine-steel parts, and a temperature of 1600 degrees F. is maintained for a period of ten hours.

Before carburizing, the spindles are roughed out on a Jones & Lamson turret lathe and rough-turned and bored, leaving 0.015 inch stock for grinding purposes, this allowance being also left for grinding the threads at the nose end of the spindle. After the spindles have been carburized, the nose end is hardened, being heated to from 1350 to 1400 degrees F., back to about one inch beyond the front bearing surface. (See Fig. 1.) The rear end of the spindle remains soft, since this end fits into a casehardened cone *G* and this cone forms the rear spindle bearing. Prior to the grinding operations, a file and scleroscope hardness test is conducted, and then two center plugs are inserted in the ends of the spindle, these being a very light drive fit in the bore. The center plugs are not removed from the spindle until after all the grinding operations on the exterior have been completed. This prevents inaccuracies due to changing the relation between the center line of the work and the ground surface during the grinding operations.

Machining Operations on the Lathe Spindle

The grinding operations on the spindle exterior are performed according to regular shop practice, but the finish-grinding operation does not complete the out-

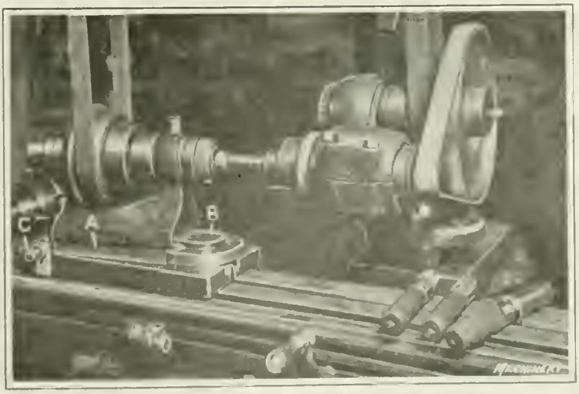


Fig. 8. Grinding the Spindle Bore and producing a Bearing Surface for the Collet Chuck

side of the spindle, for that surface where the front bearing is assembled is required to be hand-stoned in order to obtain the desired bearing surface. This operation, which is also performed on the cone for the rear spindle bearing, is accomplished by testing with Prussian blue and then removing whatever minor surface irregularities may have been left by the grinding operation. The stoning operation is performed with the cone assembled on the spindle, and after the fitting is finished, the spindle and cone remain as one unit. This unit, together with the two bearings in which the spindle was mounted during the stoning operation, becomes the permanent combination of parts with which the lathe is to be equipped. Although these unit assemblies of the spindle are interchangeable in a broad sense, this stoning operation is performed in order to secure the highest running condition of the spindle. This is a minor operation as regards effort to secure perfect fit, but is of utmost importance for a precision tool running at 2800 revolutions per minute.

At the completion of the next two operations, grinding the threads *N*, Fig. 1, on the spindle nose and chasing the threads on the spindle for the adjusting nut *P*, the center plugs are removed from the spindle. The spindle is next assembled in its previously fitted bearings in the headstock, preparatory to grinding the bore diameters, and is then mounted on a swiveling fixture attached to the table of a Fraser bore grinder, as illustrated in Fig. 8. The block *A* swivels at *B* and may be set against stop *C* and locked by a screw that extends through a radial slot at the rear of the block. In this operation the straight hole *S* and the taper *T* (Fig. 1) are ground to form a seat and fitting surface for the collet chuck. This is accomplished by first locking the swivel block at an angle for grinding the taper, and then swinging it in line with the spindle for the straight hole. Thus two operations are performed at one setting of the work, with the assurance that the surfaces will bear the correct relationship to each other. The time required to grind both surfaces, floor to floor, is twenty-five minutes per spindle. A 46-K Norton wheel is used and the sizes are held to "Go" and "Not Go" gage limits. The plug gages for this hole, as well as the chamber gage for the taper, are shown on the table of the grinder. Finally, the headstock is disassembled and cleaned to obviate the possibility of abrasive or other foreign matter being located in the bearings.

The concluding installment of this article, which will be published in the April number of MACHINERY, will describe the grinding of the spindle bearings, cone, and collet chuck, the machining and graduating operations on the index slide, and the painting and inspecting of the assembled lathes.

* * *

INDUSTRIAL DEVELOPMENT IN AUSTRALIA

The war stimulated industrial development in Australia to a remarkable degree. A great many new industries sprang up during the war, and new tariff regulations have been made to protect some of these industries. Among the more important are those making electrical materials, hardware of various kinds, and agricultural machinery. There has also been a considerable development of the extensive steel plants of the Broken Hill Proprietary Co., of Newcastle. This is now the leading manufacturing industry of Australia, being equipped for nail making, wire drawing, the making of galvanized and plain sheets and tin plate, the rolling of structural steels and plates for shipbuilding, rails, wire rod, etc. It has been announced that several large British manufacturing firms intend to erect plants in Australia to produce their goods there instead of exporting from England. The representative of one of the largest engineering firms in Great Britain has recently visited that country. This firm has at present a contract for the construction of three 15,000-ton vessels for the Australian Government, and it is believed that plans have been made for developing a shipbuilding industry in Australia, rather than having all Australian ships built in England.

INDUSTRIAL CONDITIONS IN SWEDEN

Special Correspondence to MACHINERY

Stockholm, February 10

The industrial conditions in Sweden are far from satisfactory. Practically all the factories are running on short time with a reduced number of workmen, and the general tone of business is not very optimistic. Most of the manufacturers do not expect conditions to be better for several months, and there is a possibility that there will be but little improvement even then. No one seems to be able to analyze the real trouble, but considers it simply part of the business depression existing at the present time all over the world.

There are only two factories, to the writer's knowledge, that are working full time. One of these is a small concern making a special machine for which a large order is on hand. The other is one of the large shipbuilding works where Diesel engines and a number of ships are being built. This company secured an order a long time ago for Diesel engines with a contract so worded that it cannot be cancelled, and in this way this concern will have work enough to keep it going for several months.

There is only one automobile building plant in Sweden, situated a few miles from Stockholm. The stock of this company was listed at 125 last September, but is now down to 30. This company is backed by one of the most powerful banks in Sweden. Measured by American standards this is not a large concern, the yearly output being only about 300 cars.

The De Laval Separator Co. is working only three days a week, and it is stated that a further reduction may have to be made. The two large ball bearing manufacturers in Gothenburg are working five days a week with prospects of further reduction in capacity. There is very little buying done and little prospects of any appreciable trade in the near future.

American manufacturers are at a distinct disadvantage in trying to do business in Sweden, both on account of the general conditions and on account of German competition. At the present time the Germans are able to deliver, which they were not capable of doing a few months ago. It is said that they are now fulfilling their contracts to satisfaction, and that the difference in price asked by them as compared with American prices is very great. A few weeks ago a Swedish manufacturer wanted to buy a three-spindle drilling machine. The price of a well-known American make was about 30,000 Swedish crowns in New York. A German firm had a very similar machine in stock in Hamburg, which was offered for 5000 Swedish crowns. The same firm offered steam hammers for 7500 crowns that cost about 20,000 crowns in the United States.

A few months ago German manufacturers were not filling the orders they took and hence lost a good deal of prestige, but they are now meeting their obligations and deliveries very well, so that there is little chance at present for American machine tools, particularly as long as the exchange situation remains where it is. The present high value of the dollar is about as effective a barrier to American business abroad as could be conceived.

Management problems are receiving considerable attention in Sweden at the present time. A special journal dealing with management known as "Northern Journal on Organization" is published in Stockholm, a recent issue of which contains translations of articles by Taylor on "High Wages and Low Labor Cost"; by Gantt on "Shop Management"; by Hathaway on "Scientific Management," and by a number of other American authorities on management. The European countries realize the necessity for closer attention to management problems and scientific methods of production in order to be able to hold their own in the world's trade.

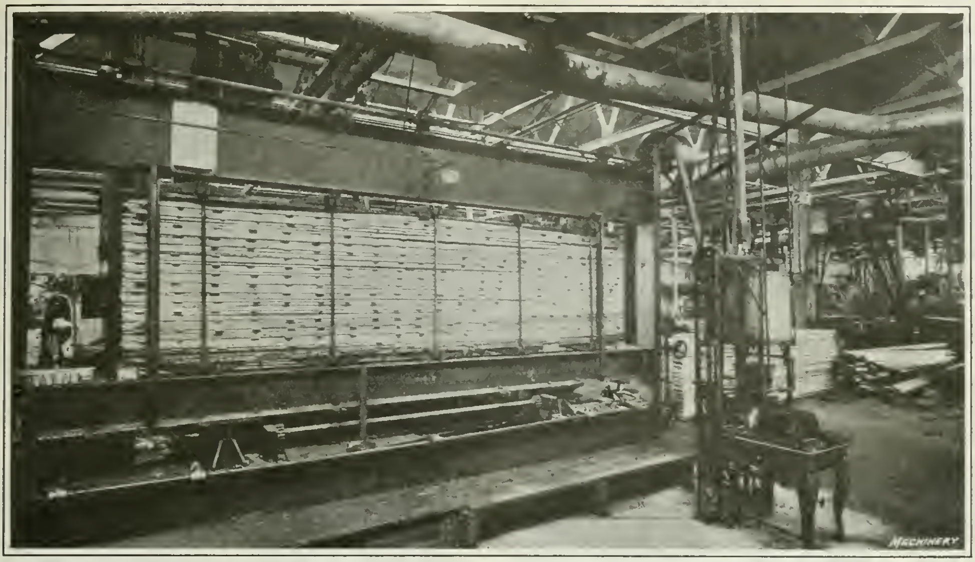


Fig. 1. Hydraulic Press which exerts a Pressure of Thirty-five Tons on a Stack of Sills after the Sections have been coated with Glue

Making Wooden Sills for Chassis Frames

Methods Employed in the Plant of the Franklin Mfg. Co., Syracuse, N. Y., for Producing the Wooden Side Members of Chassis Frames

THE construction of the chassis is one of the unusual features of the Franklin car, as the side members or sills are made of wood. These wooden sills are more expensive than those of pressed steel construction, but they are considered preferable for passenger cars. The advantages claimed for wooden sills are that they combine lightness with strength, and possess the property of absorbing shocks instead of transmitting them like steel. According to tests made at the Franklin plant, a chassis frame having wooden sills of approved construction is 65 per cent stronger than a steel frame of the same weight.

The first important step in the manufacture of these sills is selecting the wood. Second-growth white ash has proved to be most satisfactory, as it is strong but resilient and light. This wood is obtained chiefly from the Catskill Mountain region and from northern Pennsylvania. The lumber intended for the sills is air-dried or seasoned for at least six months and preferably for two or three years. As a result of this air-drying, most of the sap disappears and shrinkage takes place.

This air-dried material, after being sawed roughly to a shape, is placed in the dry kiln where it remains for about a week. This kiln is equipped with radiators and fans for circulating the heated air, and a temperature of about 130 degrees F. is automatically maintained. The lumber is sprayed with live steam during a period of about forty-eight hours, in order to cause the remaining sap to flow out through the pores of the wood. After this spraying period, the room is kept filled with steam during the remainder of the time that the lumber is in the kiln. This curing process is to prevent any twisting, warping, or checking of the wood after it is made up in a sill.

The sill is rectangular in cross-section, but it is not made of one solid piece, a laminated construction being superior. Fig. 2, which represents a cross-section, shows the three main strips that form the sill, and the thin strips at the top and bottom. The sections are carefully selected, not only to secure flawless material, but so that the grain of all three main sections lies in different directions.

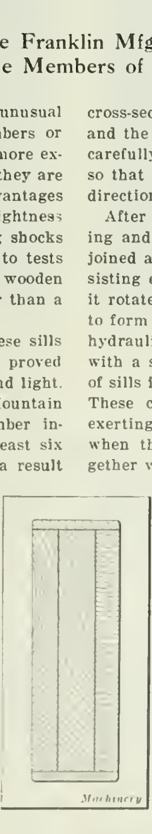


Fig. 2. Cross-section of Wood Sill for Chassis Frame

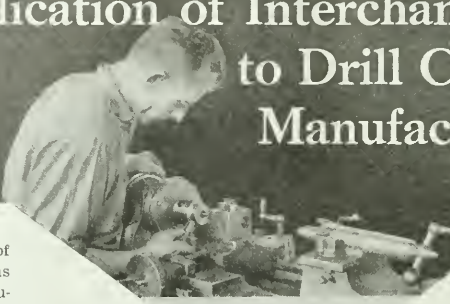
After the lumber is cured in the kiln, it is ready for planing and gluing. The planed surfaces of the sections to be joined are first covered with glue by a special machine consisting of a revolving brush which is supplied with glue as it rotates. When enough strips have been coated with glue to form a stack of seventeen sills, they are placed in a large hydraulic press, where they remain for one hour. This press, with a stack of sills in place, is shown in Fig. 1. The pile of sills is held together as one unit by the five clamps shown. These clamps are tightened while the hydraulic press is exerting a pressure of thirty-five tons on the sills, so that when the stack of sills is removed, they are still held together very tightly by the clamps. The sills remain in these clamps about twenty-four hours.

Band-sawing and shaping operations next follow, and the narrow "weather strips" are attached to the top and bottom to exclude all moisture from the joints. The sills are next planed to the thickness required, and then twenty screws are driven into each sill by means of a screw-setting machine in order to reinforce the three glued sections. A sanding machine is used to give the sills a smooth finish, and then after boring certain holes, cutting the sills to length, and shaping the front ends, they are ready to be assembled to the chassis.

* * *

The American Welding Society has recently organized a section in Cleveland. Other sections of the society, which has its headquarters at 33 W 29th St., New York City, are now in existence in New York, Pittsburg, Philadelphia, and Chicago.

Application of Interchangeability to Drill Chuck Manufacture



Second of Two Articles Describing the Tooling and Gaging Equipment Used by the Marvin and Casler Co., Canastota, N. Y., in Manufacturing the Casler Twin-screw Drill Chuck

THE first installment of this article, which was published in the February number of MACHINERY, described in detail the machining and gaging methods and the equipment used in the manufacture of the body, operating screws, and cap-plate of the Casler drill chuck. The present installment deals with the operations on the jaws, concluding with a description of the assembling and final truing up.

Preliminary Operations on the Chuck Jaws

With only minor exceptions, the right and left jaws are machined and gaged in the same way and are held to the same functional clearances. For that reason these two parts will be considered as one in describing their manufacture, except in instances where it is necessary to distinguish between corresponding operations on the mating jaws. The jaws are made from Midvale tool steel having a carbon content of 0.80 to 0.90 per cent. The stock is first inspected and cut into convenient lengths for handling, so that the preliminary rough-machining may be done before these short bars are cut into pieces of approximately the desired length for the jaws. The radius on the outer surface (see assembly view, Fig. 10) is then planed.

The bars are next cut into short lengths and are disk-ground on one side to furnish a locating surface from which to grind to thickness on a Blanchard grinder. This thickness *A* is held to within limits of + 0.000 and — 0.001 inch. It will be realized that this dimension is of basic importance and that the sides of the work must be parallel. Therefore a double check is taken to assure absolute accuracy with regard to this thickness, and in Fig. 12, "Go" and "Not Go" gages used are shown at *A* and *B*.

The blanks are then burred and returned to the Blanchard grinder where face *B*, Fig. 10, is ground for establishing a limit for dimension *C* of + 0.010 and — 0.000 inch. This operation is illustrated in Fig. 11, which shows a number of the blanks set upright on the table of the grinding machine and held in a vertical position by means of special parallels *A*. Obviously some such method of supporting the work in a vertical position is necessary, since the blanks rest on the curved surface that was planed in a previous operation. The snap gage used in connection with this operation may also be seen lying on the table of the machine.

Milling the Teeth on the Chuck Jaws

The next operation on the jaws is performed on a Kempsmith milling machine, equipped with a special arbor carrying eight cutters, and an indexing fixture having capacity for eight jaw blanks. This milling machine and its equipment is shown in Fig. 12, and the operation performed consists of milling the teeth in the jaw and straddle-milling the over-all length. An inspection of the illustration will make this obvious, and will also make it fully apparent that by em-

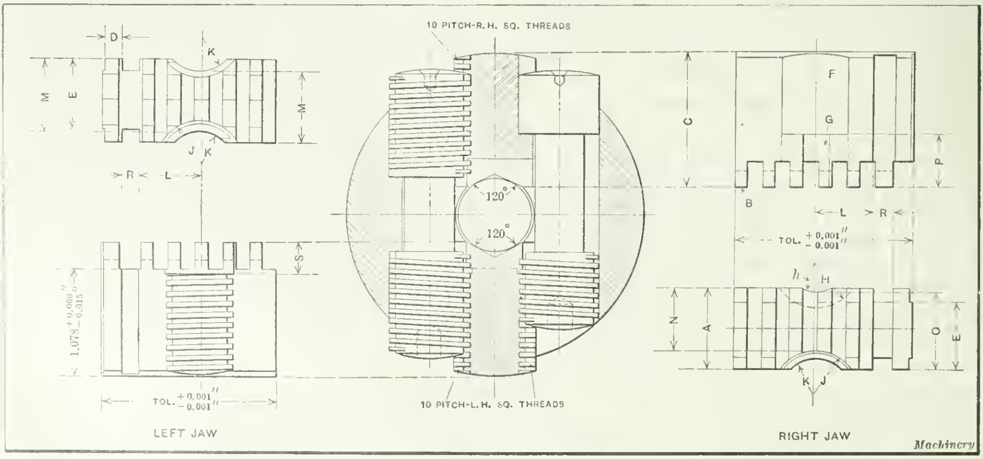


Fig. 10. Assembled Chuck, showing Relation of Parts, and Views of the Left- and Right-hand Jaws

ploying a permanent set of cutters and an arbor, the relationship between the gashes in the teeth and the parallel ends of the blanks can be kept uniform. It was stated in the preceding paragraph that a double check was taken on the thickness of the jaws; this is done by employing gages *A* and *B*, and the operator who has ample time for this purpose, attends to both the gaging and milling operations. The teeth are not cut in any jaw until it has satisfactorily passed this thickness test. Four jaws which have just been removed from one side of the milling fixture are shown on the machine table, from which the appearance of the work after the operation has been performed may be seen.

In describing the construction of the fixture and its method of operation, reference should be made to Fig. 13, which is a sectional view and partial plan view of the fixture. The position of the work is indicated by heavy dot-and-dash lines, showing that four pieces are loaded in each of the two stations of the milling fixture and clamped between jaws *A* and steel faces *B* by means of the clamping nuts *C*. When the nuts are released, coil springs interposed between the clamping jaws and the body of the fixture force the clamping jaws away from the work so that the pieces may be quickly and readily removed. The locking detent *D* may be operated by the eccentric cam-lever *E*, to withdraw it from the steel bushing *F* in the base of the fixture, so that the turret of the fixture may be revolved 180 degrees, and the detent inserted in a similar bushing on the opposite side of the fixture. The general idea incorporated in this fixture is not new, it being simply an adaptation of the quantity production idea of reducing the amount of idle time of machine and operator. The operator loads and unloads one station and checks the thickness of blanks to be loaded, while the four blanks in the operating station are being machined. The width of the teeth gashes and teeth themselves are not of vital importance to the interchangeability of the chuck parts.

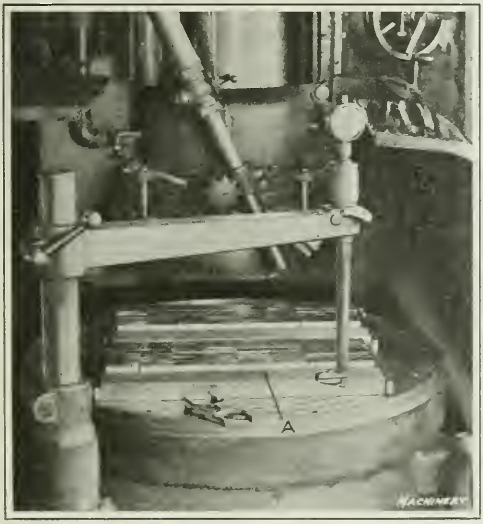


Fig. 11. Jaw Blanks ground to Width on Surface Grinder

Machining and Gaging the V-groove

The next operation consists of milling the 120-degree included angle in the tooth sections of the jaws (see sectional view, Fig. 10). This operation is performed on a Van Norman milling machine, and the fixture used is illustrated in Fig. 14, in which the work is located vertically on steel seats *A*. These strips are set into the cast-iron body of the fixture on each side, and extend the entire length, so that five blanks may be set up on each side and clamped in pairs by means of the bolts *B*. Attention is called to the liberal locating surface provided for the horizontal side of the blanks, which insures that the center of the V-grooves will be at right angles to the previously ground surface, a condition which is absolutely essential to assure perfect alignment for the drill shank with the center line of the drilling machine spindle when the chuck is in use.

The vee must be centrally located between the parallel sides, and must be of the proper depth to within limits of ± 0.005 inch. The depth of this vee is checked by employing a low-limit measuring wire and a high-limit measuring wire, which are laid in the V-groove with a flat block resting on the top surfaces of the teeth. The central location of the V-groove is held to within a tolerance of 0.001 inch, and the method of checking this is of considerable interest. A $\frac{3}{8}$-inch diameter hardened and ground steel roll having a central hole in which a spring wire is assembled is used in checking this measurement. This wire is bent to a rectangular shape and the ends are welded together, so that when the roller is laid in the V-groove, the wire may be sprung over the curved outer surface of the jaw to hold the roller in the groove. The jaw is then laid flat on its side, resting on a surface plate, and a check block and Koch indicator are used to measure the height of the hardened steel roller from the surface plate and to determine its degree of parallelism.

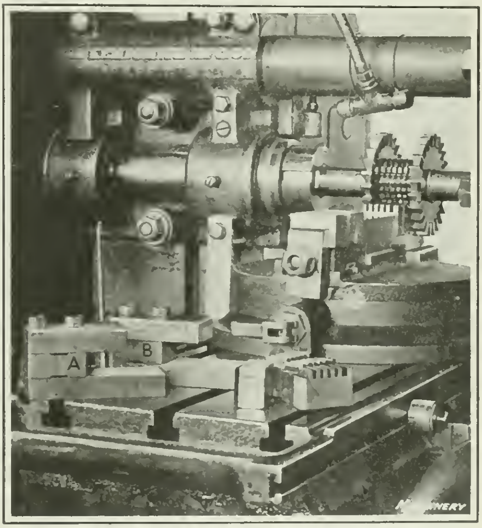


Fig. 12. Straddle-milling the Jaws and cutting the Teeth

Keyway Milling Fixture and Inspecting Equipment

The keyways in the sides of the jaws must be machined to extremely close limits, since these keyways or guides determine the degree of fit for the jaws and jaw gash in the body. The V-grooves having previously been machined centrally, and held to a tolerance of 0.001 inch can be advantageously used as registry points when clamping the jaws in the milling fixture in which they are held during the milling of these keyways. Fig. 15 shows a surface plate with the fixture used in this operation resting on it; also a collection of gages and a piece of work showing the keyway *P* milled in this operation.

The fixture has a capacity for four pieces, these being placed with the V-grooves engaging the double V-blocks *A*, abutting against the hardened steel locating buttons *B*, and resting on the hardened steel seats *C*. The clamping jaws *E* are so designed that they engage the curved outer surface of the jaws and exert a downward pressure when the work is clamped in position. The clamping straps *D*, which are

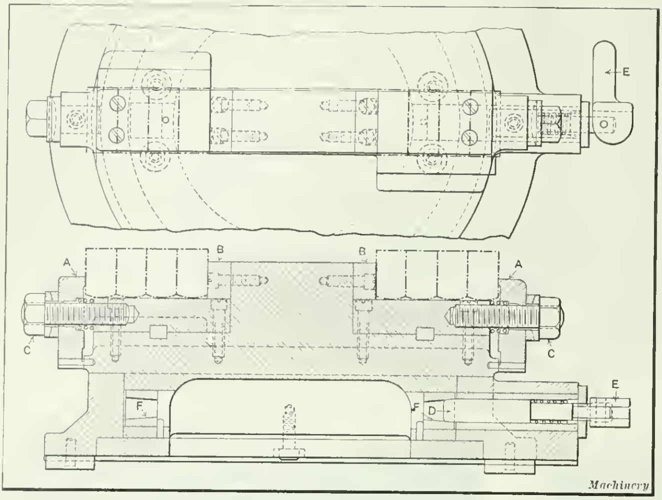


Fig. 13. Sectional and Partial Plan Views of the Milling Fixture illustrated in Fig. 12

employed to hold the work by exerting a pressure at right angles to that of jaws *E*, are provided with a pivoted evener jaw *F*, so that when this jaw is tightened the end pressure on each piece of work will be equal. There are two cutters *G* used on the arbor of the milling machine, so that at the same time that the keyways are milled a cut is taken on the end of the jaw to produce a shallow tongue which fits in a clearance space in the jaw gash (see surface *T*, Fig. 1, page 510, February number). In this straddle-milling operation, dimension *D*, Fig. 10, is held to limits of + 0.000 and — 0.001 inch.

Referring now to the set of gages in Fig. 15, it will be seen that gage *H* is a combination "Go" and "Not Go" gage for width *R* (Fig. 10) of the keyway, which has a limit of + 0.000 and — 0.001 inch; gages *J* and *K* are "Go" and "Not Go" gages, respectively, for the thickness *D* (Fig. 10) of the jaw guide; and gage *L* is a double-ended "Go" and "Not Go" gage for inspecting dimension *E* (Fig. 10), which is held to limits of + 0.000 and — 0.005 inch from each side of the jaw. That is, in using gage *L*, the work is located against the flat surface of the gage, first from one side and then from the other, both ends of the gage being used in the same manner. Gage *M* is a functional gage, containing a T-slot which is a duplicate of that in the chuck body. The jaws must slide smoothly through this functional gage, otherwise they are rejected until they can meet the requirements of this gage. Gage *N* tests the relation of the keyway to the parallel sides of the jaw and also in relation to each other; that is, the keyways must be directly opposite each other as well as parallel.

In describing the machining operations on the jaw body, particular emphasis was placed upon the accuracy of machining surfaces *L*, Fig. 1 (see page 510, February number), and at this time equal emphasis should be made in connection with the inspection of the jaw keyway, since it will be apparent that the upper surface of this keyway rides on surfaces *L* which are machined square with the sides of the jaw gash, just as the keyway is milled square in relation to the sides of the jaw. In other words, any slight discrepancy between these mating parts in this particular surface will impair the functioning of the chuck and destroy the interchangeability of its parts.

It will be realized that jaws having the peculiar shape of those used in this chuck present a condition which demands the utmost care in inspection work, as well as in machining operations, in order that the claims for interchangeability may be fulfilled. The fact that a combination of screw threads and irregular contact areas enters into the manufacturing problem is sufficient to introduce a condition which adds to the degree of precision which the jaw and body must have in their fitting.

Counterboring Thread and Screw Clearance Grooves

Both the left- and the right-hand jaws have clearance grooves on their sides for the body of the operating screws, and grooves for the threaded sections in which the operating screws function, as will be seen by referring to Fig. 10. These grooves are machined by counterboring, and the operations are performed on a specially equipped drilling machine, as shown in Fig. 16. For each set of jaws there are three jigs of the type shown at *A* used, but for the purpose of description the one illustrated will enable the features of all these jigs to be understood. Although the jigs themselves are of interesting construction, the special attachment used in connection with the jigs is of equal interest.

A special auxiliary spindle *B* provided with a flexible joint *C* is fitted to the spindle of the drilling machine and its lower end operates in a bronze bushing within the cast-iron bearing *D*. The jig is seated on a slide *E* which, in turn, rests on a cast-iron base clamped to the bottom of a deep oil-pan *F*. Handle *G* operates a lever and link mechanism by means of which the jig is advanced on the slide to a forward position when it is desired to load or unload the work. Special two-step counterbores such as shown at *H* enable the thread groove and the clearance for the operating screw to be counterbored at the same time. The jig holds two jaws, the counterbore passing down through the space between these jaws, but in the illustration one of these jaws is shown lifted from its proper position so that the counterbored surfaces and the method of securing the work in place may be seen.

The jaws fit accurately in the openings in the fixture which contain keys that fit the previously milled keyways in the jaw, and are pushed down until it is possible to insert the hardened steel plugs *J* in holes *K* of the jig, so that these

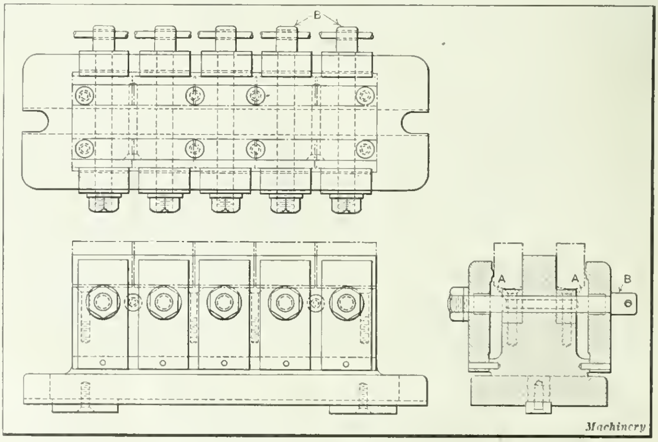


Fig. 14. Milling Fixture for milling the 120-degree V-grooves in the Teeth of the Jaws

plugs will engage the V-grooves in the top of the jaws. Thus, it will be seen that the keyways and the V-grooves, and not the length of the jaws, are in reality the surfaces from which these counterbores are located. When the jaws are pushed down, the curved end of the jaws is in contact with the extremities of the hardened steel fingers *L*, which fulcrum at *M* and bind the work against the hardened steel plugs *J* when the knurled-head screws *N* are tightened. The contact of these fingers is on the center line of the jaws, so that the pressure is properly applied. In operation, the work is constantly flooded with coolant which flows into the deep oil-pan especially provided to accommodate a copious supply of liquid. As previously stated, during the period of removing and replacing the work, the fixture is slid forward where the work can be conveniently done without interference with the cutter.

Referring to the two grooves *F* and *G* for the secondary screw (see Fig. 10), the limits allowed on the radii *H* and *h* are + 0.012 and — 0.000 inch. The thread clearance groove *J* on the opposite side of this jaw is of the same radius and has the same tolerance as both thread clearance grooves on the left-hand jaw. These grooves for the primary screw clearance are indicated by the same reference letter, and the limits allowed for these grooves are + 0.015 and — 0.000 inch. The radius *K* for both jaws is the radius of the surface in which the threads are subsequently cut, and this radius has the same tolerance as that allowed for radius *J*, that is, 0.015 inch. The length *S* of the screw clearance counterbore is held to very close limits, that is, + 0.000 and — 0.008 inch, and there is a limit of ± 0.005 inch for dimension *P* of the secondary screw.

It was previously mentioned that a key in the jig engages a keyway in the jaw as a means of locating the jaws for counterboring these surfaces. The limit on this dimension *L* for each jaw is ± 0.002 inch. Referring to the gaging equipment shown at *O*, Fig. 16, it will be obvious that gages of this type provide a "Go" and "Not Go" limit for the radii of the counterbored surfaces, and a similar means of inspecting dimensions *M*, *N*, and *O*, Fig. 10. In gaging, the jaws are simply laid on the block and brought under the hardened steel gaging members. The limits for dimensions *M* are — 0.001 and — 0.005 inch; for dimension *N*, + 0.009 and — 0.010 inch; and for dimension *O* ± 0.007 inch.

Special Hobbing Machine for Cutting Threads in the Jaws

The jaws have square threads of 1/10 inch pitch, and these are machined on a special hobbing machine illustrated in Fig. 17. The machine has two work-holding fixtures *A* in which the jaws *W* are located in a similar manner to the method followed in clamping the jaws in the previous operation, that is, by means of keys for the keyways and a steel plug for the V-groove. It will be seen that the fixtures are dovetailed to the work-head *B* so that they can be changed to provide for hobbing other sizes of jaws. Two jaws of the same hand are hobbed at one time, and a two-fluted hob *C* is employed for the purpose. The opposed work-heads are fed toward the hob by means of suitable gears, the power being delivered from the gear-shaft which passes through the machine and on the end of which the handle *D* is fitted.

A ratchet wheel *E* and a pawl *F*, are adjusted to give the proper amount of feed for the work-heads per hob revolution. Every thousandth inch of feed is represented by four ratchet teeth on the wheel, and by locating the handle *G* in the proper angular position, trip *H* will cause the mechanism to knock off when desired. The hob is intermittently thrust forward after each complete revolution, a distance equal to the pitch of the screw, or 1/10 inch. This sudden forward movement of the hob occurs between the time that the two rows of teeth, which are located on opposite sides of the hob, are passing from one jaw to the other. The two jaws are so placed in relation to the hob that the radial arcs of the counterbored surfaces would, if completed, form a full circle. This leaves an opening between the jaws sufficient to enable the hob to advance to bring its teeth forward 1/10 inch to the starting point.

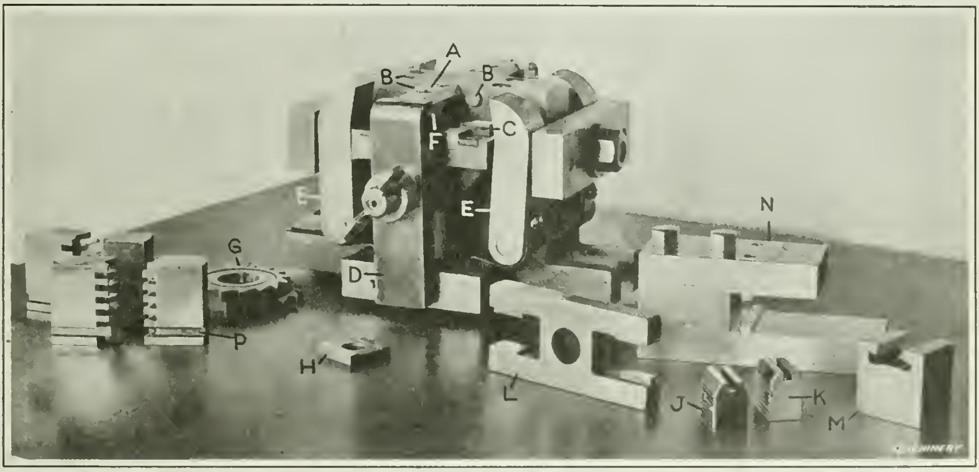


Fig. 15. Milling Fixture and Gages used for milling and inspecting the Keyways in the End of the Jaws

The backward traverse of the revolving hob, during which the cut is taken, is controlled by a cam and roller at the rear of the machine, and the sudden forward movement is governed by spring action, the spring being located at the end *S* of the spindle so as to operate as soon as the contour of the cam permits. The feed per spindle revolution is obtained by a cam, carried inside the driving pulley, in contact with which a roller operates. This roller is carried on arm *J*, which is thus swung backward and forward. The throw of the pawl *F*, and consequently the number of teeth taken up by the feed-pawl, may be regulated by means of the knurled adjusting screw *K*. The two shoulder plugs *L* in the work-heads enable the position of the fixtures to be adjusted as may be necessary to correct any errors in the threads which show up during the inspection of the first pair of jaws hobbed in any particular lot.

The gaging equipment used for testing the threads is of an interesting nature. There is a master block *M* in which a master screw is fitted, which is operated by a knurled knob. The block has a floating roller *N* against which the jaws, after being laid on the block, are drawn by means of

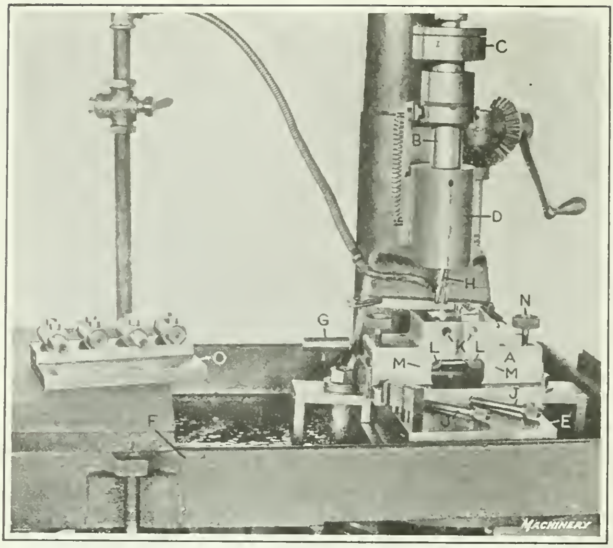


Fig. 16. Drilling Machine and Two-station Jig used for Counterboring Operations

the master screw. The floating roller contacts with the V-groove while the threaded jaw and master screw are in engagement, the flat side of the jaw resting on the flat surface of the block. This is the identical relation of contact surfaces that exists in the finished chuck; in other words, this is a functional gage. The collar *O* of the master screw and the upper surface of the master block are so graduated that when the limits have been established these two lines will coincide. A limit snap gage *P* of special design is used in conjunction with hardened and ground master screws *R* which fit the threads in the jaws, as shown in the illustration. Then the jaw, with the master screw in engagement with the threads, is slid under the gaging points so that the limits for depth of thread may be carefully and accurately checked.

It is impossible to give any limits for establishing the dimensions between the V-groove and the threads, but for the depth of the threads the hob is held within limits on the radius of + 0.002 and — 0.000 inch. Between the thread grooves and the outside diameter of the operating screw there is a basic clearance of 0.005 inch. After hobbing, the curved ends of the jaws are ground and polished, before being finally subjected to heat-treatment. The jaws are hardened at a temperature of 1425 degrees F., and are quenched in oil, after which they are drawn in oil for a period of thirty minutes at a temperature of 310 degrees F. They are finally wire-brushed to remove the oxide scale and clean the surfaces preliminary to the final inspection before being assembled in the chuck body.

Assembling and Final Truing-up Operations

In assembling the chuck, the body is held in a bench vise with special jaws, as shown in Fig. 18, and the primary screw is forced in so that its neck fits tightly in the recess provided for it in the body. Then by employing a long brake-lever to hold the screw in place, it is worked by means of a suitable crank which fits in the wrench socket, until the shoulders of the recess become rubbed down or burnished and the screw operates freely. The cap-plate is then assembled and the primary screw removed. The jaws are next forced into the body by means of a foot press shown at the left in Fig. 18. The body is then located in the special fixture *A*, mounted on a shaper table, and the jaws worked to a functional fit by a special connection to the ram of the shaper. In place of the regular tool-head, a special arm *B* is attached to reciprocate the three rods *C* through the fixture. Two of these are guides and the middle one is the means provided for working the jaws back and forth in the body.

While this machine is in operation, the assembler is engaged in reassembling the primary screw with the two jaws in the body just removed from this fixture, and in preparing the next body for the arbor press by driving two jaws partly into the gash by means of a wooden mallet. Then with the primary screw that was first fitted in the body and the two jaws that were worked to a functional fit in the jaw gash, assembled, the chuck is passed along and is hand-fitted and the secondary screw assembled. There is no fitting necessary in assembling the secondary screw. This completes the assembling, and the chuck is then tested for torque on the screw and jaw threads by applying a 75-pound leverage pressure to them.

The assembled chuck is then placed on an arbor, on which it is secured by means of its own jaws, and the small diameter of the body trued up. The next operation is that of rough-taper-boring the shank hole on a Porter-Cable lathe. After the hole has been rough-taper-bored, the chuck is disassembled leaving the cap-plate in place, the jaws and screws being kept together and filed in pigeon holes, as shown in Fig. 6, page 513 of the February installment. These pigeon holes are numbered to correspond with the number of the chuck which is stenciled on the outside of the body. The body and the assembled cap are then fitted to a tapered arbor by means of the rough-bored tapered hole; and the central hole in the plate through which the drill extends when the chuck is in use is bored concentric with the shank hole. In case the outside diameter of the assembled cap does not conform to the outside diameter of the chuck body, a light cut is taken to true up these diameters. The outside diameter of the body and cap-plate is then ground for finish, stenciled with the maker's name, and returned to be reassembled.

With the jaws and screws reassembled in the chuck body the tapered shank hole is rebored on a Reed-Prentice 10-inch

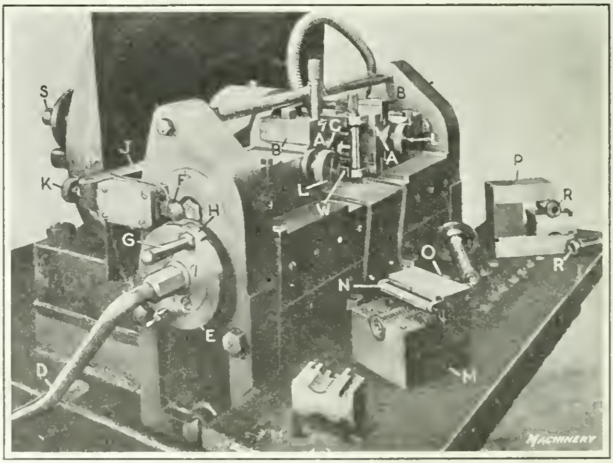


Fig. 17. Single-purpose Jaw Hobbing Machine with Two Dovetailed Work-heads

lathe equipped with a taper attachment, which consists of a bar having a taper surface operating in a block at the front of the cross-slide. This set-up is shown in the heading illustration in which the projecting end of this bar may be seen. The angular traverse of the single-point boring tool employed in this operation is accomplished by a finger on the slide-screw which engages the tapered surface of the bar. The lathe is equipped with a special faceplate, which has a stud over which the chuck is slid and held by means of the regular chuck jaws.

The concentricity of the tapered hole and the chuck is then tested by fitting a long tapered plug into the shank hole, this plug being hardened and ground and extending 6 inches beyond the end of the chuck. Then by employing a Koch indicator to engage the extremity of this plug, the running truth of the chuck may be readily tested. With the point of the indicator at a distance of 6 inches from the end of the chuck, it cannot fluctuate more than 0.006 inch and still pass final inspection. This completes the manufacturing processes in which the factors of accuracy and interchangeability enter. The wrench provided for the chuck is made of 3½ per cent nickel steel, and is properly heat-treated and quenched in No. 2 Houghton quenching oil.

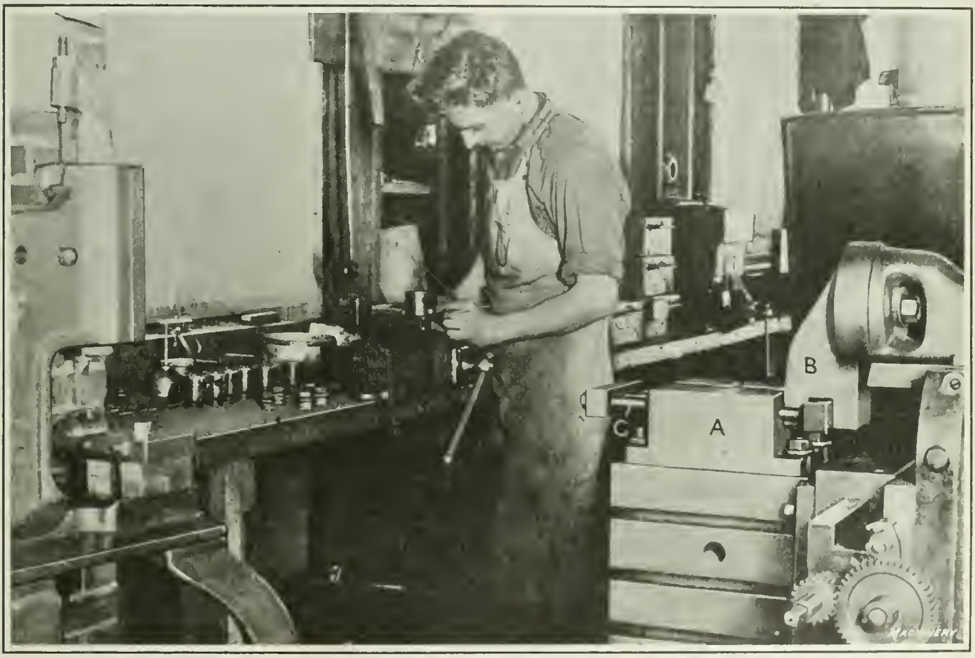


Fig. 18. Equipment employed in assembling the Drill Chuck including Bench Vise, Foot Press, and Specially Equipped Shaper

* * *

NOVEL METHOD OF TRANSPORTATION

A company known as the Road-Rail Loco-Tractors Ltd. has been formed in England for developing a novel system of transportation in rural districts and on tea, sugar, and rubber plantations. In this system, a rubber-tired tractor draws a train of cars, the tractor running on a prepared road track outside of two rails set to a narrow gage on which the cars run. This scheme was utilized in East Africa during the war to overcome the transportation difficulties met with in that rough uneven country. It is stated that the tractive effort of a rubber-tired vehicle on a road is double that of a locomotive on rails, while the resistance of cars running on rails is only about one-half that of vehicles running on a road; thus a double advantage is gained.

FUELS FOR MELTING BRASS

A recent number of *Graphite* contained an article discussing the merits of the various fuels used in melting brass, in which it was stated that the best fuel for this purpose is that which will give the best quality product for the least manufacturing cost, and that the cost per pound of brass melted should be the basis upon which the fuel cost should be considered. The available fuels used for melting brass are: Coal, coke, fuel oil, city gas, producer gas, water gas and various similar types of manufactured gas, and natural gas. Most of the brass produced in this country is melted by the use of coal and coke. The results obtained are satisfactory so far as flexibility, reliability, and quality of the product are concerned. For a small installation, and for small heats of special mixtures, where great flexibility is required, coal and coke fires are most satisfactory and inexpensive. The investment required in coal or coke brass-melting furnaces is less than for any other. Oil is an easy fuel to handle, but at present it is expensive and hard to obtain, and the rate of consumption indicates a greater future scarcity and much higher prices.

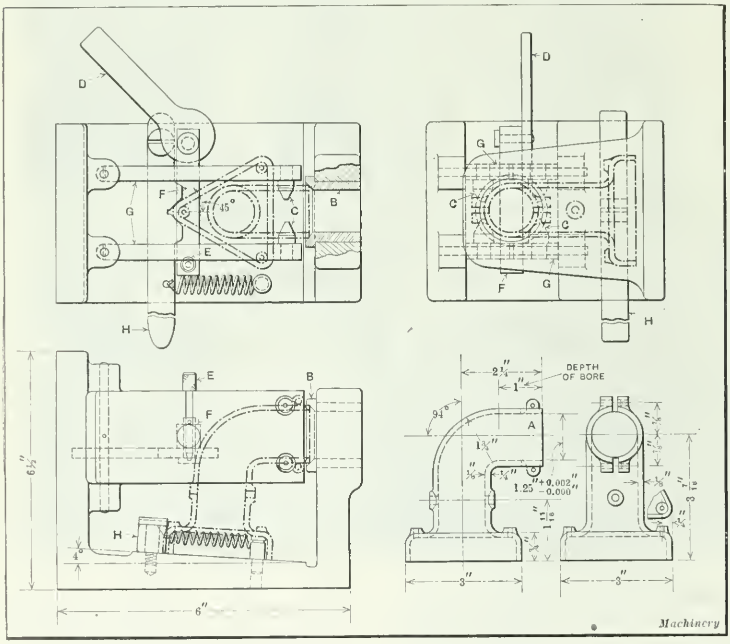
City gas is no more expensive than coal or coke, if all factors are considered, among which the following are the most important: First, less labor is required to operate gas furnaces; second, the crucibles have a longer life; and third, there are no ashes to handle or treat. These factors are true for all types of gas fuel used in crucible furnaces. In the case of gas, the difference in the price of fuel is more than counterbalanced by the great saving possible in labor and ash-treating, and by the greater speed in melting.

Manufactured gas can be used to great advantage in crucible melting, and by many it is regarded as much more satisfactory than either oil or natural gas because of the lesser tendency to oxidize the carbon in the pots. Another factor to be considered in connection with the use of gas in crucible brass-melting is the fact that the same gas can be used profitably in annealing and heat-treating furnaces in the same plant.

Jig with Cam-actuated Clamping Arrangement

By W. BURR BENNETT, President, Wayne Engineering Co., Honesdale, Pa.

A JIG which embodies in its design clamping and locating arrangements of an unusual nature is shown in the accompanying illustration. This jig was designed for locating and holding an aluminum part known as a carburetor hot-air intake, which is shown in the lower right-hand corner of the illustration. The machining operation performed in the jig is that of boring the 1.25-inch hole *A* to a depth of 1 inch. It will be seen that the center line of this hole is at an angle of 94 degrees with the vertical; this, together with the general design of the part, calls for a somewhat unusual holding means. It is necessary that the bored hole be concentric with the outside diameter of the end in which it is bored.



Detail of Carburetor Intake, and Jig in which it is held when boring Hole

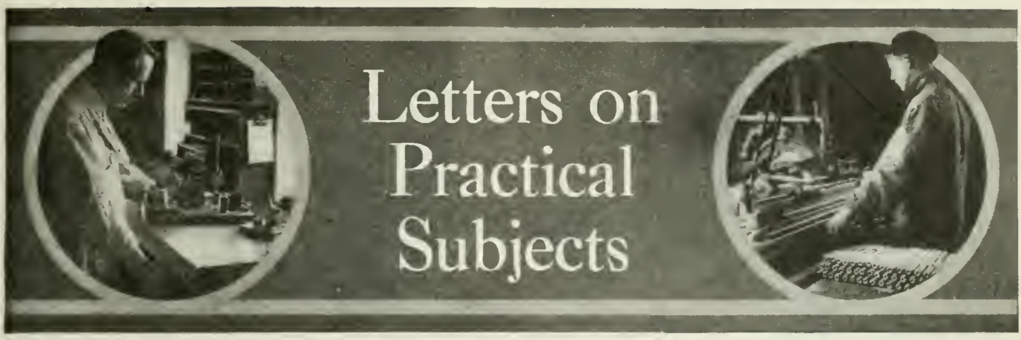
In the illustration of the jig the position of the work is shown in heavy dot-and-dash lines. The base of the part, which is triangular in shape, is seated on its previously ground surface, at an angle of 4 degrees. In this position it is held by spring tension, with the L-section in which the hole is bored located concentrically in the cupped bushing *B*. The support for this part of the casting consists of four conical-head guide pins *C* which are brought into contact with the outside of the work in the relative position shown in the side elevation. The arrangement whereby these pins hold the work allows for variations in the diameter of the casting so that after it has been located in a concentric position against the angular surface of bushing *B*, it may be securely held in place.

The jig is operated and the work located in it in the following manner: After the boring operation has been performed and it is desired to remove the work from the jig, release the cam-lever *D*, withdraw the knurled-head pin *E* from the cam-rod *F*, thus releasing the hinged gates *G* in which the guide pins are carried. By depressing the tension bar *H*, the work may then be readily removed. It will be seen that the cam-rod *F* is of circular section except at the end to which the cam-lever *D* is attached, this being of square section. It will also be seen that the cylindrical part of this member extends through both gates *G* after the work has been located on its angular seat and the gates have been swung in place, so that it is a simple matter to drop in pin *E*, the head of which rests on the upper surface of the outer gate, and quickly clamp the work by operating the cam-lever handle which draws the two gates together so that the opposed pairs of guide pins are brought into contact with the work.

It might appear that the piece would be tipped in the jig when thus located, but this does not occur in actual practice. The arrangement makes for quick clamping action and provides a support for the thrust of the boring tool in such a location that it eliminates any tendency of the work to spring or distort under thrust of the cutter. It will be appreciated that this desirable feature is often difficult to obtain when locating a part of this type. One other noticeable feature of this jig is that it is of comparatively heavy construction for such a light piece of work, but it has been found that making jigs and fixtures stiff and heavy is good practice, as they will stand more rough usage by the workmen and so give satisfactory results for a longer period of time.

* * *

Production can often be materially increased if a more suitable grinding wheel for a particular class of work is substituted for the one being used. In this connection, the following experience of the Norton Co. is presented. One of their customers had been grinding pistons, 3½ inches in diameter and 5 inches long, with a grain 36, grade N, crystolon wheel. The production with this wheel averaged 10 pistons per hour and about 10 pistons per dressing of the wheel. By substituting a grain 36, grade L wheel, a production of 35 pistons per hour was obtained and the number of pistons ground per dressing of the wheel, increased to 32. The second wheel could be made to cut faster because it was softer, and being soft, the wheel wore slightly and constantly renewed its cutting face.



Letters on Practical Subjects

RECESSING AND CHAMFERING TOOL FOR HORIZONTAL BORING MACHINE

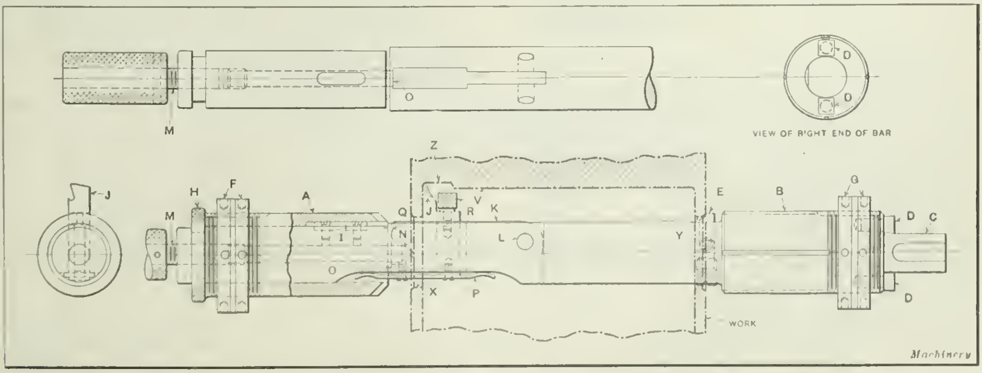
The boring-bar type of tool here illustrated has been designed for use on horizontal boring machines of the class in which the spindle revolves and the work is clamped on a stationary table. Several novel features are employed in its construction. On account of its length it is essential that the boring-bar be well supported, and this is accomplished by providing a suitably bushed bearing on each side of the work, in which the bar rotates while it is being used. The work is indicated in the illustration by heavy dot-and-dash lines. The operations performed by the boring-bar consist of chamfering the outer ends of holes *X* and *Y* and boring recess *Z*.

When the boring-bar is mounted in position for an operation, the surfaces which rest in the bearings previously mentioned are the circumferential surfaces of cutter *A* and part *B*, the latter being integral with the boring-bar proper. The boring-bar is connected to the driving spindle of the machine by means of a universal joint, the socket of which is slipped over end *C* and drives the boring-bar through two square keys *D*. Pin-cutter *E* chamfers hole *Y* when the boring-bar is fed toward the left. Cutter *A* is provided with teeth on the beveled end which chamfer hole *X* when the boring-bar is fed toward the right. In order to insure that neither hole *X* nor *Y* will be chamfered beyond the desired depth, stop-collars *F* and *G* are provided. These come in contact with the ends of the bearings that support the boring-bar and prevent further feeding of the bar. Cutter *A* is driven through key *I*, and is locked in place by the U-shaped collar *H*, which can be readily slipped off the boring-bar to permit the quick removal of the cutter from the bar and the withdrawal of the bar from the work after the completion of an operation.

Recess *Z* is machined by means of tool *J*, an ingenious arrangement being used for expanding this cutter after holes *X* and *Y* have been chamfered. It will be seen that this cutter is secured to a block *K* which swivels on pin *L*. In the front end of the block there is a wedge-shaped slot *N* in which the right end of screw *M* projects. This end of the screw is tapered to suit the slot, and so when the screw is rotated by turning the knurled handle on its left end, the opposite end of the screw advances into the slot and forces the block up or down, depending upon the direction in which the screw is rotated. If block *K* is forced up, the tool is fed into the work and, if it is lowered the reverse is true. The depth of the cut taken by tool *J* is regulated by block *K* coming in contact with surface *O* of the opening cut through the boring-bar to accommodate the block.

When the end of screw *M* is withdrawn from the slot, the withdrawal of the cutter from the recess to clear surface *V* on the work is assured by the flat spring *P*, which is attached to the block by means of two screws and which bears against the boring-bar at two points, thus causing the block to be pulled down until surface *Q* of the block comes in contact with surface *O* of the bar. The manner in which the cutter is ground will be apparent from reference to the left-end view of the bar. It is obvious that the boring-bar cannot be inserted through the hole of the work with cutter *J* in place; this cutter is attached to block *K* through an opening in the wall of the work, being secured to the block by means of the knurled-head screw *R*.

In operation, the boring-bar, with cutters *A* and *J* and collars *F* and *H* removed, and the tapered end of screw *M* withdrawn from the slot in block *K*, is passed through the hole at the right end of the work. Recess cutter *J* is then fastened to the swiveling block, as previously mentioned, after which the chamfering cutter *A* is put on the bar and secured in place by collar *H*. The cutters are now ready for operation, and after the boring-bar has been made to revolve, it is advanced through the work until hole *Y* has been chamfered,



Boring-bar with Two Cutters for chamfering Holes and a Third Cutter having an Expanding Arrangement for producing a Recess the feeding movement of the boring-bar being obtained by means of a large pilot wheel that is used to operate the main spindle of the machine. The movement of the boring-bar is then reversed in order to chamfer hole *X* with cutter *A*. Next, while the boring-bar continues to revolve, the operator grasps the knurled handle on screw *M*, causing the tapered end of the screw to advance into the slot in block *K* and gradually feeding the cutter into the work. When the required depth has been reached, the feed of the machine is thrown in and the boring-bar advanced toward the left until the recess has been cut to the length required. The reason for employing a universal joint to drive the boring-bar is so that the latter will be held in correct alignment with the work during the operation, this being a common method of drive employed in performing work of this nature.

F. Server

BALL-GAGING MACHINE

The gaging of balls for high-grade ball bearings is at best difficult, due to the exactness of the operation and to the desired rapidity of the performance. Special machines have been designed for the purpose of sorting the balls so accurately that the variations in the diameters of the balls in an assortment will be less than the tolerance permitted on the balls entering the construction of one bearing. A machine based on the simple principle illustrated diagrammatically in Fig. 1 has been in use for a long time. It will be clearly seen that the balls are made to roll over an inclined plate having a tapered slot. When the ball reaches the point where the slot is wider than the diameter of the ball, it falls through the slot into a pocket in the machine. In this way the balls are sorted into a number of receptacles according to their size, even though the exact size of the balls in any one receptacle may be unknown. Each ball acquires momentum when rolling on the slide, and this prevents it from falling perpendicularly upon reaching the gaging point, so that, instead the ball follows the path indicated by the heavy dot-and-dash line in the illustration.

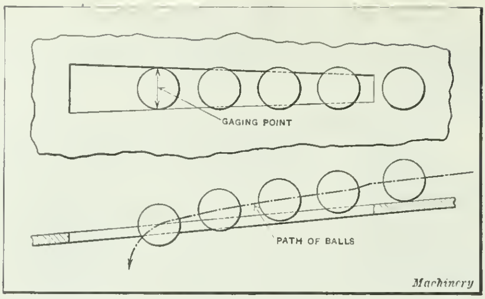


Fig. 1. Principle on which Balls are sorted in a Ball-gaging Machine

The machine illustrated in Fig. 2 has been designed by the writer to sort the balls according to a predetermined dimension, use being made of the well-known principle of the snap gage. Referring to the illustration, it will be seen that the driving shaft *A*, which rotates at the rate of 100 revolutions per minute, is driven by pulley *B*. The balls to be sorted are placed in hopper *C* and are agitated by the revolving part *D* which causes the balls to enter the enlarged opening of hole *E*, one at a time. Part *D* is mounted on shaft *F*, which is driven from the driving shaft through bevel gears *G* and *H*, the ratio of which is such that part *D* rotates at the rate of 150 revolutions per minute. The balls roll down passage *E* by gravity and drop, one at a time, into five holes in plate *I*, which is rotated by means of two sets of spur gears that connect shafts *F* and *J*. The ratio of this gearing is such that plate *I* revolves twenty times per minute, and as the plate rotates, the balls drop into slot *K* from the holes which they enter from passage *E*. The number of balls fed into slot *K* is 100 per minute.

The balls roll from slot *K* down an incline until they reach the position indicated by ball *L*, where they are stopped by weight *M*. At this point it will be noticed that there is an opening in the path of the balls, which is larger than their diameter. This opening is covered by two steel gaging plates *N* and *O* (see section *X–X*) having a space be-

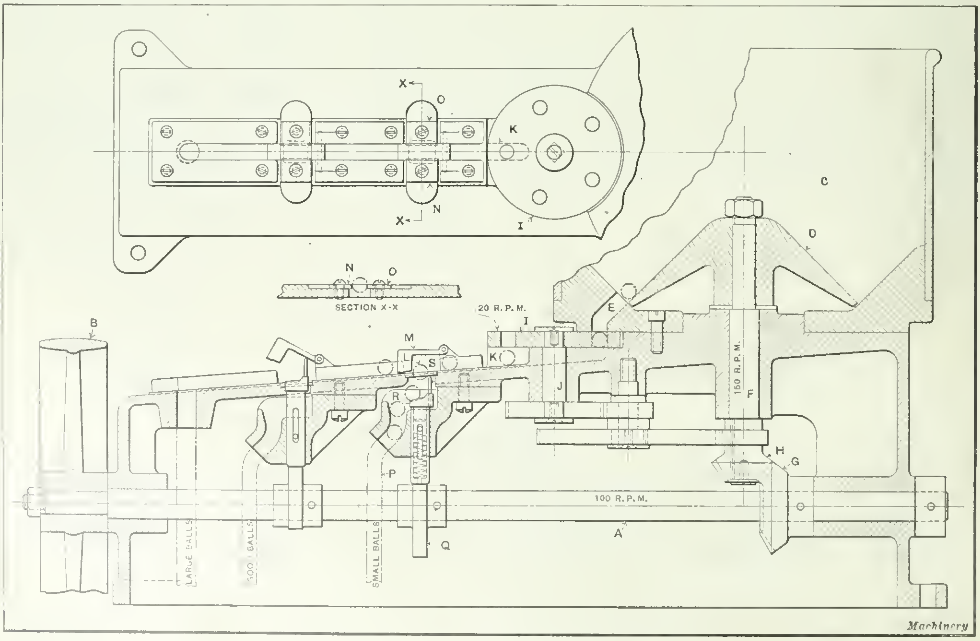


Fig. 2. Improved Design of Ball-gaging Machine having a Number of Stations provided for sorting the Balls

tween them of a width that will permit the ball to drop through the slot if it is smaller than the desired size. The gaging plates are properly spaced by means of a size block, the holes in the plates being larger than the screws by which they are attached to the machine housing, so that the plates can be set accurately by pressing them against the size block. When a ball drops through the gaging plates at this point, it is conducted to a container by means of the flexible pipe *P*.

If the ball is larger than the size limited by the opening, it cannot, of course, drop through, and so will hang on the plates until cam *Q* pushes plunger *R* upward, at which time the ball is lifted by the plunger so that it can roll down the incline to the next gaging station as weight *M* is swung upward by pin *S* on the plunger. The cam, plunger, and weight at the second station, are shown in the position they occupy when a ball is released from the station. Actually, however, the two cams on shaft *A* are so arranged that both plungers are raised and lowered together. If the ball falls through the gaging slot at the second station, it is within the required limits; however, if it does not drop through, it rolls down the incline to the end, where it is conveyed to a receptacle to be reground. This design can be developed to have an unlimited number of gaging stations, so as to sort balls of exceedingly slight variations in diameter.

New York City **Charles Ruiz**

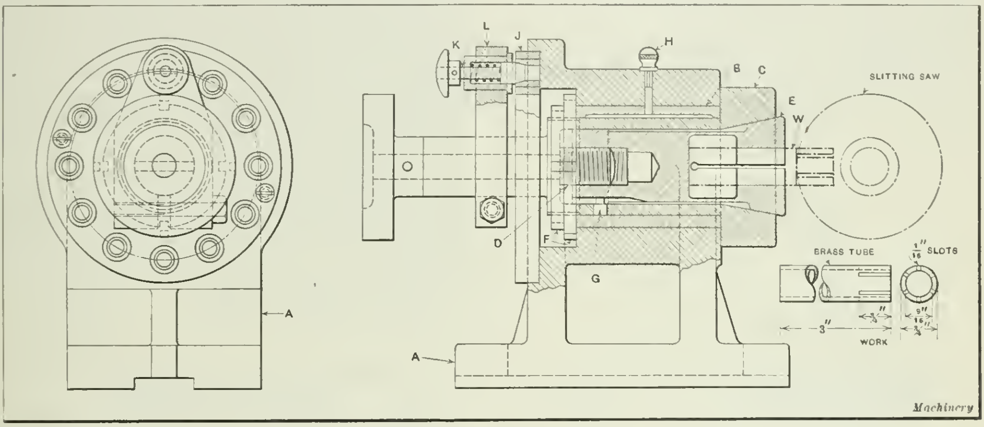
COLLET INDEX-HEAD

The construction of the collet index-head described in this article is clearly shown in the accompanying illustration, together with a piece of work which is representative of the type for which this collet index-head is especially adapted. The work is a piece of brass tubing, in the end of which six slots are cut 1/16 inch wide. The operation is performed on a Whitney hand milling machine, the base casting or body of the device being designed with a locating slot corresponding in width to the slots in the milling machine table. This collet head is suitable for use in cutting slots and keyways in a variety of light work.

The index-head itself consists of the previously mentioned body *A*, provided with a steel bushing *B* in which the collet sleeve *C* fits. It will be seen that this sleeve extends through and beyond the head at the rear, forming a bearing for the draw-bolt *D*. The split collet *E* is of standard construction, and is tapped in the end for the draw-bolt, as clearly shown, so that when the draw-bolt is screwed into the collet the latter will be drawn in and will securely chuck the work. A handwheel is pinned to the end of the draw-bolt, the construction being such as to permit the chucking of the work independently of the special indexing feature of this collet head. End play is taken up by two adjusting nuts *F*, and the collet is prevented from revolving by guide pin *G*, which fits into a slot in the collet.

Oiling facilities are provided by an oil-hole leading down through the body and the sleeve bushing *B*, to an oil-groove in the sleeve. A knob *H* is provided for this hole as a means of excluding dirt and other foreign substances. The indexing feature of the head consists of an index-plate *J* with a number of suitably laid out and bushed index-holes in which the spring detent or index-pin *K* may be engaged. The index-arm *L*, in which this spring-actuated pin is carried, is attached to the draw-bolt end of sleeve *C*, a construction which permits the chucking of the work and the subsequent indexing to be independently performed.

In operation, the cutter is set central with the index-head. The work is inserted in the collet and chucked in the regular manner by operating the draw-in handwheel. The table of the machine is then advanced until the slot has been cut to the proper depth, after which the work is withdrawn from the cutter and the spring pin *K* pulled out of its index-hole and revolved the required number of holes to give the proper spacing of the slots. The index-plate shown has twelve bushed holes, so the head is indexed every second hole.



Collet Index-head, and Type of Work for which it is especially suited

Collets can, of course, be designed to suit any type of work within the range of the head, and a number of index-plates may be used with the head, since these plates fit into and are attached by screws to the main casting. These two features extend the range of usefulness of this attachment so that a great variety of light work may be handled. This head has been used on such work as cutting 5/16-inch slots in steel and 3/8-inch slots in cast iron.

Pittsburg, Pa. **William Owen**

PITCH OF JIG CLAMPING SCREWS

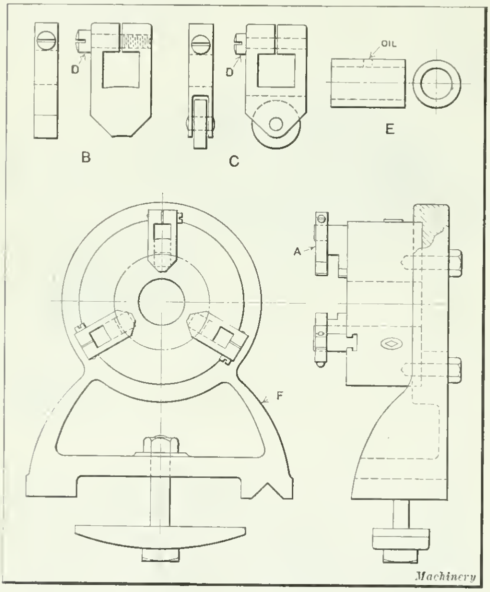
A tool designer is often obliged to use a thumb-screw for clamping work in a jig, when he would prefer to employ a cam-operated device but is prevented on account of the expense, or due to lack of space. In such cases the best results are secured by using a clamping screw having a coarse pitch. A screw 3/8 inch in diameter having sixteen threads per inch, may be powerful enough to hold the work, but the horizontal movement obtained in one revolution of a screw 3/4 inch in diameter, having ten threads per inch, is 1.6 times that obtained by the former. Thus, it is obvious that a 3/4-inch screw permits the work to be clamped and released more quickly than a 3/8-inch screw, and when the screw must be moved a considerable distance in clamping and releasing the work, much time can be saved by applying this principle.

Syracuse, N. Y. **Elmer C. Cooley**

SELF-CENTERING LATHE STEADYREST

The accompanying illustration shows a self-centering steadyrest which will center work as accurately as will the regular universal chuck used in its construction, provided care is taken to obtain accurate alignment when machining and fitting the parts. The device consists of a cast-iron frame *F* similar to that of the ordinary steadyrest but without the hinged top or the slides and adjusting-screw brackets. Instead of using frame *F*, a standard could be made of a plain angle-plate, bored out for the chuck, and provided with bosses cast on the bottom which could be machined to fit the lathe ways. The frame or angle-plate, as the case may be, is bored out and recessed accurately in line and on a level with, the line of the lathe centers. A universal chuck is then fitted in the recess and bolted in place. The capacity of the steadyrest depends of course, upon the size of the hole in the chuck.

As the regular chuck jaws would spoil the finish on work revolved between them, special auxiliary jaws *A* are made and fitted over the regular jaws as shown. These can be either plain cast-iron jaws as shown in the enlarged view at *B* or they may be of steel and provided with hardened steel rollers as shown at *C*. The jaws are split and fitted with screws *D* for clamping over the outside chuck jaws. Sometimes it is better to use a plain bronze bushing *E* which is accurately reamed out to take the work. The bushing is, of course, held in the regular chuck jaws instead of in the auxiliary ones.

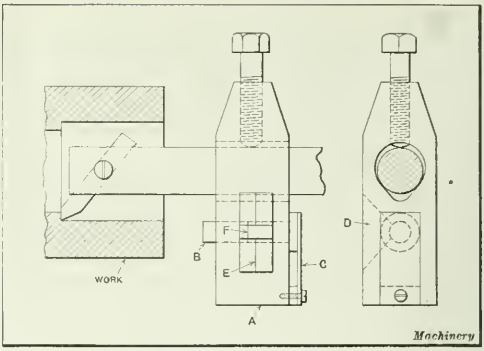


Self-centering Lathe Steadyrest

Oakland, Cal. H. H. Parker

INDICATING STOP FOR BORING OPERATIONS

The illustration shows an indicator stop made by the writer to facilitate the boring of holes to shoulders which cannot be seen during the machining operation. The common methods of filing a mark on the boring-bar, or placing a chalk mark on the ways of the bed, to indicate when the cutter has been fed to the required depth, often prove unsatisfactory. However, with the stop illustrated, a depth gage is used to set the cutter for boring a hole, and the way the stop is employed insures accurate boring to depth.



Boring Stop having Scribed Lines that indicate when Hole has been machined to Proper Depth

It will be seen that the device consists essentially of stop *A*, pin *B*, and flat spring *C*. Stop *A* has a hole *D* milled in it to the depth of the hole provided for pin *B*. A line *E* is scribed on each of the slanting surfaces of this hole, and another fine line *F* is turned on pin *B*. In setting the cutter for boring to a certain depth, pin *B* is depressed until line *F* coincides with lines *E*, and the depth gage is used between the cutter and the edge of stop *A*. When pin *B* is released, spring *C* forces it back to the position shown. During the performance of the operation, the cutter is fed into the work until the lines of the stop and pin coincide, at which time the feed of the lathe carriage is disengaged by the operator. The latter should watch the stop from the time that pin *B* makes contact with the work, so that accurate boring will be obtained.

Rosemount, Montreal, Canada Harry Moore

ATTACHMENT FOR MILLING TURBINE-BLADE SPACERS

Production of the peculiarly shaped piece *A*, Fig. 1, which is a spacer used in large quantities to separate disk blades in the steam turbines manufactured by the Moore Steam Turbine Co., Wellsville, N. Y., was greatly increased by means of the milling machine attachment illustrated in Fig. 2. The part is made from special U-shaped rolled stock. The operation is performed on a Kempsmith milling machine, and consists of cutting the tongue on one end and severing the piece from the stock. Five milling cutters are required, three being mounted on the regular milling-cutter arbor of the machine, and the other two being placed on a special arbor provided on the attachment.

The operation is accomplished by clamping one end of the work in the vise of a fixture mounted on the machine table and then traversing the table past the cutters. Eighteen pieces of stock are clamped at one time in this fix-

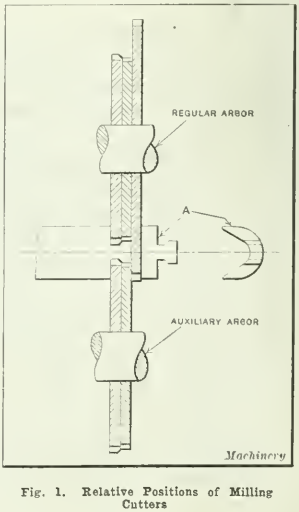


Fig. 1. Relative Positions of Milling Cutters

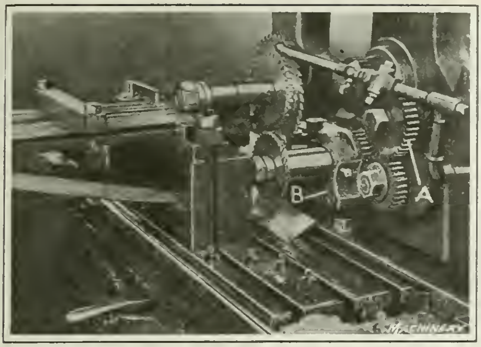


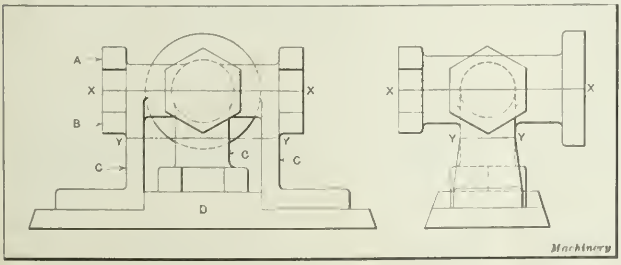
Fig. 2. Special Attachment used in milling Spacers for Steam Turbine Disk Blades

ture, care being taken to have them all parallel with the cutter-arbors, the U-shaped hollow of the stock being placed in a horizontal position as clearly seen in the illustrations. By this arrangement, eighteen spacers are formed and cut off at each traverse of the table. The opposite ends of the stock are supported on a horse and slide readily with the moving table, as the pieces of stock are clamped together at several points along their length. After a traverse of the table has been completed, the vise jaws are opened and the stock is pushed against a stop to locate the pieces properly for the next traverse, the vise jaws then being retightened.

The auxiliary milling-cutter arbor is mounted on a slide attached to the column of the machine, the arbor being driven by means of spur gears *A*, Fig. 2, which are also mounted on the slide and which are, in turn, driven by a gear on the regular arbor. The slide is not clamped in position on the column, but instead is located by a jack placed on the knee of the machine in back of the table. The projecting bearing *B* of the slide rests on the top of the jack elevating screw, permitting vertical adjustments of the slide and the milling cutters on the auxiliary arbor, which are secured by turning the nut on the jack. The production obtained through the use of the attachment described averaged 250 pieces per hour. A. L. HIGHBERG

PATTERN FOR A FIVE-WAY VALVE

The designer of a five-way hydraulic valve to be used under high pressures was informed by a patternmaker that its design prevented it from being cast; subsequently, he took the drawing to another patternmaker who constructed the pattern as illustrated. It was decided to cast the valve solid and bore the different ports on a machine after the casting had been made. The pattern is made in three sections, *A*, *B*, *C*, being split along the lines *XX* and *YY*, at which places dowels and holes are provided for aligning the sections with each other. It will be noted from the illustration that the three portions of the pattern comprising section *C*, are attached to core-print *D* and thus held together.



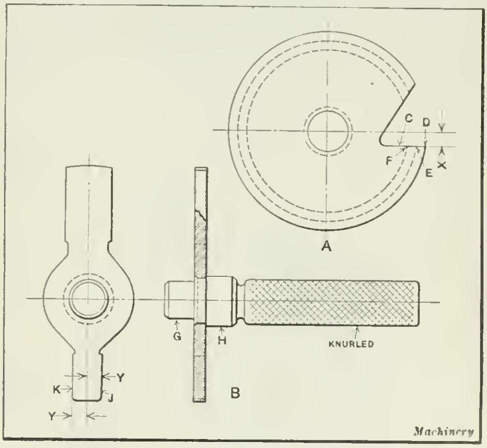
Design of Five-way Hydraulic Valve which permits Convenient Molding

In molding this pattern, sections *B* and *C* are placed together in the drag section of the flask with face *XX* of section *B* on the bottom board. After sand has been rammed around the sections up to the top of core-print *D*, the core-print and section *C* are lifted from the mold. A core corresponding to the core-print is then placed in the position formerly occupied by the core-print, and sand is rammed over the core to the top of the drag. Such a core is called a "ram-up" core on account of being rammed in the mold. The drag is then turned over so that face *XX* of section *B* is on top, after which section *A* is placed on section *B* and the cope is attached to the drag. After sand is rammed over section *A*, the cope is removed, section *A* extracted from it, and section *B* lifted from the drag. The cope is then replaced and the mold is complete except for closing the cope, making the gate, etc.

Kenosha, Wis. M. E. DUGGAN

GAGE USED IN GRINDING CIRCULAR FORMING TOOLS

In grinding the cutting edges of circular forming tools of the design shown at *A* in the accompanying illustration, great care must be taken to see that surface *C* is ground the proper distance below the center of the tool, and that it is ground so that when it is set for turning work, it will be in a plane exactly parallel with that of the horizontal center line of the automatic screw machine or lathe. If these points are not observed, the work will not be turned to the desired dimensions. For instance, if dimension *X* of the tool is slightly more or less than the distance that cutting edge *D* is set below the center line of the machine, obviously cutting edges *E* and *F* will not be in the same horizontal plane as cutting edge *D*. If dimension *X* is less than specified, cutting edge *D* will be higher than the others; and if the dimension is more, the reverse will be true. This, of course, has an effect on the diameters of the various surfaces of the work.



Gage for Use in grinding the Cutting Edges of Circular Forming Tools

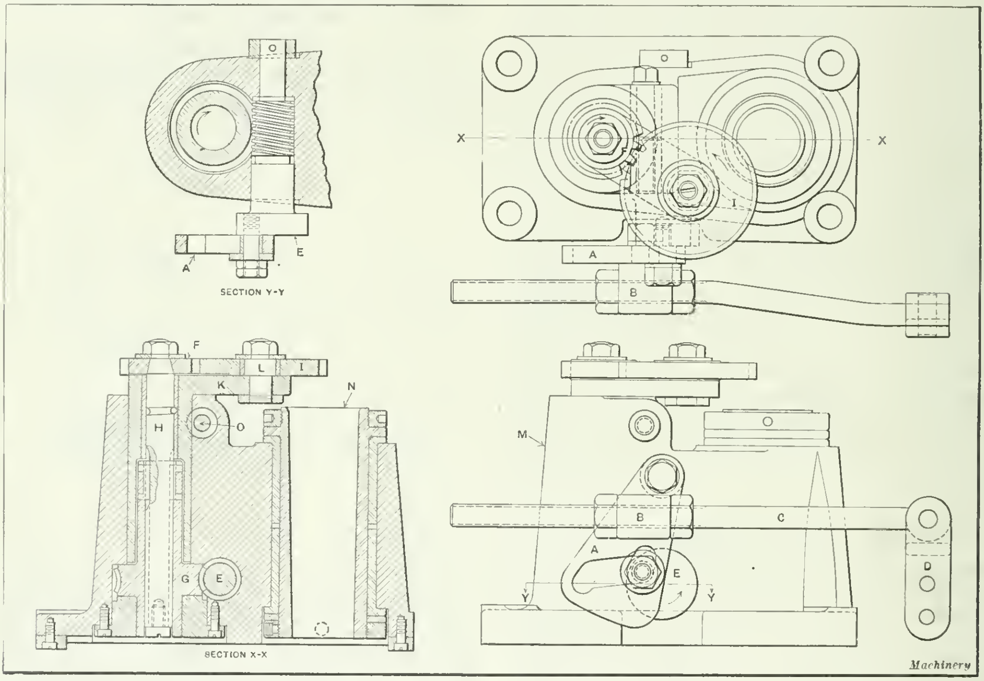
The gage shown at *B* was designed for ascertaining whether surface *C* has been ground properly, so that all cutting edges will lie in the same horizontal plane when cutting edge *D* is set in the correct relation to the center line of the machine. This gage may be used on two types of tools where dimension *X* differs, the lower end of the gage being used for testing the tool shown in the illustration. Dimensions *Y* on the gage are the same as dimension *X* on the tool, and in using the gage, either plug *G* or *H* is inserted in the hole through the tool, and surface *J* or *K* of the gage is lined up with surface *C* of the tool. By holding the parts to the light, it can readily be observed whether these surfaces coincide. Plugs *G* and *H* are of different diameters to accommodate cutters having two sizes of holes. The gage could also be provided with a knurled handle to facilitate its use. B. Spector

INDEX-HEAD FOR GEAR-TOOTH ROUNDING MACHINE

The geared index-head here illustrated was designed to replace a friction index-head on a spur-gear tooth-rounding machine, because trouble was experienced with the friction head due to slippage of certain parts, which resulted in improper indexing of the work and the production of poorly rounded teeth. With the new design, the indexing of the work, one tooth for every cut, is assured on account of the teeth of the work being in engagement with a gear in the indexing mechanism. The indexing movement occurs during the out and in strokes of the machine table after each cut has been completed and before another takes place; the manner in which it is obtained will be described in the following:

The index-head *M* is bolted to the machine table, and on the out stroke, the cam-plate *A* is swiveled about fulcrum *B*, which is held in a fixed relation to the machine base, irrespective of the movements of the table, by means of link *C* and bracket *D*. The cam-plate is returned to the position illustrated on the in stroke of the machine, and during its movement it has turned shaft *E* one revolution in the direction indicated by the arrow in the front view. By referring to section *Y-Y*, it will be seen that there is a worm integral with shaft *E*, and from section *X-X* it will be evident that this worm drives a worm-wheel *G* mounted on the vertical shaft *H*. The worm and worm-wheel are of such a pitch that one revolution of the worm causes gear *F*, which is mounted at the top of shaft *H* and is driven by it, to move a distance of one tooth. Gear *F* drives the intermediate gear *I*, which is in engagement with the teeth of the work. The gear on which teeth are being rounded is mounted on an arbor that is inserted in sleeve *N*. From this description, the operation of the indexing mechanism should be readily understood.

It will be seen that gears *F* and *I* are mounted on a sliding arm *K* which can be adjusted vertically to suit various heights at which work is placed in the head, being clamped in any position within the capacity of the head by means of the clamping screw *O*. Arm *K* can also be swiveled about shaft *H* so as to bring the teeth of gear *I* in engagement with work of various diameters. Gears of different pitches can also be accommodated, as stud *L* is eccentric to permit the center distance between gears *F* and *I* to be altered to suit. Perfect mesh of gears *F* and *I* and the work is obtained at the original setting for a class of work by loosening the nut on gear *F* and turning the gear without causing shaft *H* to be rotated, this being possible on account of the fact that gear *F* is not keyed to the shaft but is driven by being clamped on a tapered seat.



Index-head assuring Positive Indexing of the Work on Gear-tooth Rounding Machine

Port Huron, Mich. A. Bassoff

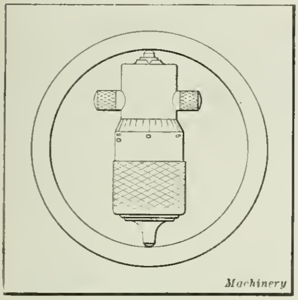
* * *

It is likely that the iron and steel industry in South Africa will gradually develop into an important factor in the world's industries. There are now six steel companies in operation, producing pig iron and open-hearth steel. The quantities produced are as yet comparatively small, but new equipment is being installed for further developments. The South African Government is endeavoring to aid the development of the iron and steel industry by assisting it in every possible way, and has entered into contracts with one of the steel companies to purchase 50 per cent of the South African federal railways' rail requirements for seventeen years. The annual requirements of South Africa in rails amounts to about 77,000 tons, and about 100,000 tons of other iron and steel products are used annually.

SHOP AND DRAFTING-ROOM KINKS

INCREASING THE RANGE OF AN INSIDE MICROMETER

In the accompanying illustration is shown a common inside micrometer, the range of which was considerably increased by substituting a piece of 5/32-inch drill rod in place of the shortest rod furnished with the micrometer. This simple change made the micrometer available for sizes as small as 1.610 inches. Such an increase would mean to many toolmakers, a doubling of the usefulness of this tool at a negligible outlay of time and material. While it is true that when thus equipped, the micrometer lacks both a positive stop and graduations for sizes less than 2 inches, it is also true that many toolmakers for a long time used inside measuring instruments that lacked both these features. The clamp screw holds the short rod firmly in place; and a 2-inch outside micrometer furnishes a ready means for taking readings or for setting the inside micrometer to sizes less than 2 inches.



Inside Micrometer provided with Short Rod to increase its Range

Wilkinsburg, Pa. William S. Rowell

DETERMINING THE WEIGHT OF SMALL STAMPINGS

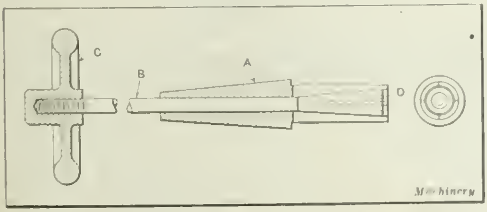
Recently, while compiling data pertaining to the weights of small stampings, the writer found that the use of Machinery's Decimal Equivalent Sheet in connection with a scale for weighing parcel post packages, enabled the correct weight of each piece, expressed in decimal form, to be quickly obtained. The ratio of ounces to the pound being the same as sixteenths to the inch, the weight of an ounce, for instance, expressed decimally, would correspond to the sixteenth of an inch or 0.0625 pound.

Ypsilanti, Mich. Floyd Graves

EXPANSION ARBOR

The accompanying illustration shows an expansion arbor that operates on the principle of a draw-in chuck. This arbor can be used in finishing work where the tailstock center cannot be employed, although the draw-in rod is provided with a center at *D*, which can be used when desired. The body of the arbor is tapered at *A* to fit the taper hole in the lathe headstock. The draw-in rod *B* serves to hold the arbor in place and also expands it in the work. Rod *B* extends through the machine spindle and is provided with a small handwheel *C* which bears against the spindle when the arbor is expanded. To loosen the arbor, the handwheel is turned back and the hub tapped lightly with a hammer. A number of arbors, to take work of different internal diameters, can be used with the same draw-in rod.

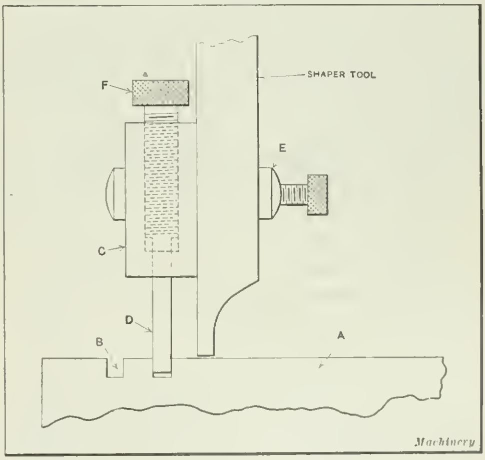
Oakland, Cal. H. H. Parker



Expansion Arbor operated by Draw-in Rod

GROOVE-SPACING DEVICE FOR SHAPER

The groove-spacing or tool-setting device here illustrated was designed for use on a shaper tool when cutting a series of twelve equally spaced grooves. As a large number of pieces were required to be grooved in this way, the device saved considerable time by providing a simple means of obtaining accurate spacing between the grooves. The piece *C* was made from 5/8-inch square steel stock, being drilled and tapped to receive the threaded locating pin *D*. When in use, the device is clamped to the shaper tool by clamp *E*. The illustration shows quite clearly how the device is employed in setting the tool for each cut. After cutting a groove, pin *D* is advanced until it projects beyond the point of the shaper tool, by turning knurled head *F*. The table is then set over until pin *D* drops into a previously cut groove in the work *A*, as shown. The pin is next screwed back to clear the work, after which the groove is cut. This operation is repeated until the twelve grooves are completed.



Device for locating Shaper Tool when cutting Equally Spaced Grooves

Rosemount, Montreal, Canada Harry Mooae

* * *

Commercial attaché Julian Arnold states that imports into China of different kinds of machinery are frequently credited to Canada when the machines arrive in Shanghai via Vancouver. Thus China has imports of textile machinery recorded in 1919 from Great Britain valued at $1,058,000; from the United States, $1,040,000; and from Canada, $1,482,000. It is quite evident that practically the entire exports of textile machinery from Canada to China were of American manufacture

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

PROBLEM IN TRIGONOMETRY

L. M. S.—Will you please show how to find angles *A* and *B* from the angle and dimensions given in the accompanying illustration?

ANSWERED BY MAX SILVER, NEWARK, N. J.

The following is a simpler solution of this problem than that appearing in the November number of MACHINERY, page 279. Referring to the illustration, first draw line *XY*, connecting the intersections of the dotted circular arc with lines *a* and *b*. Then, from center *O* draw a line perpendicular to line *XY*, continuing until it meets line *b* at *P*. From trigonometry,

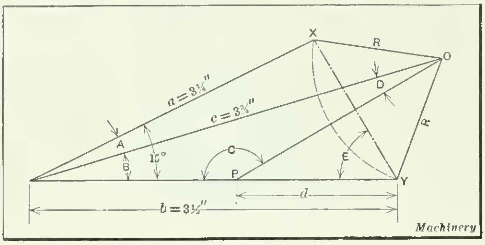


Diagram developed in Solution of Trigonometrical Problem

$$(XY)^2 = a^2 + b^2 - 2ab \cos 15 \text{ degrees}$$

Substituting the given values in this formula,

$$(XY)^2 = 10.5625 + 12.25 - 21.975 = 0.8378$$

$$XY = 0.9153 \text{ inches}$$

Then, according to the law of sines,

$$\frac{XY}{\sin 15 \text{ deg.}} = \frac{a}{\sin E} \qquad \sin E = \frac{a \sin 15 \text{ deg.}}{XY}$$

Substituting values,

$$\sin E = \frac{3.25 \times 0.25882}{0.9153} = 0.919$$

Therefore,

$$E = 66 \text{ degrees } 47 \text{ minutes}$$

The triangle *OXY* is an isosceles triangle, and for this reason line *OP* bisects line *XY*. It is now possible to determine the length of line *d* by the formula

$$d = \frac{XY \sec E}{2}$$

Substituting the known values and solving,

$$d = 1.1609 \text{ inches}$$

and

$$b - d = 3.5 - 1.1609 = 2.3391 \text{ inches}$$

It is evident that

$$C = E + 90 \text{ degrees}$$

Thus

$$C = 66 \text{ deg. } 47 \text{ min.} + 90 \text{ deg.} = 156 \text{ deg. } 47 \text{ min.}$$

Again, according to the law of sines

$$\frac{b - d}{\sin D} = \frac{c}{\sin C} \qquad \sin D = \frac{(b - d) \sin C}{c}$$

Inserting the proper values,

$$\sin D = \frac{2.3391 \times 0.39421}{3.75} = 0.24589$$

and

$$D = 14 \text{ degrees } 14 \text{ minutes.}$$

$$B = 180 \text{ deg.} - (C + D) = 180 \text{ deg.} - (156 \text{ deg. } 47 \text{ min.} + 14 \text{ deg. } 14 \text{ min.}) = 8 \text{ deg. } 59 \text{ min.}$$

and

$$A = 15 \text{ deg.} - B = 15 \text{ deg.} - 8 \text{ deg. } 59 \text{ min.} = 6 \text{ deg. } 1 \text{ min.}$$

MATHEMATICAL PROBLEM

D. D. H.—Can someone show how to find dimension *x* in the illustration, the lengths of sides *a*, *b*, and *c* being given and angles *AEB* and *CED* being equal?

A.—First, designate both angles *AEB* and *CED* as angle *N*. It is obvious that $N = X - Y$. Then,

$$\tan N = \tan (X - Y) = \frac{c}{x}$$

$$\tan X = \frac{s}{x}, \text{ and } \tan Y = \frac{b + c}{x}$$

From trigonometry the following relation is obtained:

$$\tan (X - Y) = \frac{\tan X - \tan Y}{1 + \tan X \tan Y}$$

Substituting the values previously found,

$$\frac{c}{x} = \frac{\dfrac{s - b - c}{x}}{1 + \dfrac{s (b + c)}{x^2}} = \frac{x (s - b - c)}{x^2 + s (b + c)}$$

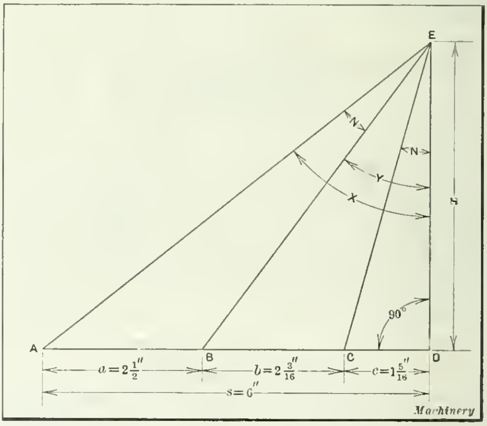


Illustration showing Conditions of Mathematical Problem

Clearing of fractions and combining terms,

$$x^2 (s - 2c - b) = cs (b + c)$$

$$x = \sqrt{\frac{cs (b + c)}{s - 2c - b}}$$

Reducing the dimensions of sides *a*, *b*, *c*, and *s* to sixteenths of an inch and inserting these numerical values,

$$x = \sqrt{\frac{21^2}{19}}$$

Therefore,

$$x = \frac{21\sqrt{19}}{19} = 4.8177 \text{ inches}$$

W. W. J.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, February 11

THE position of the general engineering trades is reflected in the machine tool industry and may be summed up as being very quiet. Few tools are being sold, and short working hours are general. Railway, electrical, and marine shops are the most active, and there is still plenty of work for shipbuilders; in fact, but for the shipyard joiners' strike, this particular industry would not be much disturbed. Although inactivity has developed to an astonishing degree, optimism is not wanting, and the position will yield to the improved conditions that will slowly but surely develop. With markets for raw materials falling, quotations for finished products will follow suit.

As far as the machine tool trade is concerned, there may be some reductions, but only in so far as lower raw material values justify. Wages are not reduced, and in machine tool building wages represent a large proportion of the manufacturing cost. Many firms are putting through batches of their most popular lines to stock, and are taking the risk against any attempt at a forced realization; but while stocks may have accumulated and the financial position proves rather difficult to handle, most of the makers have a reserve which will tide them over and render unnecessary the realization of stock at reduced prices for the sake of getting the money necessary to continue work. Many of the inquiries are from locomotive and car builders, pipe manufacturers, and railway shops and dockyards abroad. In South America the railways have large schemes of reconstruction afoot, and there should be good business for someone there before long. Shipbuilding in Spain also accounts for a few inquiries. The Indian market, which flared up for a time, is for the moment flat.

German Tools and Competition

The representatives of German machine tool makers are reported to have been active in the Lancashire districts. They are seeking to appoint sole agents who will carry their products, one firm alone having been approached by four separate concerns. Machine tools from these sources are arriving and are being readily disposed of because on the question of price a considerable advantage is held.

In view of the important decision made by the Machine Tool Trades Association at its annual general meeting last week, the question of German agencies will soon settle itself. At that meeting Sir Alfred Herbert moved from the chair the resolution that none of the members should handle German machine tools. In proposing this resolution Sir Alfred stated that his own company was an importing as well as a manufacturing company, and stood to lose, in common with other importers, anything that was to be lost, in sacrificing the right to import machine tools while remaining members of the association. He was quite aware of the nature of the argument against the resolution. The argument was that German machine tools would be brought in anyway by somebody, and why should the members of the association be deprived of the profit, if there be any, attached to the importation of German machine tools? There were many trades to which profits attached, in which trades they preferred not to embark, but he felt that it would satisfy the findings of the association to uphold the high standard which it aimed at, if its members were prepared to make such sacrifices as might be attached to the refusal to deal in German goods. If the resolution was carried, there would be a very serious blow at the importation of German goods in the future.

On the other hand, if the resolution was not carried, they could all begin, if they chose, to import German goods, and they would begin to sell them or try to sell them. There was no need to remind them that as long as the German exchange remained at its present level, it was impossible to compete with German machine tools. It was no use trying, because it was not a question of 10 or 15 per cent, which they might sacrifice out of their margins, but 50 or 70 per cent, which they could not compete with. Under these circumstances, if the resolution was carried, they would all begin to deal in German machine tools.

An amendment offered by some member to include American machine tools in the resolution was not favored by Sir Alfred, and it did not find many supporters. The amendment, finding no seconder, was withdrawn; and as a result of a full and interesting discussion, Sir Alfred's original resolution was not carried. The feeling of the meeting was that adoption of the resolution would not prevent the commercial handling in this country of German tools, and that as manufacturers the British machine tool builders did not fear their ability to hold their own. Another aspect is that a considerable agency trade is done through British firms with countries abroad who do not object to German tools.

The Autumn exhibition held by the Machine Tool Trades Association at Olympia produced a satisfactory financial result, whereby the funds of the association were improved by the substantial sum of over £8000. It was decided to hold the next exhibition in 1924.

Machine Tool Imports and Exports

The final month of the year continued the favorable tendencies which prevailed for the three previous months. As exports increase, their average value per ton falls; imports rise in average value per ton as the weight falls. The imports are still much too heavy to indicate a healthy state of exchange. The returns for the complete year show that the most striking difference is the enormous rise in the tonnage and value of imports, with no defined tendency to return to pre-war levels. The exports have increased in tonnage by nearly 50 per cent over the pre-war level; and this is the more satisfactory owing to the steady level from 1913 to 1919, which was not greatly disturbed by the war.

Iron and Steel Trade

In the iron and steel trade, recent quotations show substantial reductions in price. Notwithstanding these, buyers are not committing themselves except to purchases of materials urgently required. They are content to wait for further cuts, which they regard as inevitable. Meanwhile foreign competition is becoming more intense, particularly on the part of Belgium, which country is securing orders much needed at home. There are still considerable stocks of finished iron and steel goods in most of the distributive channels, and it is reported that big engineering concerns are to put in the market some large stocks of raw material bought against orders which have been cancelled or otherwise suspended. Scottish steel manufacturers have reduced the price of steel by £5 a ton during the last two months, but Sheffield manufacturers say they could not produce billets at the Belgian price of £11 to £12 per ton and at the same time pay the current rate of wages, even if all profits were sacrificed.

Employment and Piece-work

The official returns of employment in the engineering trades last month showed a decline as compared with the previous month. With some classes of men in certain districts it was fairly good, but in most of the principal districts it was slack. A large number of men were out of work, and there was much short time. With iron-founders, employment was good at most centers, but not so good as in previous months. One of the most satisfactory features of the crisis is that with the consent of the operatives a great many factories, instead of indulging in wholesale discharges, are running on the short-time alternative.

The piece-work system, which applies very generally in the Birmingham area, is being largely extended in the foundries, where it was formerly resisted by the unions. It is credited with having been very influential in promoting a marked increase of output. The patternmakers are now the only body of workmen who stand outside the payment by results principle.

Women in Engineering Industry

The advent of women in the engineering trade is an accomplished fact. A small limited company has been formed by women under the title of Atalanta, Ltd., which has powers to manufacture automobiles, bicycles, and the like, but with the special purpose of manufacturing engineering components. Shops have been secured at Loughborough, but the women, it is noticed, are not quite self-reliant, since they have secured the services of Mr. Schofield of the Loughborough Technical College, who during the war devoted himself to the training of women.

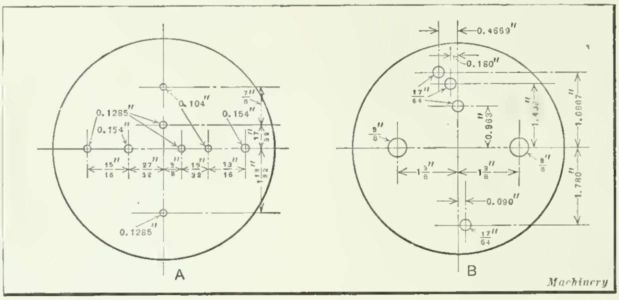


Fig. 1. (A) Part drilled on Machine shown in Fig. 2. (B) Part drilled on Machine shown in Fig. 3

New British Machine Tools

As an addition to its range of turret lathes having a center height of 8 inches, Alfred Herbert, Ltd., Coventry, is now building the No. 3 combination turret lathe, uniform in many dimensions with the No. 9 machine. The new model, however, will handle work of greater length, between the spindle flange and the turret face, namely, 51 inches. This new machine was originally designed just prior to the outbreak of the war, but its manufacture was not proceeded with until recently. As an outcome of specialized experience, the lathe embodies several features of interest, in particular the provision of power movements wherever possible. Oldfield & Schofield Co., Ltd., Halifax, has recently developed a crank-shaping machine, which is being built on an interchangeable basis, in 12-, 16-, 20-, 24- and 30-inch stroke sizes. They are supplied in either cone-driven or gear-box types. Through this gear-box eight speed changes are obtainable by means of sliding gears. The shafts run in ball bearings. In order to eliminate knocking through wear at each end of the ram stroke, the crank-arm, which is a steel casting, is fitted with a hardened steel bushing in the first hole and rocks on a hardened steel stud.

* * *

The United States Steel Corporation reports that from January 1, 1912, to September 30, 1920, it expended over $81,000,000 for safety, sanitation and welfare among its employes.

MACHINES FOR MULTIPLE DRILLING OPERATIONS ON SMALL PARTS

The manufacture of small interchangeable parts such as shown in Figs. 1 and 5 presents a problem of interest to production engineers and designers. While it may not be a difficult matter to make a few parts like the one shown at *A*, Fig. 1, by employing tool-room methods, it becomes an entirely different problem when it is required to produce parts of this kind on a production basis and at the same time maintain the required accuracy. From the illustration it will be evident that considerable time must be consumed in drilling the various holes required in the piece if an ordinary single-spindle drilling machine is employed, even though an accurate drill jig is provided. For instance, it will be necessary to place an 0.1285-inch drill in the drilling machine spindle and drill the three holes which require this size drill. Then this drill is removed and replaced with an 0.154-inch drill. After drilling the two holes of this size, the drill is removed and a 0.104-inch drill substituted, with which the two remaining holes are drilled.

To perform the drilling operation in this way results in the loss of considerable time that could be saved by the use of a multiple-spindle drilling machine with which the work can be done in one operation. A machine adapted for this particular operation, which was made by the Langelier Mfg. Co., Providence, R. I., is shown in Fig. 2. The close grouping of the spindles of the multiple-spindle drilling head of this machine is a feature of particular interest. Referring to the illustration, it will be noted that tight and loose pulleys are mounted on the base of the machine. The drive is from an overhead belt, which can be shifted from the tight to the loose pulley, or vice versa, by a conveniently located foot-pedal.

It will also be noticed that a kettle-shaped coolant tank is attached to the lower oil or coolant tray which is cast integral with the machine base. A pump for circulating the coolant is located at the bottom of the coolant tank. This pump is driven from the main drive shaft on which the tight and loose pulleys are located, by means of a belt. When the machine is in operation, the coolant is pumped through piping to a nozzle which delivers it to the drills. From the work the coolant drips back into the coolant tank tray and thence through a strainer into the tank. The drilling head is advanced to the work by means of a rack and pinion operated by the usual type of hand-feed lever. The weight of the drilling head is balanced by two extension springs.

The special-purpose Langelier drilling machine shown in Fig. 3 was built for the purpose of drilling the part shown at *B*, Fig. 1. Referring to this illustration, it will be noted that two 3/8-inch holes and four 17/64-inch holes are required to be drilled. It will also be noted that these holes must be accurately located in relation to each other. In producing this particular piece of work, it was found desirable to drill the two 3/8-inch holes separately, and for this purpose the machine was equipped with the single spindle shown at the right. For the four 17/64-inch holes, however, a multiple-spindle drilling head was provided. By locating the single-spindle and the multiple-spindle drilling head on the same base as shown, it is possible to transfer the work quickly from one drilling position to the other.

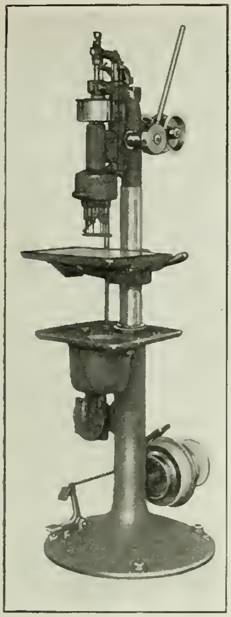


Fig. 2. Machine for drilling Part shown at A, Fig. 1

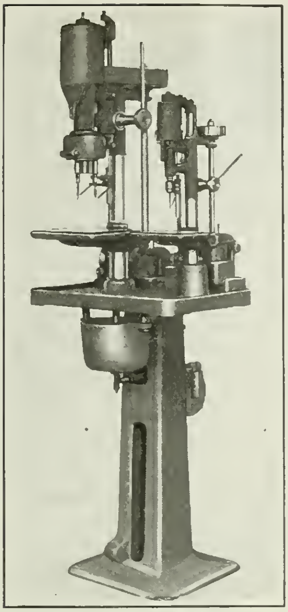


Fig. 3. Machine for drilling Piece shown at B, Fig. 1

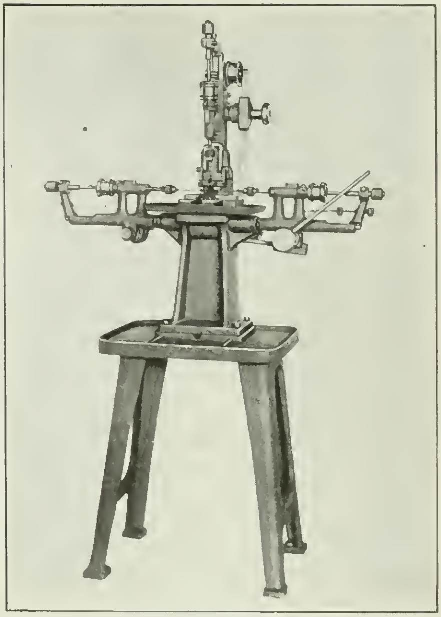


Fig. 4. Three-spindle Machine designed for drilling Battery Cap illustrated in Fig. 5

The Langelier machine shown in Fig. 4, was designed for drilling a storage battery cover (Fig. 5). The two 1/8-inch horizontal holes and the 1/8-inch angular hole are drilled simultaneously by a movement of one feeding lever, which rotates a shaft on which two pinions are mounted. One of the pinions meshes with a rack which actuates the horizontal spindle shown at the right. The other pinion operates a rack which, in turn, transmits motion to the horizontal spindle shown at the left, through another rack and pinion. A similar rack and pinion is also used to transmit motion to the angular spindle. It will be noted that each of the spindles is provided with a pulley so that a separate belt drive is employed for each. The vertical or angular spindle runs at a speed of 2900 revolutions per minute, and the horizontal spindles operate at a speed of 3200 revolutions per minute. The rate of output of this machine is five pieces per minute.

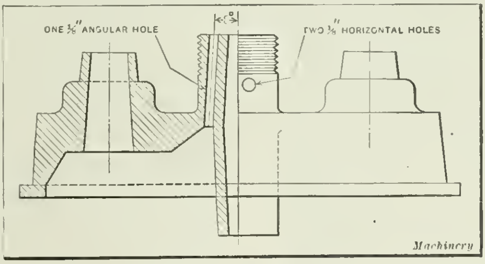


Fig. 5. Part drilled on Machine shown in Fig. 4

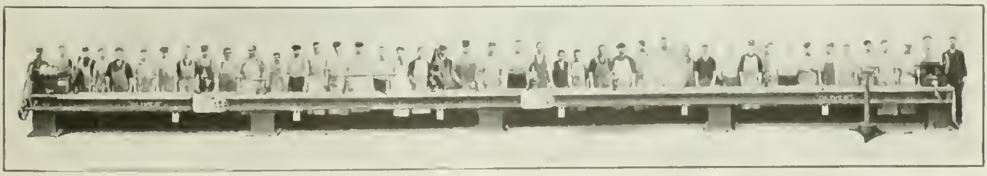
* * *

SPECIAL WOOD-TURNING LATHE

The special wood-turning lathe shown in the accompanying illustration was designed and built by the Oliver Machinery Co., Grand Rapids, Mich., in accordance with specifications written for the United States Government. This machine is known as the Oliver No. 18-A special wood-turning lathe. It will swing work 32 inches in diameter, and has a bed 62 feet in length. Reference to the illustration will show that the lathe is equipped with two carriages and two steadyrests. The carriages are provided with power feed, and the steadyrests furnish support for long heavy work such as spars or ship masts. The forty-four men lined up at the back of the machine give an idea of the exceptional length of this machine. It may be mentioned that each man in the group, from the designer to the shipping clerk, had some part in the production of the machine.

* * *

Important work is planned on the railway systems of Japan for the next few years. A large appropriation has been made by the government for the electrification of some of the important railway lines of the country, and it is believed that still larger appropriations will be made in the near future for general development of the whole railway system. It is expected that in connection with this work a great deal of material and rolling stock will be imported into Japan.



Oliver Special Wood-turning Lathe built for the United States Government for turning Ship Masts

Prices and Wages in the Machine Tool Industry

An Interview with a Machine Tool Manufacturer

Of all the problems facing machine tool builders, none is more important than that relating to the prices of machine tools and the wages paid in the machine tool industry relative to the wages paid to other classes of labor. At this time, when there have been decided reductions in the prices of the products of the textile, leather, and other industries, as well as of many of the raw materials used in those industries, buyers generally expect similar reductions in every field, and are looking forward to reduced prices for machine tools and accessories.

It is therefore of importance that a careful analysis be made of the conditions existing in the different industries with a view to determining whether the reductions in prices made in some directions justify reductions elsewhere. It is quite clear to any observer who wishes to examine the facts that the conditions in the textile industry, for example, are entirely different from those in the machine industry.

The Question of Materials

First let us deal briefly with the question of raw materials. In the textile industry the raw materials used have been reduced in price in some instances about one-half, in some cases even a greater amount. In the shoe and leather industry a similar condition obtains. In the machine-building industries there have been no such reductions. The price of steel quoted by the U. S. Steel Corporation is today the same as two years ago, and that price is about twice the price of six years ago. In the case of cast iron, the reductions on castings amount to no more than 10 per cent, at best, while in many localities there has, as yet, been no reduction at all. True, there has been a reduction in pig iron from the high peak price, amounting to from 20 to 30 per cent. On the average machine tool this reduction would justify a decrease in price of not more than 2 or 3 per cent, because the cost of the raw material in the form of pig iron, compared with labor and other costs in the manufacture of machine tools, is quite insignificant. As a result, the textile industries are in a position to show a decided reduction in the price of their finished product because of the reduction in the raw materials that they use. The machine tool industry is practically unaffected by any reductions that have as yet been made in the materials this industry uses.

The Question of Wages

The real question to be analyzed, however, is that of wages. In the machine tool industries, wages and prices have risen since 1915 in practically the same ratio, both having just about doubled. In the textile and leather industries prices have trebled and quadrupled, and wages have risen on an average 150 per cent. In one specific New England mill center, wages rose 173 per cent from January 1, 1916, to the highest peak in 1920. In another large textile center the rise was 169 per cent. Hence, mill workers who in the past were paid less than machinists, have been paid at a higher rate, and the machinists and toolmakers, whose skill and knowledge should entitle them to a higher reward than that received by the comparatively unskilled labor of the textile mills, are not receiving the compensation that will attract to the industry the best classes of workers, simply because the industry has been unable to obtain prices comparable to those obtained in the textile industries.

We have now come to a turning point where the textile mills are forced to reduce wages; but in the machine industries wages cannot be reduced in the same proportion except in some localities where they were unduly advanced by the pressure of the emergency that we have passed through, and where a decided adjustment is necessary. Where the advances were reasonable, however, a higher standard would be created in the machine-building industry if wages could be practically maintained. Many manufacturers believe that this would be the best policy for the welfare of the machine tool industry of the country, and that for that reason prices should not be reduced at the present time, because they have never been unduly increased.

Of course, there have been several reductions in machine tool prices recently, and wage adjustments no doubt will have to be made to meet the new conditions. But drastic price reductions are not warranted, and by avoiding them, it will be possible to maintain wages at a level commensurate with the skill and ability of the worker in the machine tool industry. Textile workers, for example, need not always have the ability to read or write. Their education can be much inferior to that of the workers in the machine-building industries. The machinist or toolmaker, on the other hand, needs an education and mental equipment superior to that of most of the average workers in other industries and trades, and if possible his wages should be such as to attract and hold a high grade of men.

Basis for Determining Reasonable Wages

The best method whereby a reasonable wage in the machine tool industry might be determined would be to compare the wage schedules in force in machine shops on January 1, 1915, with the schedule in force on January 1, 1921, and to base the present rate on a definite ratio between the wages of six years ago and today, making as a basis for the present wage schedules the present cost of living and the wages paid in other occupations that require the same skill that the machinist must have.

In most instances it will be found that if the machine tool industry is to be enabled to pay wages based upon a comparison such as mentioned, present prices cannot be reduced. The buyers of machine tools must be impressed with the fact that machine tools did not increase in price in the same ratio as numerous other manufactured products; and for that reason they cannot be reduced simply because other industries are enabled to undertake reductions. Drastic wage reductions may be warranted and feasible in the textile industry because the increases have been extraordinary, but such great reductions in wages are not advisable in the machine tool industry, because it is in the interest of the industry as a whole to maintain a high standard of workers. Manufacturers in general are reluctant to make the work in the industry less attractive than in other occupations because of unfavorable wage conditions. They wish to maintain a fair rate of wages to keep the right kind of workers for the development of the industry. The development and improvement in machine tools, in turn, means a great deal to the users of machine tools, who are thereby enabled to purchase more highly productive machines, increase their output, and reduce their costs.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Hartness Automatic Lathe. Jones & Lamson Machine Co., Springfield, Vt. 693
Boston Rotary Surface Grinding Machine. Boston Scale & Machine Co., 100 Ruggles St., Boston 20, Mass. 694
Wilmarth & Morman Twist Drill Grinder. Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich. 695
"Twisto" Tool and Holder. John H. Montstream, 121 Newington Ave., Hartford, Conn. 696
Punch Press Attachment. Gem City Machine Co., Dayton, O. 696
Tool-room Laying-out Instrument. Aldeen & Hillman, 1704 Sixth St., Rockford, Ill. 697
Bench Stand for Portable Electric Drills. Standard Electric Tool Co., Cincinnati, Ohio 698
Newman Multiple Drill Head. Newman Mfg. Co., 717-719 Sycamore St., Cincinnati, Ohio 698
Geometric Double-spindle Threading Machine. Geometric Tool Co., New Haven, Conn. 698
"Pecorp" Drilling Machine. Providence Engineering Corporation, 521 S. Main St., Providence, R. I. 699
Easton Scoop Car. Easton Car & Construction Co., 50 Church St., New York City 700
Johansson Replaceable-end Plug Gage. C. E. Johansson, Inc., Poughkeepsie, N. Y. 700
Foster-Johnson Adjustable Reamer. Foster-Johnson Reamer Co., Elkhart, Ind. 700
Abrasive Surface Grinding Machine. Abrasive Machine Tool Co., East Providence, R. I. 700
Diamond Surface Grinding Machine. Diamond Machine Co., Providence, R. I. 701
No. 26 Lea-Simplex Saw. Earle Gear & Machine Co., Stenton and Wyoming Aves., Philadelphia, Pa. 702
American Double-head Broaching Machine. American Broach & Machine Co., Ann Arbor, Mich. 702
Storm Cylinder Reboring Machine. Storm Mfg. Co., Sixth Ave. and 4th St. S., Minneapolis, Minn. 702
Edlund Drilling Machine. Edlund Machinery Co., Cortland, N. Y. 703
Miller & Crowningshield Multiple-spindle Index-centers. Miller & Crowningshield, Greenfield, Mass. 703
Barrett-Cravens Industrial Tractor. Barrett-Cravens Co., 171 N. Ann St., Chicago, Ill. 703
Marschke Dry Grinder. Marschke Mfg. Co., Indianapolis, Ind. 704
Giddings & Lewis Boring, Drilling and Milling Machine. Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. 704
"Thor" Rotary Wire Brush. Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. 705
Houston, Stanwood & Gamble Plate Press. Houston, Stanwood & Gamble Co., Cincinnati, Ohio 705
Massillon Trimming Presses. Massillon Foundry & Machine Co., Massillon, Ohio 705
U. S. Electrical Grinding, Buffing and Polishing Machine. U. S. Electrical Mfg. Co., Los Angeles, Cal. 706
Precision Thread Lead Variator. Precision & Thread Grinder Mfg. Co., 1 S. 21 St., Philadelphia, Pa. 706
Bickford-Switzer Counterbore. Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass. 707
Lumsden Oscillating Surface Grinder. Alfred Herbert Ltd., 54 Dey St., New York City 707
Bickford-Switzer Drill Grinder. Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass. 708
Pletz 9-inch Shaper. Carl Pletz & Sons, Cincinnati, Ohio 708
Grant Automatic Chamfering Machine. Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn. 709
Weigel 25-inch Drilling Machine. Weigel Machine Tool Co., Peru, Indiana 709
Pittsburg Impact Testing Machine. Pittsburg Instrument & Machine Co., 40 Water St., Pittsburg, Pa. 709
Scalbom Die Square and Bevel Gage. Scalbom Mfg. Co., 11 S. Desplaines St., Chicago, Ill. 710

Hartness Automatic Lathe

The Hartness automatic lathe is adapted for the simultaneous performance of boring, turning, and facing operations, and is therefore especially suitable for the efficient machining of simple castings and forgings of the class of which ring gears are typical. Sufficient capacity is furnished for handling work up to 12 inches in diameter by 6 inches in length. The cutting tools are mounted on their heads in such a way that when a series of cuts is being taken, the strains are distributed and the tools operate under conditions that will insure freedom from vibration.

A MACHINE for simultaneously performing boring, turning, and facing operations on work up to 12 inches in diameter by 6 inches in length, which is intended especially for the machining of simple forgings and castings such as ring gears, has been recently introduced to the trade by the Jones & Lamson Machine Co., Springfield, Vt. Although this machine is not suitable for drilling and tapping, it is adapted for the finish-boring of rough and cored holes. The cutting tools employed on the machine are short and stubby, and they are mounted on the heads in such a way that when a series of cuts is being taken, the tools are grouped in and around the work.

Two tool-heads are provided on the machine, as shown at *A* and *B* in Figs. 1 and 2, these tool-heads being of the cat-head type and supported on the ends of large hollow bars carried by bearings in the main frame which contains the work-holding spindle on which chuck *C* is mounted. The construction of the main frame is such that the tool-heads are supported beyond the chuck face and practically in line with the cutting thrusts, thus giving a rigid control of the tools in relation to the work-spindle. The tool-heads are swiveled slightly in order to bring the different tools in contact with the work and they are fed longitudinally in relation to the work-spindle for the performance of boring and turning operations.

Tool-head *A* is primarily intended for precision boring and turning operations, while tool-head *B* is especially suited for facing operations. The oscillating and longitudinal movements of the tool-heads are governed by cam-drum *D* which is supported at the top of the main frame. The drum has four separate cams, two on its cylindrical surface and one face-cam on each end. The cylindrical cams control the longitudinal movements of the tool-heads, while the face-cams govern the oscillating or cross-feed movements. The two cams at the front end of the drum control tool-head *A*, while those at the opposite end control tool-head

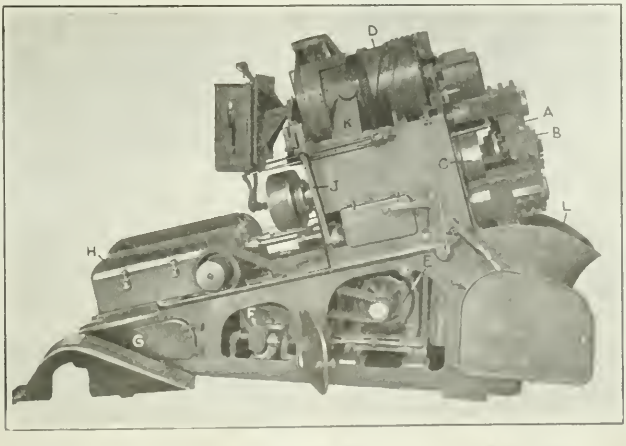


Fig. 1. Hartness Automatic Lathe for Turning, Boring and Facing Operations, developed by the Jones & Lamson Machine Co.

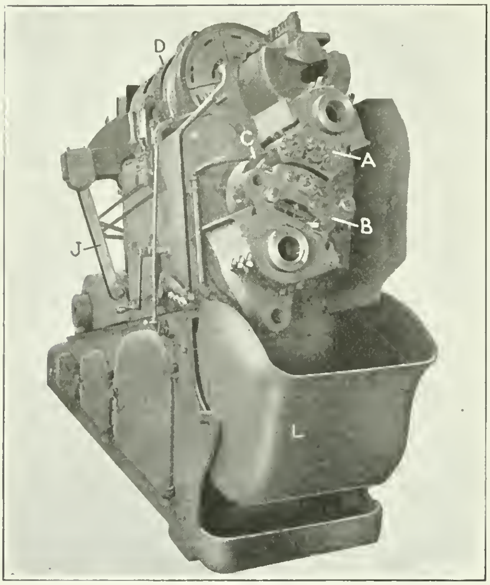


Fig. 2. End View of Automatic Lathe showing Arrangement of Both Tool-heads

B. The arm shown at *J* transmits the movement imparted by the rear face-cam to the bar on which tool-head *B* is mounted, while the arm *K*, Fig. 1, imparts the lengthwise movement of the cylindrical cam to this tool-head.

The main frame of the machine is mounted on a base, the upper surface of which is inclined. When the machine is motor-driven, the motor is located in this base, as shown at *E*, and it is connected with the gearing in the transmission case by means of a silent chain or belt drive. The pump is also placed in the base at *F* and driven from the main drive of the machine. The various gears and clutches employed for obtaining the different speeds of the work-spindle and cam-drum *D* are contained in the transmission case *H* which is located at the rear of the machine. All the gears are made of hardened steel, and ample lubrication is provided by a spray system. Fig. 3 shows the transmission case with the cover lifted, from which an idea of the arrangement of the gearing may be obtained. By placing this gearing in a separate box, it is claimed that ideal conditions of adjustment, changing of gears, and accessibilty are secured. The change-gears are placed in the base compartment and are selected by the operator to best suit a given job.

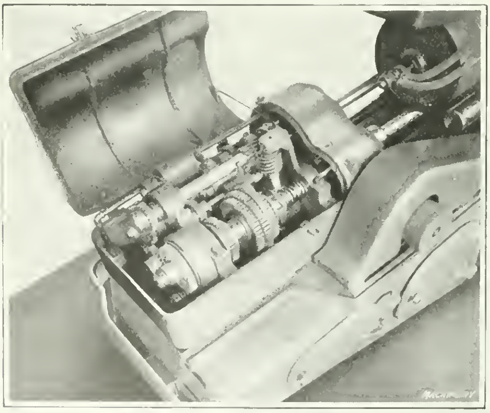


Fig. 3. Transmission Case with Cover lifted, showing Gearing controlling Speeds of Work-spindle and Cam-drum

Two work-spindle and two cam-drum speeds are provided, the latter being automatically controlled by trips on the drum. There are flexible connections on the shafts, extending from the transmission case to the main frame, so that perfect alignment between these two units is not essential. Hopper *L* is provided as a receptacle for chips falling from the work and cutting tools. Although the machine is shown equipped with a motor drive, it may also be furnished for driving from a countershaft. The machine is only about 2½ feet wide, so it is convenient for an attendant to operate two or more at one time. The weight of this automatic lathe is 7200 pounds, and the floor space required is about 4½ by 9 feet.

BOSTON ROTARY SURFACE GRINDING MACHINE

The Boston Scale & Machine Co., 100 Ruggles St., Boston 20, Mass., has placed on the market a rotary surface grinding machine illustrated in Fig. 1, which has been satisfactorily used on a production basis for more than a year. An unusual feature of the machine is the method of imparting reciprocatory motions to the head carrying the grinding wheel spindle. This motion is obtained by oil flowing under pressure, the direction of the flow being controlled by a balanced reversing mechanism. The result is a smooth and even motion convertible instantly from the slowest to the fastest speed and vice versa, or to any intermediate speed. It is stated that this arrangement permits the machine to be used for any length of time at a short stroke on a large number of similar pieces, without producing unevenly worn parts.

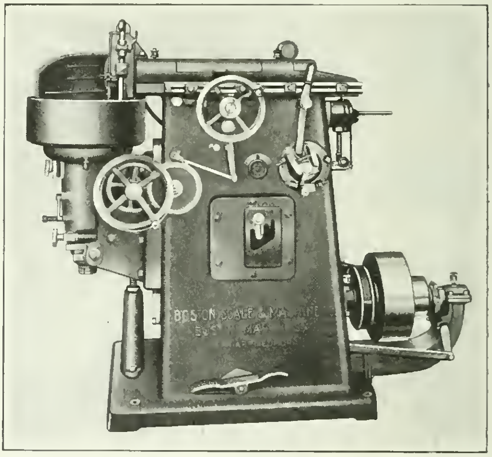


Fig. 1. Rotary Surface Grinding Machine built by the Boston Scale & Machine Co.

Another advantage of this arrangement is the wide range of speeds which may be imparted to the reciprocating head, the minimum speed being one full stroke forward and return, that is, a distance of 17 inches, in ten minutes. This

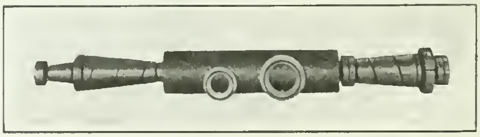


Fig. 2. Grinding Wheel Spindle furnished with a Tapered Bearing at Each End

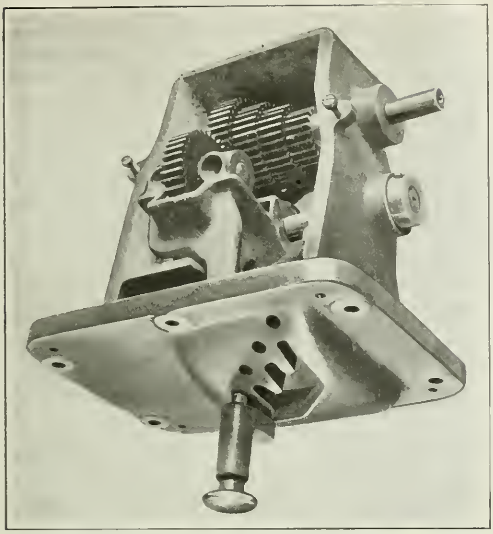


Fig. 3. Change-gear Box controlling Speed of Magnetic Chuck Spindle

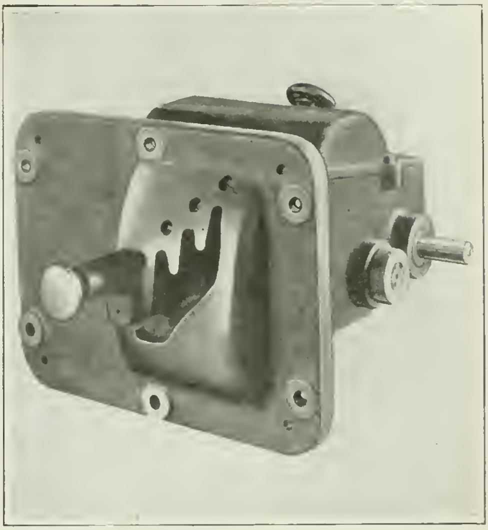


Fig. 4. Change-gear Box, showing Cover permitting Splash-oiling

speed may be converted instantly to the fast speed of ten full strokes per minute or to any intermediate speed, the range being indicated on a graduated sector. The reversing mechanism is of a simple cylindrical rotary type, balanced and not liable to wear. The pump which supplies power for the wheel-head is also of the rotary type, and can develop a pressure of 100 pounds. The working pressure is about 40 pounds, and a relief valve is set at 60 pounds.

The machine is equipped with a 12-inch diameter magnetic chuck supported on the top of a vertical spindle. The speed-cone change-gears that control the speed of this vertical spindle are enclosed in a gear-box, and are so arranged that the gears and shaft bearings are splash-oiled. The gearing and gear-box are arranged as a unit, as shown in Figs. 3 and 4, and can be removed as such from the machine. The grinding wheel spindle is provided at each end with a tapered bearing of liberal dimensions. Provision is made for adjusting each bearing for alignment and wear. A hardened bearing is also furnished to take the thrust obtained in a backward stroke. The grinding wheel spindle is shown in Fig. 2. The chuck spindle has a taper bearing at the upper end to receive thrusts with minimum wear while grinding and to insure a free-running bearing. The bottom bearing of this spindle may also be adjusted for wear and vibration. This spindle can be tilted 10 degrees in either direction. The grinding wheel spindle and the chuck spindles are both one-piece forgings and, together with the change-gears, are made of chrome-nickel steel and heat-treated.

The machine is driven by a 14-inch diameter clutch pulley carrying a 4-inch belt. An automatic feed is provided for the vertical spindle which ranges from 0.0025 to 0.005 inch in increments of 0.00025 inch. This feed may be automatically disengaged at any desired point. The wheel-head may be set to grind a 6½-inch face on any disk up to 16 inches in diameter, provided the work can be held on the chuck. Work up to 17 inches in diameter can be swung inside the water pan. The machine weighs 2800 pounds.

WILMARTH & MORMAN TWIST DRILL GRINDER

Several new features have been added to the "Yankee" twist drill grinder manufactured by the Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., the most important of which is the adaptation of the machine for grinding drills with tapered and collared shanks, as

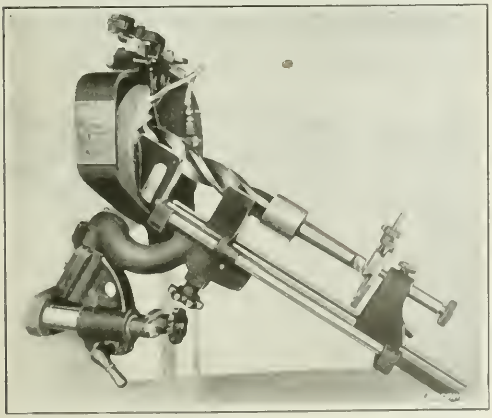


Fig. 1. Improved "Yankee" Drill Grinder made by the Wilmarth & Morman Co.

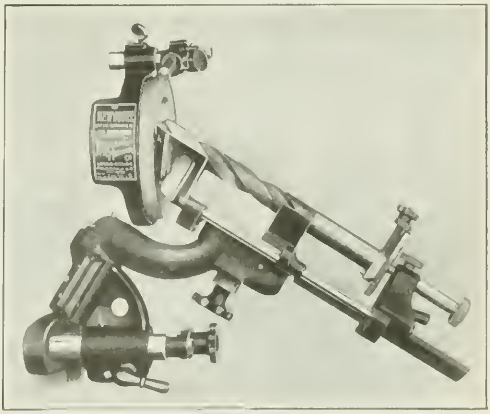


Fig. 2. Manner of holding Long Straight-shank Drill during Grinding Operation

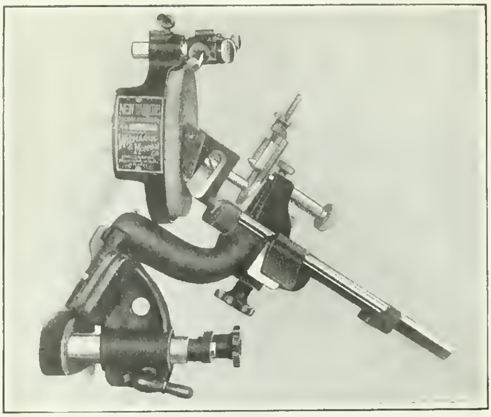


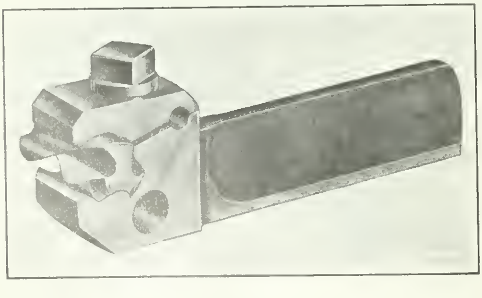
Fig. 3. Grinding Short Straight-shank Drill on "Yankee" Drill Grinder

well as those with straight shanks. The manner in which a long drill with a tapered and collared shank is held during a grinding operation is shown in Fig. 1. In addition to the support at the front of the drill and at the end of the shank, the drill is also supported at the back end of the fluted section by a V-block mounted on a round bar which extends along the holding attachment. This V-block may be slid along the bar to suit drills of various lengths and, when a drill is too short to warrant its use, it may be swung out of the way.

A long straight-shank drill is shown being ground in Fig. 2. It will be noted that the shank end is not supported by the center on the tailstock, as shown in Fig. 1. The method of holding a short straight-shank drill is shown in Fig. 3. In this illustration the V-block support is swung out of the way so that it will not interfere with the tailstock. The machine is made in a variety of styles, nine belt-driven and eight motor-driven, these styles being made up in different combinations from four holders having the following drill capacities: No. 52 to 5/8 inch; 3/32 to 1½ inches; ¼ to 2½ inches; and ½ to 4 inches. Each grinder is equipped with means for obtaining different clearance angles on the work and has a built-in wheel-truing device.

"TWISTO" TOOL AND HOLDER

A tool bit of novel design, which is known as the "Twisto" tool, and a holder for mounting this bit on a machine, have been developed by John H. Montstream, 121 Newington Ave., Hartford, Conn. This tool bit and holder are shown in the accompanying illustration, in which it will be noted that the bit greatly resembles a section of a three-fluted twist drill. It is provided with six cutting edges—three on lands at one end, and three on lands at the other—these cutting edges being arranged helically at an angle that gives an efficient chip rake to each of the cutting lips. In using this bit, the edges may be reground as they become worn. The regular length of a bit is 2 inches, so that there is approximately 6¾ inches of cutting lip available.



"Twisto" Tool Bit and Holder made by John H. Montstream

The tool bit is clamped rigidly in the holder, which is provided with a base that prevents the bit from tilting. This holder is also adaptable for holding circular disk cutters, which are made in various styles and sizes. Such cutters may be mounted on either side of the holder, so that either of the two cutting edges may be used if they are properly ground. The shank is of a rectangular cross-section, 1⅛ inches long and 9/16 inch wide.

GEM CITY PUNCH PRESS ATTACHMENT

The Gem City Machine Co., Dayton, Ohio, has designed a toggle attachment for application to single-action punch presses for the purpose of adapting machines of this type for the performance of deep-drawing operations, such as generally require the use of a double-action press. The claim is made that this attachment increases the rate of production of a single-action press in deep-drawing operations in some cases as much as 100 per cent, because, whereas two or three drawing operations are usually required, only one is necessary on a machine equipped with this attachment. It replaces the springs or rubber pads customarily employed, and operates in such a way that the entire amount of power transmitted to the press is utilized in the actual drawing operations. For this reason it is possible to draw heavier material on a press equipped with the attachment than can be handled on the same press without it.

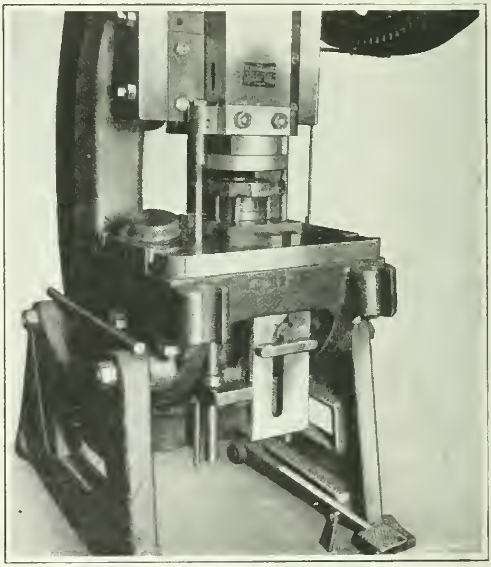


Fig. 1. Punch Press Attachment built by the Gem City Machine Co. for supporting the Pressure-ring in Drawing Operations

The device is shown mounted on a press in Fig. 1, while Fig. 2 illustrates it disassembled from the machine. The upper plate *A* is secured to the under side of the punch press frame, and has fastened to it on opposite sides two plates *B* which are provided with cam slots. Plate *A* has also secured to it four guide rods, projecting downward, upon which are slidably mounted the intermediate plate *C* and the lower plate *D*. Plate *D* is connected to the press ram by means of two rods that pass through the intermediate and top plates and have adjusting nuts at their lower ends. The lower plate is also connected on each side to the intermediate plate by means of toggles which are provided with rollers that run in the cam slot of plates *B*.

In the operation of this device, when the press ram is in its upper position, the intermediate and lower plates are also at the top of their respective strokes, and in close proximity to the top plate. The toggles connecting plates *C* and *D* are then disposed at angles between two plates. Since plate *D* and the ram are connected, as previously mentioned, their movements are in unison when the press is in operation, but during the downward movement of the ram, the intermediate plate remains stationary until the punch comes into contact with the work. Then, if proper adjustments have been made when the press was first set up, the intermediate plate begins its downward movement, and during the remainder of the stroke it maintains the same distance between it and the ram as it holds when the punch first comes into contact with the work. The drawing or pressure ring of the die is connected to the intermediate plate in a manner similar to that employed in the ordinary type of spring drawing die, and the pressure exerted on the work is sufficient to hold the metal. Any tendency of the work to wrinkle while being drawn is immediately resisted by the pressure-ring, because of the fixed relation that exists between the intermediate plate and the ram.

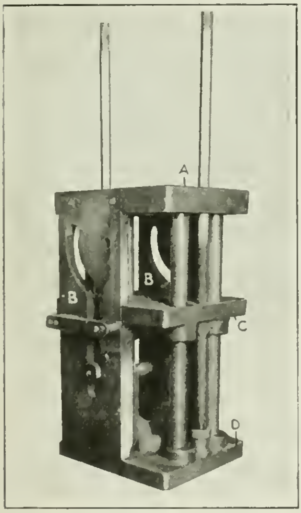


Fig. 2. Attachment with Moving Parts in Positions occupied at End of a Downward Stroke

Any pressure developed is transmitted to the intermediate plate, and from it through the toggles (which are now in vertical positions) to the bottom plate, thus placing the rods connecting the latter to the ram, in tension rather than in compression. The cam-rollers of the toggles move in the straight portion of the slots during the drawing operation. On the upward stroke of the press ram, the bottom and intermediate plates travel in unison, until the rollers reach the cammed portion of the slots in which they operate, whereupon, the toggles begin to assume angular positions and the intermediate plate comes to rest just before the finish of the stroke. The attachment shown in the accompanying illustrations was built for a punch press having a stroke of 3 inches, but it has sufficient capacity for use on presses having strokes up to 6 inches. Its weight is 190 pounds. The application of the device to a machine does not interfere with its use for the performance of piercing or blanking operations.

TOOL-ROOM LAYING-OUT INSTRUMENT

To facilitate the accurate laying out of holes on dies, fixtures, and other work requiring similar precision in machining, preparatory to prick-punching, spotting, and finish-drilling, or for use in locating centers of holes on work mounted on lathes or milling and drilling machines, the tool shown in Fig. 1 was designed by Aldeen & Hillman, 1704 Sixth St., Rockford, Ill. This instrument is also shown in Fig. 2 placed on a piece of work on which the center of a hole is being located. Reference letters in both illustrations refer to the same surfaces or members of the tool.

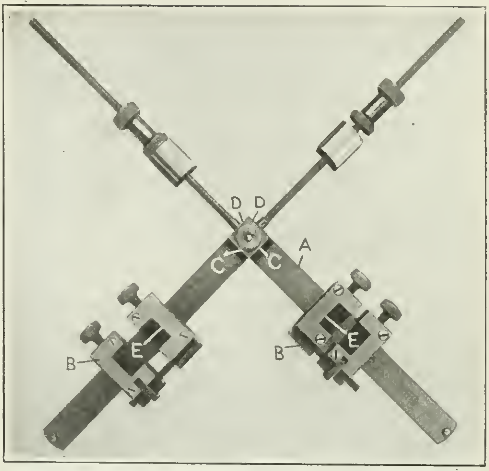


Fig. 1. Instrument designed to facilitate the Accurate Laying out of Holes on Dies, Fixtures, etc.

It will be seen that the instrument has a right-angle frame *A*, upon the two legs of which are mounted slides *B*. At the junction of the two legs, the metal is considerably thicker than in the legs, and there is inserted a hardened steel bushing for accurately guiding the drill. From this corner of the frame there project two screws in opposite directions to the legs, and upon these screws are mounted clamping members and nuts. Each of the slides *B* consists of two members connected by an adjusting screw, so that after the slide has been set at the approximate distance from the bushing in the frame, the rear member can be clamped on the frame and the front member finely adjusted before it is clamped in position; this arrangement permits the making of accurate settings.

In order to illustrate the method of using this instrument, assume that it is desired to locate the center of a hole on the piece of work shown in Fig. 2, this center being a distance *M* from the finished edge *O* and a distance *N* from another finished edge *P* at right angles to the first, both of these edges being perpendicular to the surface on which the hole is to be located. Gage-blocks of sufficient thickness to equal dimension *M* minus the distance from the bushing center to surface *C*, or 0.250 inch, are then placed on the proper leg of the frame, and the slide on this leg is tightened against the blocks as previously described. A combination

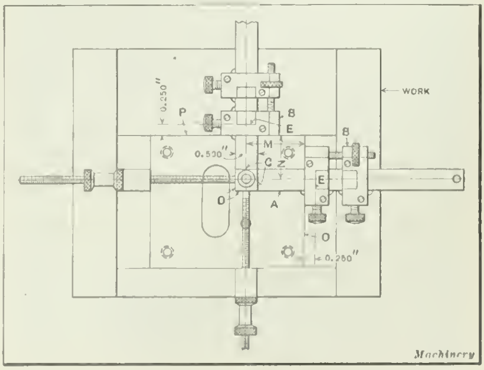


Fig. 2. Diagram illustrating Method of using Laying-out Instrument shown in Fig. 1

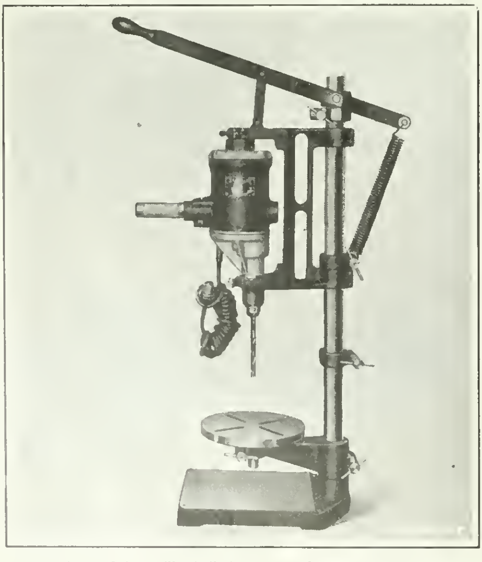
of blocks equal to dimension *N* minus 0.250 inch is next placed on the other leg, and the respective slide is properly set. The device is then laid on the work and clamped on it by means of the clamping members previously mentioned, after which the hole center is located by drilling through the bushing.

A micrometer can also be used for setting the slides, the measurement being taken from surfaces *D* on the frame to surfaces *E* on the slides, 0.500 inch being added to dimensions *M* and *N* in setting the micrometer. The bushing in the frame can be removed and replaced by a button to adapt the tool for work on the faceplate of a lathe. Pins are provided at the ends of the frame legs to prevent the slides from being accidentally pushed off. The maximum distance that the front faces of the slides can be set from the center of the bushing is approximately 3⅝ inches.

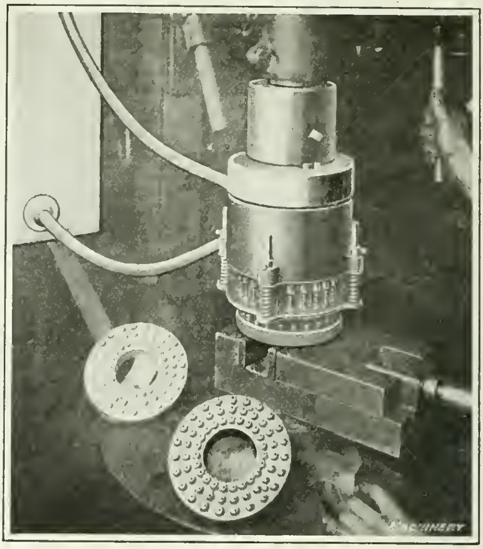
BENCH STAND FOR PORTABLE DRILLS

The accompanying illustration shows a bench stand that permits the portable electric drills manufactured by the Standard Electric Tool Co., Cincinnati, Ohio, to be used as small upright drilling machines. However, the attachment of a drill to one of these stands does not hinder its use as a portable tool, as it can be detached in a few moments. This scheme therefore increases the range of work which can be accomplished by a portable tool, and frequently eliminates the necessity of purchasing a more expensive equipment. For this reason, the stand is especially recommended for use in small shops, but it is also convenient in larger shops in cases where there is not space for the installation of a heavier and bulkier drilling machine.

The stand is made for driving electric drills of ⅜ and ½ inch diameter in steel. It is provided with a quick return and a 9-inch diameter table which is slotted as shown. The distance from the column to the center of the table is 6 inches and the vertical feed is approximately 4 inches. The head attachment on which the drill is clamped can be adjusted to any point on the column, and a clamping collar is furnished for regulating the depth to which a hole is drilled. The table can be swiveled on the column so that work may be placed on top of the base, when this procedure is desirable. The electric drill furnished with a stand may be attached to an alternating- or direct-current lamp socket.



Bench Stand for Drills, built by the Standard Electric Tool Co.



Drilling Gas Burners with a Multiple Drill Head made by the Newman Mfg. Co.

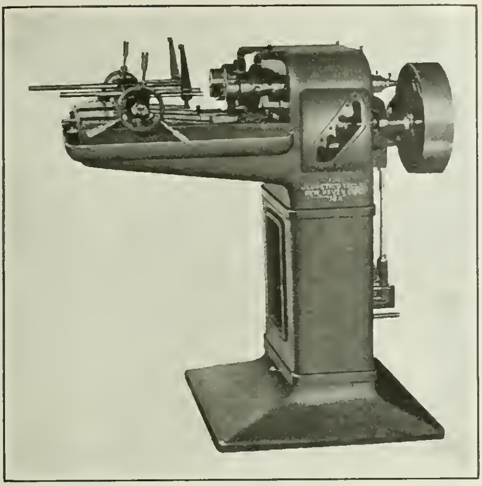
NEWMAN MULTIPLE DRILL HEAD

The accompanying illustration shows a water-cooled drill head provided with sixty-nine spindles, being used for the simultaneous drilling of holes in a cast gas burner. This drill head was made by the Newman Mfg. Co., 717-719 Sycamore St., Cincinnati, Ohio, which makes multiple drill heads of this type with any number of spindles up to 150, according to the requirements of the job on which they are to be used. These drill heads are especially useful in the manufacture of such products as hot water heaters, gas furnaces, etc., because of the amount that they permit the production time to be reduced. They are built to fit standard types of drilling machines or to suit individual requirements.

GEOMETRIC DOUBLE-SPINDLE THREADING MACHINE

In the threading of work on which the operation time is sufficient to chuck and start the threading of a second piece while the first is being completed, it is obvious that a higher rate of production could be obtained on a machine constructed to make this procedure possible. To meet such a condition, the Geometric Tool Co., New Haven, Conn., has developed the ¾-inch double-spindle threading machine here illustrated. A number of threading combinations are possible with this machine; both spindles may be fitted with die-heads for external threading or with taps for internal threading, or a die-head may be mounted in one spindle and a tap in the other for work requiring both an external and an internal thread. The latter combination may also be employed for separate external and internal threading jobs. In order to tap sizes of threads smaller than can be machined with a collapsing tap, the machine may be equipped with a ball-driven reversing tap-holder.

The two spindles are mounted in large bronze bearings and are driven by a single pulley located at the rear, but they can be driven independently by operating the change-gear levers on each side of the machine. Both carriages are fitted with a two-jaw chuck which is operated by a hand-wheel and which can be provided with special bushings or holders to suit various classes of work. An adjustable swinging gage on the side of the carriage provides an accurate means of setting the work for cutting the thread to a pre-



Double-spindle Threading Machine developed by the Geometric Tool Co.

determined length. An adjustable stop on the trip-rod ahead of the carriage governs the opening of the die-head and the length of thread, while a second adjustable stop in back of the carriage controls the closing of the die-head.

The change-gear levers previously mentioned control the spindle speeds independently, and are set to furnish the proper speeds for the threads being cut. The spindle speeds range from 75 to 225 revolutions per minute, and are satisfactory for average work, although they may be varied to suit special conditions. A geared pump forces oil from a reservoir through the spindle and die-head and against the work. When the spindles are equipped with taps, the oil is fed through pipes on the outside of the machine. The tapping range of the machine is for work from ⅛ to 3 inches in diameter when the pitch of the thread is fine, while the machine will thread work of various diameters from ¼ to ¾ inch. The greatest length of thread that can be cut at one setting of the work is 8½ inches, but by making a resetting, a length of 14 inches can be cut. The machine may be fitted with a 2¼-inch Geometric rotary die-head for cutting fine-pitch threads on brass tubing and work of a similar nature up to a diameter of 2¼ inches. The net weight of the machine is 820 pounds.

"PECORP" DRILLING MACHINE

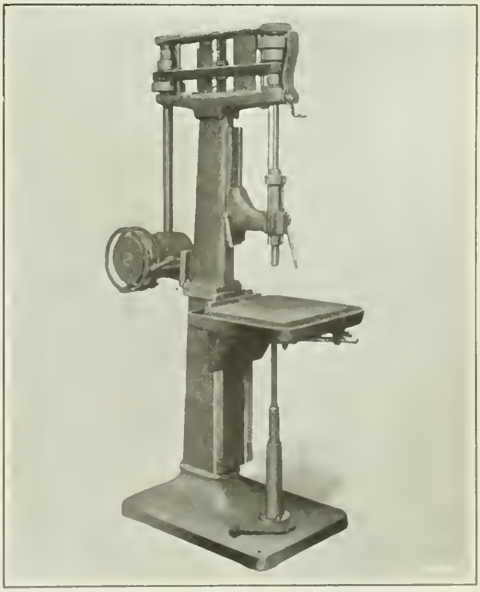
The Providence Engineering Corporation, 521 S. Main St., Providence, R. I., is now building the "Pecorp" upright drilling machine shown in the accompanying illustration, which is made ball bearing throughout. It is claimed that belt troubles are eliminated because the driving belt is straight and requires no adjustment for different speeds. The spindle is carried by ball bearings and made self-oiling. It is machined from a tough steel and finished to size by grinding. A reservoir in the sleeve contains a sufficient quantity of oil to lubricate the spindle for one week, which greatly simplifies the work of keeping a machine of this type in efficient working condition. The sleeve key runs its entire length, and rack teeth are cut directly in the steel sleeve.

The head carries the quick-change belt-shifting device, and it is stated that the complete range of speeds may be obtained in less than two seconds, the belt being shifted by forks arranged to have reciprocating movements, which hug the pulleys closely and prevent the belt from rolling over. They are operated by a crank-handle in front of the cone pulley, and directly beneath a dial showing the proper speeds for the various sizes of work. One complete turn of this handle will give any of the available speeds. On each turn, the belt shifters are positively locked in place assuring proper tracking of the belt, and no wear due to the belt dragging on improperly placed shippers.

The four-step cone pulleys are so mounted with their own self-contained ball bearings that they can be removed without disturbing adjacent parts. This unit construction is a characteristic of the machine. Slack in the horizontal belt is automatically taken up by two ball bearing idlers so arranged that they adjust themselves to the load as it is applied to the belt, this result being accomplished in such a way that the belt is only under tension when the load is applied. The table is elevated and lowered by a telescopic screw geared to a crank-handle shaft.

Tight and loose pulleys, on a horizontal shaft with a hand belt shift, supply power through a pair of bevel gears to the vertical shaft, the gears being inclosed in a substantial case so that they can run in a bath of oil. The vertical shaft and its gear are so mounted that they can be removed from the machine without tearing down the driving mechanism. According to requirements of the consignee, this machine can be arranged as a single-purpose drilling machine with one spindle speed; as a plain machine with four rates of speed available for the spindle; or as a tool-room machine with additional changes of speed. Automatic power feeds can be arranged on any spindle, alternating with built-in tapping attachments. Spindle speeds as high as 3500 revolutions per minute can be utilized on specially constructed machines. Provision can be made for motor drive with either a vertical or a horizontal motor.

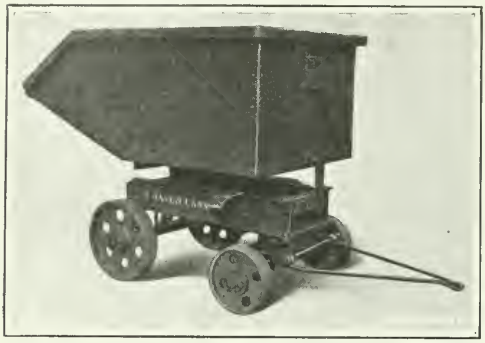
The patterns, tools, jigs, and materials for the manufacture of drilling machines formerly built by Arthur C. Mason, Inc., of Hawthorne, N. J., have been acquired by the Providence Engineering Corporation, and these machines are now included in the "Pecorp" line of drilling machines. In Machinery for May, 1918, was illustrated and described the Mason high-speed sensitive drilling machine which is made for handling drills over a range of from No. 80 to 3/16 inch, inclusive. The larger machine, shown in Fig. 1, has a capacity for drills from ⅛ to ⅝ inch inclusive. Both of these machines are now built in Providence, and a sales office is maintained at 5 Nassau St., New York City.



"Pecorp" Upright Drilling Machine manufactured by the Providence Engineering Corporation

EASTON SCOOP CAR

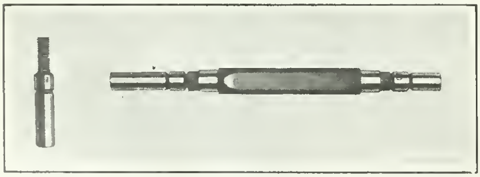
The accompanying illustration shows a scoop type of car built by the Easton Car & Construction Co., 50 Church St., New York City, which is equipped with flat-tread wheels so that it is particularly adapted to the handling of iron and steel chips, small forgings and castings, bolts, etc., in machine shops; and coal, coke, and cinders in and around boiler houses and foundries. This car can be readily pulled about by one man, or it may be attached to the rear of an industrial truck and hauled from place to place as a trailer. The body of the car is mounted on a structural steel turntable, so that it can be turned around and dumped from any one of the four sides. The front axle swivels, being provided with a machined cast-iron ball-bearing turntable that permits the car to be turned around in a circle having a radius of practically its own length. The low loading height of the car is especially convenient for hand loading. Its capacity is 27 cubic feet.



Scoop Car built by the Easton Car & Construction Co., for hauling Chipa, Small Forgings and Castings, etc.

JOHANSSON REPLACEABLE-END PLUG GAGE

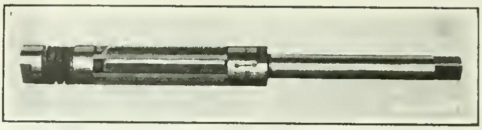
A new type of tolerance plug gage has recently been placed on the market by C. E. Johansson, Inc., Poughkeepsie, N. Y., the main feature of which is that the ends are replaceable. By means of this provision when the "Go" end becomes worn, it can be replaced, and as it is unnecessary to throw away the unworn or "Not Go" end and its holder, the useful life of a gage may be extended indefinitely by simply replacing the worn end as the occasion demands. The ends are securely locked in place so that they do not become loose while being used. This type of tolerance plug gage is being made in sizes ranging from 1/8 to 47/64 inch.



C. E. Johansson Tolerance Plug Gage with Ends which may be replaced when Worn

FOSTER-JOHNSON ADJUSTABLE REAMER

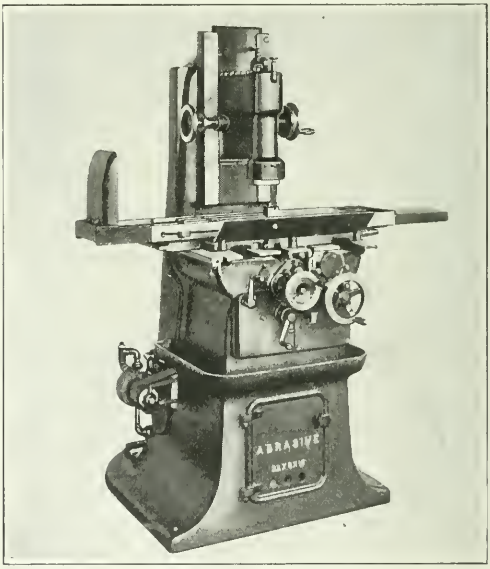
An adjustable general-purpose reamer which can be readily and accurately expanded or contracted, and which is sold under the trade name of Kylin, has been developed by the Foster-Johnson Reamer Co., Elkhart, Ind. This reamer is expanded or contracted by operating a single adjusting nut, and the amount of expansion or contraction can be read directly on the tool by means of micrometer graduations. A helical spring at the front end affords an easy and accurate adjustment. It is stated that by incorporating this spring in the construction of the reamer, a very high quality of finish is imparted to the work. The reamer is suitable for many classes of work, being made in thirteen sizes, of which the nominal diameter ranges from 5/8 to 1½ inches, the smaller sizes having four blades, and the larger ones, six.



Kylin Expanding and Contracting Reamer with Micrometer Adjustment, made by the Foster-Johnson Reamer Co.

ABRASIVE SURFACE GRINDING MACHINE

A sensitive vertical-spindle surface grinding machine suitable for tool-room use and for certain classes of production work such as the squaring of shaft ends on centers and the surfacing of small pieces held by a magnetic chuck, has been developed by the Abrasive Machine Tool Co., East Providence, R. I. It is especially suited to resharpening pilot dies by employing a cup-wheel, the claim being made that a wheel of this style is more efficient than a disk wheel for such an operation. The general features of the machine are the same as those of the horizontal-spindle type of surface grinding machine brought out by the same concern during the latter part of 1917 and of which mention was made in the December number of MACHINERY for that year.



Vertical-spindle Surface Grinder for Tool-room Work and Certain Classes of Production Work, built by the Abrasive Machine Tool Co.

The wheel-spindle is carried on radial thrust bearings, and all high-speed shafts are likewise mounted on ball bearings. The adjustment of the wheel-head is accomplished by means of a screw actuated by a worm and worm-wheel. Two handwheels are provided for this adjustment, one for obtaining a fine feed, which is provided with 0.00025-inch graduations, and another for securing rapid movements of the head. The gears for operating the table and the cross-feed are in a self-contained unit in which the gears and clutches run constantly in a bath of oil. All belts and other moving parts are enclosed, so that the safety of the operator is insured, and all bearings are carefully guarded against the admission of dust or water. The machine can be equipped with a countershaft for a belt drive or with a concealed motor drive. The longitudinal and transverse feeds of the machine are automatic, the maximum longitudinal movement being 22 inches and the transverse movement, 8 inches. The vertical adjustment of the grinding wheel head is 10 inches, and wheels up to 5 inches in diameter may be used.

DIAMOND SURFACE GRINDING MACHINE

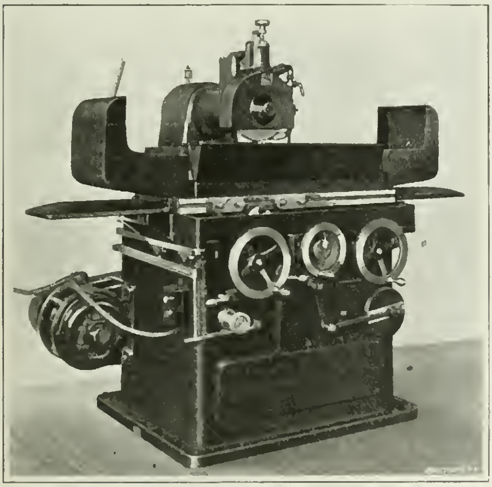


Fig. 1. Surface Grinding Machine recently developed by the Diamond Machine Co.

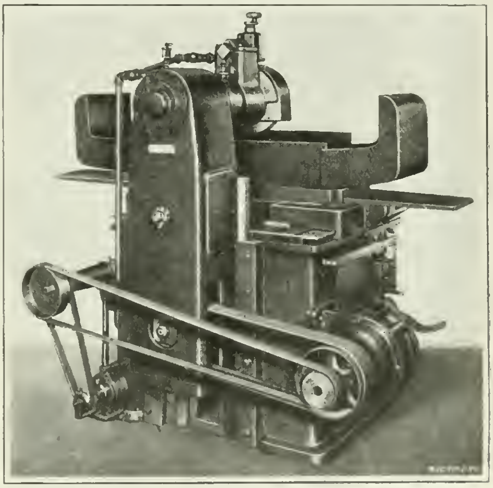


Fig. 2. Rear of Machine illustrated in Fig. 1, showing Integral Construction of Wheel-head and Column

Rigidity of the essential parts of a machine tool depends quite as much upon the distribution of mass and the maintenance of a condition of dynamic balance as upon mere weight. In following out this principle in the design of the Type C surface grinding machine shown in Figs. 1 and 2, the Diamond Machine Co., Providence, R. I., decided to concentrate a great deal of metal in the vicinity of the wheel-spindle bearing adjacent to the grinding wheel. This machine has a capacity for grinding work up to 24 inches long, 10 inches wide, and 8 inches high, and so it is suitable for the grinding from the rough of many pieces that would otherwise need to be planed and subsequently finish-filed or scraped. The machine is equipped for feeding coolant to the work, which after having served its purpose, flows from the table through channels into a separate compartment within the base of the machine where the grit settles. The clear liquid is pumped back to the "spreader" or special form of nozzle which directs the stream to the point of grinding. This coolant keeps the wheel from becoming loaded with metal particles and improves the character of the ground surface.

An unusual feature of this machine is that the wheel-spindle head is cast integral with the vertical column, and so the combined column and head, rather than the head alone, is adjusted up and down to suit different thicknesses of work. One of the advantages obtained by this arrangement is a large surface area for the ways of the vertical slide. Another feature of the machine, which has been previously referred to, is the construction of the main spindle bearing nearest the grinding wheel. This is a composite plain and ball bearing, which combines the advantages of both types. The plain bearing consists of a floating bushing adjacent to the ball races. It is claimed that by constructing the wheel-head in the manner described, and by employing the double bearing, all chatter is eliminated and a high quality of finish is obtained on the work. There is no appreciable wear on the floating bushing because the ball bearing takes care of radial thrusts. The rear end of the spindle is also provided with a ball bearing. The driving pulley of the spindle is placed between the two spindle bearings and nearer the rear bearing, so that any vibration of the driving belt will not cause corresponding vibration of the spindle.

The handwheels for horizontal and transverse adjustments of the table and vertical adjustments of the wheel-head are arranged side by side at the front of the base for the convenience of the operator. Longitudinal travel of the table is obtained by operating the left handwheel, the table being moved about 2 inches per revolution of the wheel. The table is moved transversely 0.500 inch per revolution of the central handwheel, and the handwheel at the right is used for raising or lowering the wheel-head, the latter being moved a distance of 0.100 inch per revolution of the wheel. The rims of the central and right handwheels have a graduation for each 0.001-inch movement of the table and wheel-head, these graduations being so widely spaced that the operator can readily adjust these members to 0.0001 inch. Ball thrust bearings are provided on both the horizontal and vertical adjusting screws.

The ways on which the adjustable members slide are completely covered by metal guards to prevent their injury from the collection of abrasive dust or gritty water. The longitudinal travel of the table is accomplished by means of a train of belt-driven gears, and reversal is effected by a single shifting belt. A simple device insures a complete shifting of the belt at the end of each stroke. Momentary pressure upon a trigger causes the table to stop at the completion of any stroke already begun, and the table travel may be stopped instantly at intermediate points by disengaging the clutch connected to the left handwheel. The transverse table feed is automatic and adjustable from 0.001 inch to 0.020 inch. The feed takes place at both ends of the table travel and can be made in either direction. There is an automatic stop for this feed, which can be set to disengage at any desired point

In order to give an idea of the capacity of this machine

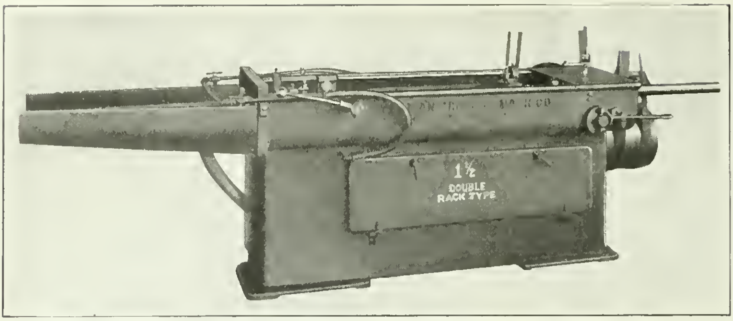


Fig. 1. No. 1½ Double-head Rack-operated Broaching Machine developed by the American Broach & Machine Co.

it is stated that a cut 0.234 inch deep and 1/16 inch wide has been taken, the total cross-sectional area of the cut being 0.015 square inch. However, such a cut is not recommended, because the average grinding wheel would wear away too fast for economy, this case being cited only to show that the machine is claimed to surpass the capabilities of modern grinding wheels. The machine illustrated is motor-driven, but it can be arranged for driving from a countershaft when such a method is preferred.

NO. 26 LEA-SIMPLEX SAW

The Earle Gear & Machine Co., Stenton and Wyoming Aves., Philadelphia, Pa., has recently added a larger sized machine to the line of Lea-Simplex cold saws of its manufacture. This new machine is known as a No. 26, and it takes a 26-inch diameter saw blade. It has a capacity for cutting 11-inch round or 10-inch square stock, and 20-inch I-beams. As with other saws built by this concern, the new size can be furnished with either a belt or motor drive. The weight of the machine is about 4500 pounds.

AMERICAN DOUBLE-HEAD BROACHING MACHINE

A description of the No. 1½ rack type broaching machine manufactured by the American Broach & Machine Co., Ann Arbor, Mich., appeared in the October, 1920, number of MACHINERY. The accompanying illustration shows a machine of the same general construction, except that it is provided with two sliding heads instead of only one. The new machine is known as the No. 1½ double-head broaching machine. The sliding heads are made from solid billets of steel, and they are equipped with a central broaching block that permits the operator to bring the head into accurate alignment for central broaching.

The machine is so arranged that one head may be operated alone, the same as on a single-head machine. When both heads are being used, the stroke can be so adjusted that both heads will broach the same length of work. An automatic brake is provided to arrest the momentum of the driving mechanism as soon as the heads come into their stopping position. The distance from center to center of the bores in the face of the machine is 9 inches, these bores being 5 inches in diameter. The height from the floor to the center of the bores is 30½ inches. The machine is adapted to the use of broaches of various lengths up to 50 inches, and its weight is 2700 pounds.

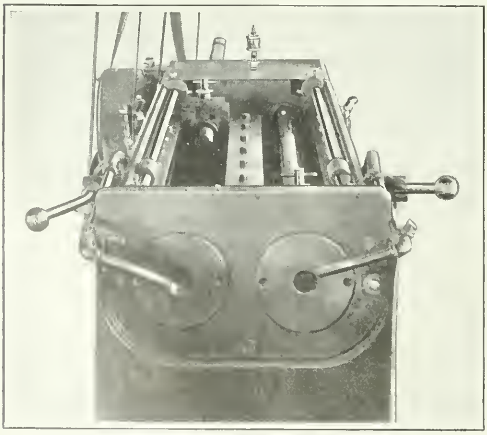
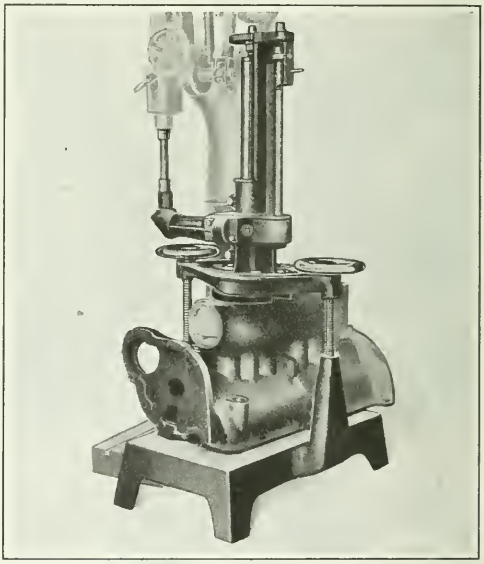


Fig. 2. View showing Top of Broaching Machine



Machine developed by the Storm Mfg. Co. for reboring Gasoline Engine Cylinders

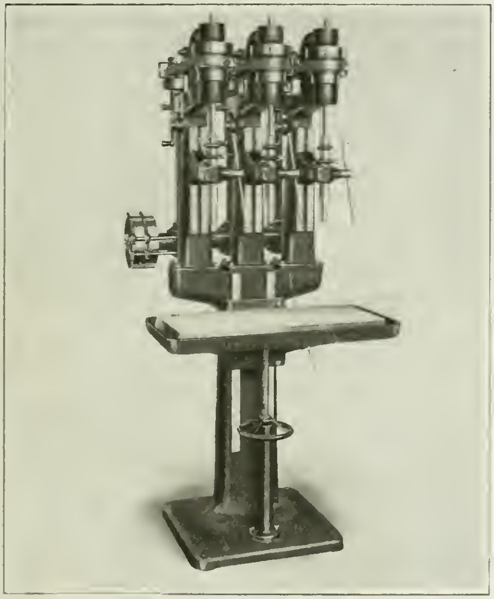
STORM CYLINDER REBORING MACHINE

The Storm Mfg. Co., Sixth Ave. and 4th St. S., Minneapolis, Minn., has developed the Type M cylinder reboring machine which is shown in operation in the accompanying illustration, this machine being driven from the spindle by a drilling machine. The main body is a one-piece casting which supports the boring-bar and the feeding and driving mechanisms. The boring-bar is hollow, made of carbon steel, hardened and ground, and has a travel of 14 inches. It is rotated by means of spiral gears and fed through an internal screw and an upper feed gear. The cutter-heads supported by the bars cannot be seen in the illustration, but they are of the Storm patented six-cutter type having a universal adjustment so that they may be set for boring to any desired size within the capacity of the machine.

A valuable feature of this tool is that it is adapted for different methods of driving. It is regularly furnished with a connection for a drilling machine as illustrated, but it can also be furnished with a pulley for a belt or motor drive, or it may be driven by hand through the use of a double-end wrench. It will be noted that the machine does not come directly under the spindle of the drilling machine but to one side, so that it does not interfere with the machining of work on the drilling machine. The tool is back-geared so that it may be used in connection with an ordinary 20-inch drilling machine, whether the machine is of the back-geared type or not. The machine may be taken off the base for reboring automobile cylinders without removing the engine from the chassis. It will rebore holes 2⅝ to 6½ inches in diameter, and weighs 300 pounds.

EDLUND DRILLING MACHINE

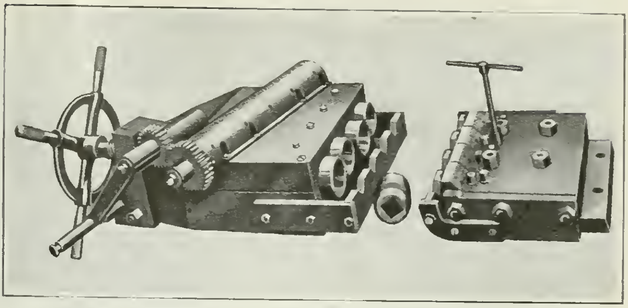
In the April, 1919, number of MACHINERY was published a description of a No. 2B sensitive drilling machine built with from one to six spindles by the Edlund Machinery Co., Inc., Box 57, Cortland, N. Y. The accompanying illustration shows a No. 1B ball-bearing sensitive drilling machine, built by the same concern along the general design of that previously described, and in combinations of from one to four spindles. On the new machine, some of the principal dimensions are as follows: Distance from the center of the spindles to the face of the column, 7 inches; maximum distance between spindle nose and table, 30 inches; vertical traverse of spindle, 3½ inches; vertical traverse of arm, 10 inches; and vertical traverse of table, 17 inches.



No. 1B Ball-bearing Sensitive Drilling Machine manufactured by the Edlund Machinery Co., Inc.

MILLER & CROWNINGSHIELD MULTIPLE-SPINDLE INDEX-CENTERS

Multiple-spindle index-centers designed to permit the rapid fluting and squaring of taps, reamers, etc., have been placed on the market by Miller & Crowningshield, Greenfield, Mass., and are shown in the accompanying illustration. The device is made with one, three, four, five, six, or eight spindles, all of which rotate in the same direction. The spindles are spaced closely, so that the several pieces of work will be held in as small a space as possible, and they are connected by equalizing levers that allow a variation of about 3/16 inch in the length of the work being milled. The spindles have tapered holes, and a drift is furnished to interchange centers. All spindles are tightened simultaneously by operating a single handle.

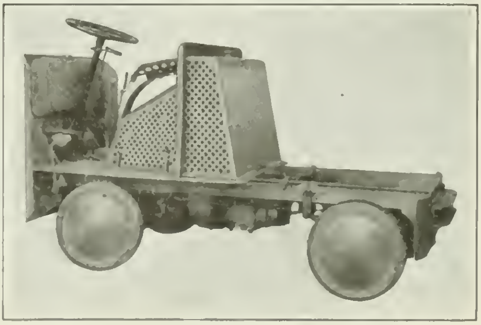


Multiple-spindle Index-centers made by Miller & Crowningshield for Use in fluting and squaring Taps, Reamers, etc.

Any number of flutes from one to twenty can be machined on work mounted on these centers, the proper indexing being obtainable by changing a spur gear. The indexing of all the different spindles is accomplished by turning a handle. In squaring and fluting work with only four flutes, no gearing is required, as one revolution of the index handle turns the spindles a quarter of a revolution. The tail block is separate from the head block and it is made in two styles, one solid, and the other having a separate vertical adjustment for each center. Both types have the same interchangeable tail-centers, which can be readily replaced if they become broken or worn out.

BARRETT-CRAVENS INDUSTRIAL TRACTOR

The chassis of a gasoline-driven tractor known by the trade name of "Powerox" and which has been designed and built by the Barrett-Cravens Co., 171 N. Ann St., Chicago, Ill., for heavy-duty hauling in factories, between shops, etc., is shown in the accompanying illustration. This chassis may be fitted with various types of bodies for carrying a load of 3000 pounds; and by the use of trailers, a load of 40,000 pounds can be drawn. In an equipment of this type, compactness of design is desirable, and in the development of the tractor attention was given toward this end, the overall dimensions being about 8 by 4 feet. The wheel-base is 5 feet, and the tractor can turn in a circle having a radius

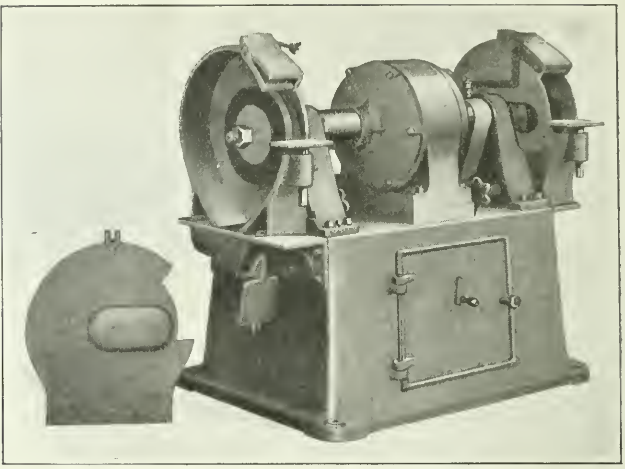


Chassis of Industrial Tractor built by the Barrett-Cravens Co.

of 10 feet. Every part is of a standard make, and the entire unit is built to 1½-ton truck specifications.

The tractor is furnished with a 25-horsepower engine having four cylinders cast en bloc, a removable cylinder head, enclosed valves, a circulating air pump, a thermosiphon cooling system, a speed governor, and a high tension magneto with fixed spark. The engine, clutch, and transmission are located under the driver's seat. The radiator is placed at the rear of the engine; it is spring-mounted and is enclosed in a heavy steel plate housing. Power is applied to the rear wheels through a worm-gear driven axle of the fully enclosed type. The transmission is of the selective type, with three speeds forward, one reverse, and a standard truck control. Constant-mesh gears are used in place of the sliding type, thus eliminating clashing and other troubles experienced with sliding gears. Speed changes are made by the engagement of special jaw clutches.

It will be noted that the wheels of this tractor are cast solid with convex faces, and that there are no projecting hubs. The employment of wheels of this type eliminates scraping of doors, machines, etc., as the tractor passes through the shop. The frame of the chassis is constructed of 4-inch channels, and all rivets are hot driven. Solid rubber tires of the pressed-on truck type are used, having a diameter of 20 inches. The speed of the tractor is regularly from one to ten miles per hour, but this may be increased by adjusting the governor.


Heavy-duty Dry Grinding Machine built by the Marschke Mfg. Co.

MARSCHKE DRY GRINDER

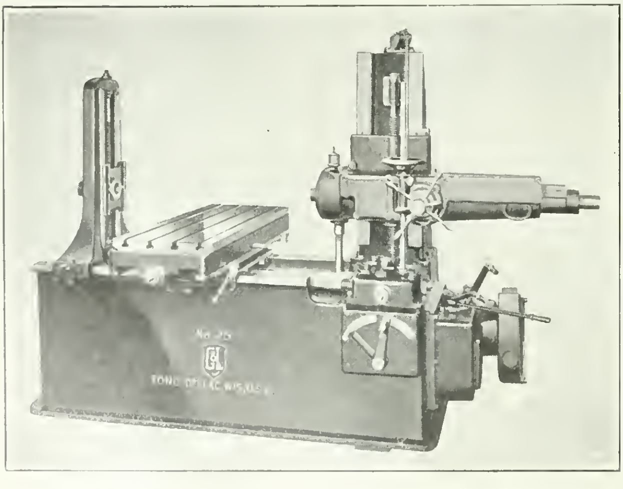
A heavy-duty dry grinding machine equipped with two 18- by 3-inch wheels has just been developed by the Marschke Mfg. Co., 1815-1831 Madison Ave., Indianapolis, Ind. This grinder is especially suitable for snagging castings and for other general foundry grinding operations. The wheel hoods are adjustable, so that the wheel may always be close to the front of the hoods; and the spark plates and steadyrests are automatically adjusted with the hoods, when the latter are positioned through the medium of the handwheel. This machine may be furnished with or without an exhaust fan; when the exhaust is supplied, it is placed in the base and driven by a chain. The motor starter is mounted directly on the door of the base, and the starting handle may be seen in the illustration. The hood supports are provided with openings that permit the heavy refuse produced in grinding brass parts to fall into receptacles, so that only the dust is taken off through the blower. Provision may be made for driving the machine by either alternating or direct current. The motor is entirely enclosed and an oil-switch starter is furnished. The speed of the grinding wheel spindle with no load is 1200 revolutions per minute, and with full load, approximately 1160 revolutions per minute. The weight of the alternating-current machine is 2200 pounds, and that of the direct-current machine, 2300 pounds.

GIDDINGS & LEWIS BORING, DRILLING AND MILLING MACHINE

A No. 25 table type horizontal boring, drilling, and milling machine which has been recently developed by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., is here illustrated. Several of the points of interest in connection with this machine are as follows: It is driven by a constant-speed pulley drive; an independent reverse is provided for both speeds and feeds; micrometer dials are furnished for all adjustments; a quick-return pilot and worm-gear are supplied at the operating end of the headstock; a change-gear quadrant facilitates thread cutting; the spindle and table are driven through helical gearing; the spindle pilot is controlled by a quick-operating clutch; and the table is equipped with adjustable automatic trips.

The reversible friction clutch and all speed and feed gears run in baths of oil, and all high-speed shafts are equipped with ball bearings. An auxiliary table of the exact height of the platen can be furnished to assist in supporting large work, this table being adjustable longitudinally and rigidly anchored to the bed of the machine. For angular work a plain hand- or power-feed revolving table can be supplied, which is 24 inches in diameter and graduated in ½ degrees.

A star-feed facing attachment can also be furnished to face parts up to 18 inches in



No. 25 Table Type Horizontal Boring, Drilling, and Milling Machine built by the Giddings & Lewis Machine Tool Co.

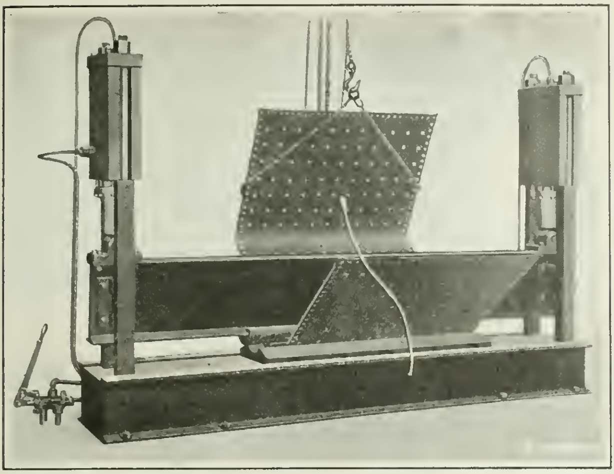


Plate Bending or Straightening Press built by the Houston, Stanwood & Gamble Co.

diameter. This device is regularly bolted and keyed to the spindle sleeve, but it can be arranged to be fastened to the spindle or to a boring-bar. When fastened to a bar, it may be used on either side of the piece being machined. Some of the principal dimensions of the machine are as follows: Diameter of spindle bar, 2½ inches; longitudinal travel of spindle, 13½ inches; maximum distance from table to center of spindle, 20 inches; distance from face of spindle to boring-bar support, 48 inches; size of table, 18 by 48 inches; transverse travel of table, 33 inches; and longitudinal travel of table, 30 inches. The approximate weight of the machine is 6300 pounds.

"THOR" ROTARY WIRE BRUSH

The Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has developed a "Thor" rotary wire brush for use on the No. 71 portable pneumatic grinder or on the No. 6 electric grinder manufactured by this concern. This attachment permits the use of the No. 71 grinder with an emery wheel, and by making a few changes, the brush attachment can be quickly added. The wires of the brush are all of equal length, interchangeable and made of specially treated steel. The concave wooden back is fitted inside of a metal cover and secures the brushes in position, the arrangement allowing the wires to bend under pressure without breaking. The brushes are particularly useful for removing paint, rust, scale, dirt, etc., in such work as cleaning steel cars, automobile bodies, steel frames, tank cars, foundry castings, and sheet metal. The brush wires can be replaced when they become worn.

HOUSTON, STANWOOD & GAMBLE PLATE PRESS

The Houston, Stanwood & Gamble Co., Cincinnati, Ohio, has recently placed on the market the plate press here illustrated, which is especially intended for use in boiler or tank shops or other plants having plate or structural steel work to be bent or straightened. The machine has a cross-beam connected to a ram at each end by bearings having a swivel pin. This arrangement gives the beam flexibility and allows it to adjust itself to any unevenness of the work. The frame consists of heavy uprights bolted through cylinders at the top and through a reinforced base casting at the bottom. The upper sectional dies are attached to the beam of the machine in a simple manner, and the lower dies are placed on the base and aligned with the upper ones by means of the channel irons which reinforce the base and extend above the latter for that purpose.

The operating lever for controlling the working and return strokes of the cylinders is located in a position convenient to the operator. The machine is built in various sizes and capacities, and for ram operation by city or other water pressure or compressed air, whichever is available in the plant. By providing suitable dies on the machine, angle-irons can be bent when they are placed back to back. From reference to the illustration it will be apparent that the cross-beam is returned to its upper position without the use of an auxiliary ram.

MASSILLON TRIMMING PRESSES

The Massillon Foundry & Machine Co., Massillon, Ohio, has brought out a line of trimming presses on which the principal feature is a new type of clutch on the driving shaft that is non-repeating and fool-proof. It marks a radical departure in clutch design, and is fully patented. These presses were designed primarily for trimming drop-forgings, the line including presses suitable for trimming drop-forgings up to the maximum size within the capacity of any drop-hammer built. In addition to this purpose, the presses are also suitable for general sheet-metal blanking and forming operations.

The main frame of the press is designed along heavy lines, and is a one-piece solid semi-steel casting with the legs cast integral. A front view of the machine showing the auxiliary shears on the left-hand side is illustrated in Fig. 1, while Fig. 2 shows a sectional view of the clutch referred to in the foregoing. In the latter illustration, it will be seen that the jaws of clutch member *B*, which is slidably mounted on a square portion of the shaft, are engaged with and disengaged from the jaws of the clutch plate *C* attached to the driving gear *D*, through the movement of roller *A* in the cam groove of clutch *B* and by the rotation

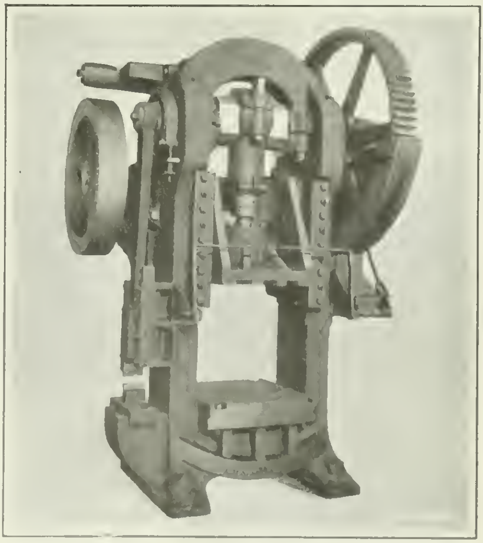


Fig. 1. Trimming Press which is Typical of a Line built by the Massillon Foundry & Machine Co.

of this clutch member. Roller *A* is mounted on a stud screwed into the clutch case, and after being adjusted to extend the desired amount into the clutch, it is held permanently in place by means of a locking nut.

In the operation of the press, when roller *A* is pulled past the highest point of the cam groove on clutch *B*, springs *E* force the clutch forward so that its jaws engage those of the plate on the driving gear and thus positively lock the driving shaft and gear together, permitting a revolution of the shaft to take place. In order to move roller *A*, the clutch case is given a portion of a revolution by lowering the tripping lever shown in Fig. 1 extending across the front of the machine. This lever is connected by means of a shaft to a rod attached to a lug on the clutch case, and so pulls the latter forward. After the driving shaft has made a revolution, clutch *B* is returned to its original position by the action of the cam groove against the roller. The jaws on both members *B* and *C* are made of hardened steel and so designed that they may be removed and replaced in case of wear.

In instances where the ordinary type of clutch fails to operate or repeats, the trouble is usually due to the failure of the clutch pin to function. Inasmuch as in the clutch described the pin is always in the cam groove, the clutch cannot fail to operate. The clutch mechanism is entirely enclosed by the clutch case and runs in a bath of oil. In addition to operation by the tripping lever as described, the clutch may also be operated by a foot-treadle. All main gears and pinions on the presses are made of open-hearth steel and have machined teeth.

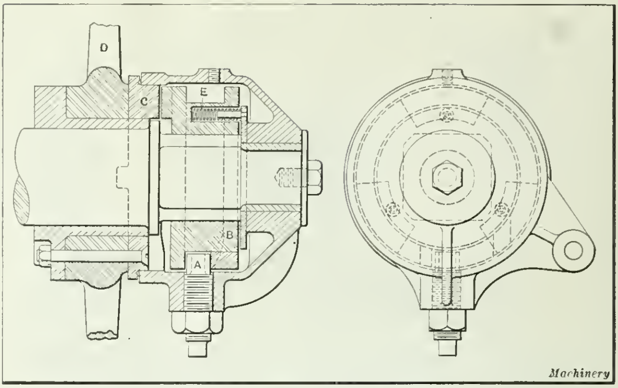
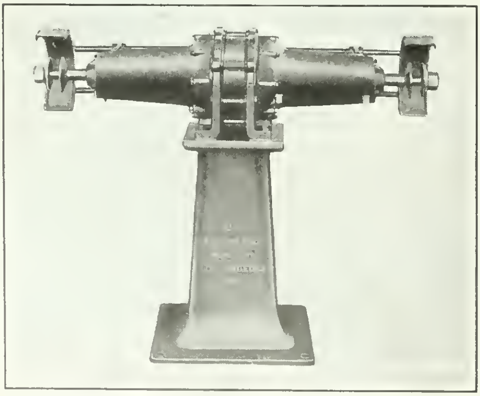


Fig. 2. Sectional View of Clutch mounted on Driving Shaft of the Trimming Press

U. S. ELECTRICAL GRINDING, BUFFING AND POLISHING MACHINE

The heavy-duty motor-driven grinding, buffing, and polishing machine shown in the accompanying illustration was originally designed for buffing pneumatic truck tires, but it has since proved suitable for use in plating plants, radiator and sheet metal works, etc. This machine is the product of the U. S. Electrical Mfg. Co., Central Ave. at Third, Los Angeles, Cal. It has an over-all shaft length of approximately 6 feet, so that two men can work on the machine at the same time without interfering with each other. Large ball bearings are used in the construction of the machine, sets of bearings being placed at the ends of the housing, while a set is also placed at the center of the machine to eliminate vibration of the rotor. The machine can be built in a number of different sizes for operation by two- or three-phase alternating current; but the most generally used size is said to be one having a five-horsepower motor running at 3600 revolutions per minute.



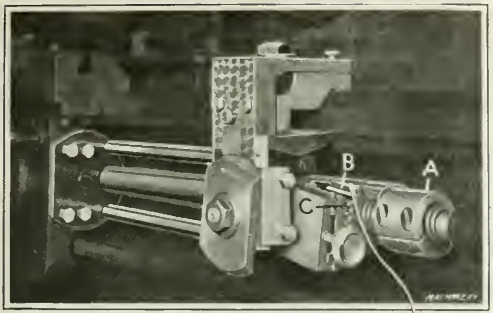
Motor-driven Grinding, Buffing, and Polishing Machine built by the U. S. Electrical Mfg. Co.

PRECISION THREAD LEAD VARIATOR

The Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., has designed a thread lead variator for application on lathes to obtain any lead with the desired precision from an ordinary lead-screw. This variator also makes it possible to cut metric threads or threads of odd or unusual lead on any lathe. In addition to these advantages, a thread can be cut with a lead sufficiently over size to compensate for shrinkage in hardening the threaded part. The variator is applied at the right-hand end of the lead-screw which is seldom in contact with the carriage half-nuts, and, therefore, is rarely worn. By placing the variator on this section of the lead-screw, its application often eliminates the necessity of providing a new lead-screw when the one on the machine becomes worn on the section receiving severe usage.

With this variator the forward movements of the carriage are controlled by nut *A*, which is placed on the lead-screw and connected to the carriage by means of long rods, and attaching members. A gear segment *B* is dovetailed to the variating nut in such a manner that when the gear segment is rotated a portion of a revolution around the lead-screw, the variating nut is rotated a corresponding amount. However, the gear segment can also be swiveled to bring its teeth at an angle with the horizontal center line of the lead-screw, but this movement has no effect on the variating nut. Rotary movements of the gear segment are governed by its longitudinal movement past rack *C* which can also be inclined to bring its teeth at an angle with a horizontal plane. In cutting a thread, the amount that rack *C* should be inclined depends upon the accuracy with which a thread can be cut when the rack and gear teeth are in a horizontal position.

From the foregoing description it will be apparent that a forward movement of the carriage is caused by nut *A* as the latter advances due to the rotation of the lead-screw. The movement of the carriage, however, is slightly accelerated or retarded for the purpose of compensating for any error in the lead-screw, by the action of gear segment *B* as it advances along rack *C*. It will be seen that rack *C* is indirectly supported from the lathe bed. A graduated scale is provided to furnish readings of the angular setting of the rack. It will, of course, be understood that the half-nuts of the carriage are disengaged at the time the variator is being used.

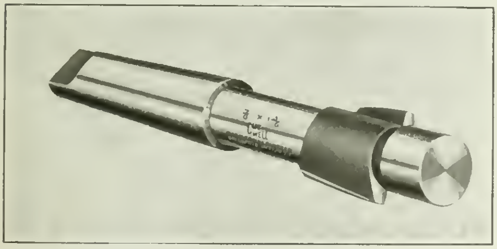


Lathe Attachment developed by the Precision & Thread Grinder Mfg. Co., to compensate for Lead-screw Errors

An interesting feature of the device is that the variating nut is not employed to return the carriage to its starting position, the latter movement being accomplished by means of a special return nut. This arrangement tends to preserve the accuracy of the variating nut and the lead-screw at the right end. A cover is furnished for protecting the lead-screw from abrasive dust when performing thread-grinding operations on the lathe. This precision thread lead variator is manufactured in two models, one of which is suitable for lathes from 9- to 12-inch swing, and the other for machines from 13- to 20-inch swing.

BICKFORD-SWITZER COUNTERBORE

A counterbore with two cutting lips, known under the trade name of "Cutwell" has been designed by the Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass., for performing counterboring operations on a production basis. This tool is shown in the accompanying illustration. It is claimed that on account of the ample clearances provided on the cutting lips and the design of the latter, work can be accomplished with expedition and chattering of the tool is eliminated. The cutting action of the counterbore is similar to that of a drill, and the chips produced are like those obtained when drilling. There is plenty of room to permit convenient resharpening of the cutting lips, and either lip is sufficiently strong to perform an operation if the resharpening has been carelessly done.



Two-lipped Counterbore which is a Product of the Bickford-Switzer Co.

LUMSDEN OSCILLATING SURFACE GRINDER

The Lumsden No. 86 oscillating surface grinder which is shown in Figs. 1 and 2 has been placed on the market by Alfred Herbert, Ltd., 54 Dey St., New York City. The particular field of this machine is locomotive, shipbuilding and general engineering shops where plane surfaces are ground on such products as steel railway buffers, journal boxes, journal box covers, etc. The capacity of the machine is for surfaces up to about 24 by 10 inches. The new machine is built on the same principle as the Lumsden oscillating tool grinder described in the August, 1919, number of MACHINERY, the grinding wheel head being mounted on a swinging arm having two trunnions supported by bearings on the bed. The arm is oscillated about the center of these bearings, the movement being obtained by a connecting-rod operated by a crank on a three-speed gear-box mounted on the bed. By adjusting the throw of the crank, the stroke of the oscillating arm measured at the edge of the wheel and in a vertical line with its center, can be varied from zero to a maximum of 24 inches.

The machine is provided with a 16-inch cup-wheel having eight segments, the wheel being mounted on a ball-bearing spindle carried in a ram having an adjustment parallel with the axis of oscillation of the swinging arm. This adjustment is employed for feeding the wheel to the work, is controlled by a handwheel on the gear-box, and can be operated when the arm is in motion. The wheel segments are 6 inches long and can be used down to a length of 1½ inches. The spindle is driven by a belt from a self-contained countershaft located at the center of oscillation of the swinging arm and supported by bearings in the trunnions, and one on the bed. T-slots are provided on the table, and the latter has a cast-iron trough. Ample supply of water is insured by a pump driven from the countershaft.

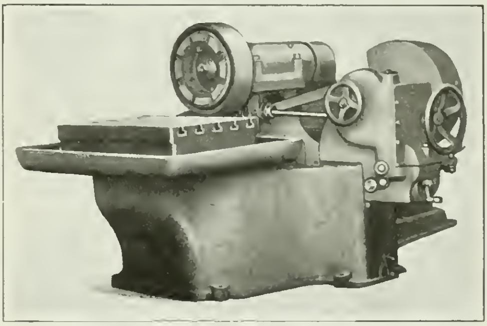


Fig. 1. Front View of Lumsden Oscillating Surface Grinder introduced by Alfred Herbert, Ltd.

The number of oscillatory movements of the wheel-head per minute, suitable for strokes of different lengths are as follows: 43 strokes up to 8 inches in length; 21½ strokes from 8 to 16 inches in length; and 10 strokes from 16 to 24 inches in length. The working surface of the table is 36 by 25½ inches; hand feed of wheel, 3 inches; wheel-spindle speed, 1088 R.P.M.; horsepower required to drive machine, 20; and net weight of machine approximately 8100 pounds.

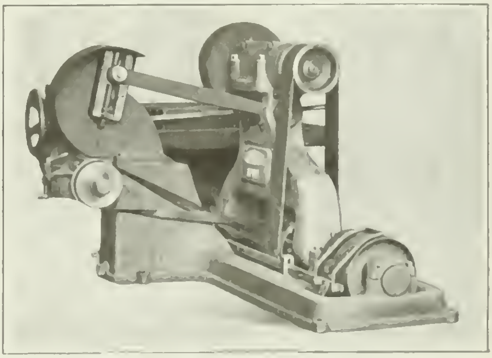
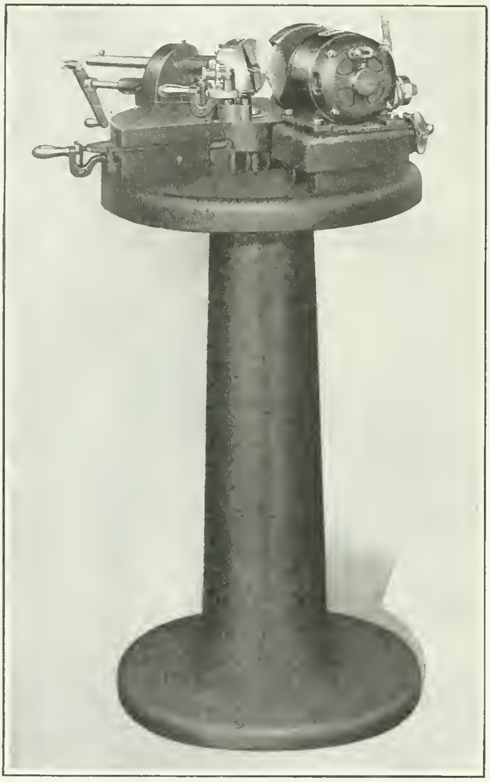


Fig. 2. Rear View of Surface Grinder showing Crank and Connecting-rod for oscillating the Wheel-head

BICKFORD-SWITZER DRILL GRINDER

A drill grinding machine constructed in such a manner that both lips of the drill are brought consecutively in contact with the grinding wheel so that the sharpening of both is completed at the same time is here illustrated. This machine is a product of the Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass., and has a capacity for grinding drills ranging from ⅛ to ¾ inch in diameter. In grinding a drill, the latter is held in a chuck, and by revolving a crank, it is given a combined rotative, eccentric, and swinging motion, which not only causes the drill to be ground to the correct radial and lip clearance, but also permits the lips to be brought consecutively in contact with the grinding wheel, as previously mentioned. The result of this arrangement is that the drill is ground true with its axis.



Drill Grinder made by the Bickford-Switzer Co.

An advantage of the machine is that its operation does not require a skilled worker, as anyone having sufficient intelligence to read an ordinary scale can grind a drill accurately, a scale being employed to set the machine for grinding drills of different sizes. The drill is located absolutely centrally on the machine by supporting the back end by a cup center, and the front end by two special jaws which locate and grip the working part of the drill. The operation of the machine is simple, it being only necessary to set several levers and revolve a crank. It is claimed that when a drill is sharpened on the machine it will be commercially perfect and will not drill a hole more than 0.002 inch larger than its nominal size, thus making it possible in some instances to omit a reaming operation on work. Only about a minute is required to make all adjustments necessary for grinding a drill (even if the drill is of a different size from the last one) and for the grinding operation.

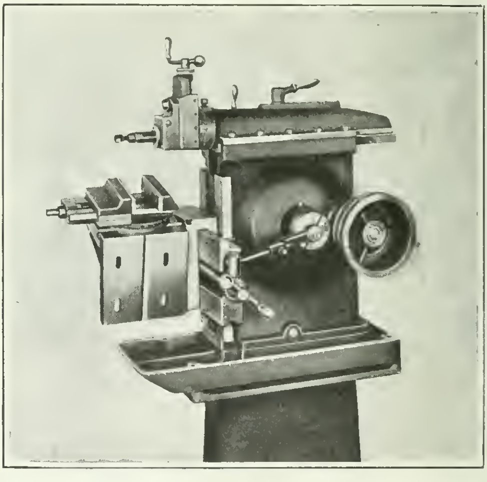
It has been repeatedly demonstrated that if a drill is slightly beveled at the outer corners of the cutting lips, its usefulness is greatly increased. On the machine described, these corners are rounded, the operation being performed during the sharpening of the lips. The machine is driven from a lamp socket, and can be arranged for either alternating or direct current.

PLETZ 9-INCH SHAPER

A 9-inch shaper has recently been placed on the market by Carl Pletz & Sons, 3116 Spring Grove Ave., Cincinnati, Ohio. This machine has been designed to meet the demand for a sturdy and accurate tool having the necessary range and capacity for handling the general run of shaper work found in a tool-room, die shop, and experimental shop. It is sturdy enough so that it has also a field as a manufacturing tool on small work. It is especially adapted for small keyseating, where it will enable rapid production to be obtained.

The ram is constructed with wide and long bearing surfaces, and can be set to any length of stroke within its range. A graduated scale is provided on the rocker arm, which shows the length of the stroke at a glance. The bearings are fitted with felt oilers, insuring proper lubrication. The column is rigid, with a heavy wall of metal all around, and with flanges at the bottom, where it is bolted to the base. The ram-way is fitted with a taper gib, which is adjustable for wear.

The cross-rail slides on a wide bearing on the column, is securely gibbed, and has provision for taking up wear. The swivel table is of box section, bolted to the saddle with four bolts, and may be set at any angle. It is graduated in degrees, the graduations being large enough to permit setting to a fraction of a degree. A dowel-pin locates the table at zero. The automatic feed will operate in either direction and can be adjusted to suit.



Nine-inch Shaper made by Carl Pletz & Sons

The drive is by a cone pulley mounted on a sleeve, thereby removing the belt pull from the pinion-shaft. The main bearing is bronze-bushed and provided with an oil reservoir. The vise is of heavy construction with hardened steel jaws; it has a graduated base, and can be swiveled to any angle. The standard equipment consists of a universal table, two wrenches, and countershaft. The pedestal is furnished with the machine at an extra charge.

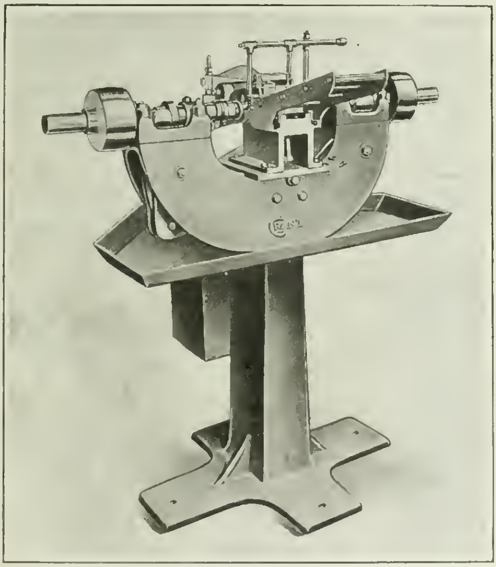
The most important specifications for the machine are: Length of stroke, 9½ inches; strokes per minute, 25 to 100;

cross-feed of table, 10½ inches; vertical feed of table, 10 inches; vertical feed of tool-head, 3 inches; table surface top, 8 by 8 inches; maximum distance from bottom of ram to table, 10¼ inches; countershaft speed, 280 revolutions per minute; weight, bench type, 535 pounds; weight, bench type, boxed for export, 635 pounds; weight with pedestal, 735 pounds; weight with pedestal, boxed for export, 850 pounds; floor space, 26 by 30 inches.

GRANT AUTOMATIC CHAMFERING MACHINE

A double-spindle automatic chamfering machine built by the Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn., was described in detail in the September number of Machinery. The accompanying illustration shows another machine of the same type but of an improved design. It is intended for performing a chamfering operation on both ends of parts. The work is placed in the inclined hopper or magazine from which it is fed by a slide mechanism to the proper machining position where it is clamped and rigidly held while the chamfering operations are being performed. The finished pieces are then automatically ejected. The hopper may be furnished to suit various kinds of work having circular, square, hexagonal, or other irregular shapes, provided an operation is to be performed on both ends.

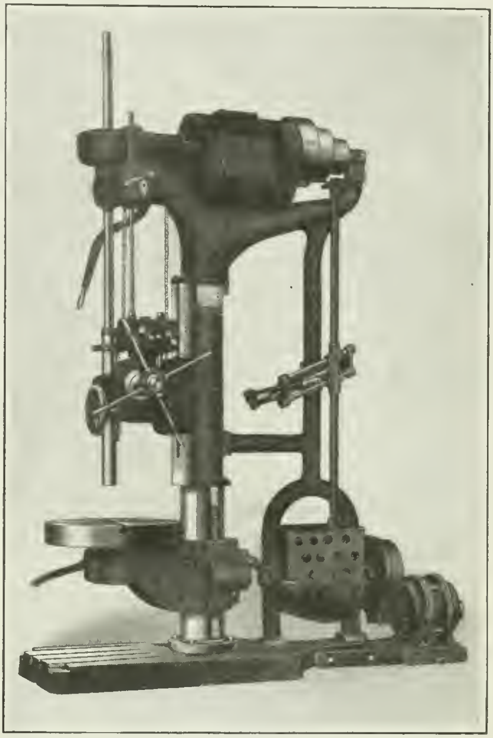
The spindle bushings have a lateral adjustment of approximately 2 inches. The spindles are fed to the work by fulcrum levers at each end of the machine which are operated by face cams. The driving pulley is placed at the rear of the machine and is provided with a roller friction clutch. The pulley shaft extends to the front of the machine and by means of worm-gearing, drives the camshaft which operates the fulcrum levers. Another set of worm-gearing operates the feeding and clamping devices. A gear-driven pump feeds cutting lubricant to the tools.



No. 183 Automatic Double-spindle Chamfering Machine built by the Grant Mfg. & Machine Co.

WEIGEL VERTICAL DRILLING MACHINE

In the October, 1917, number of Machinery, a detailed description was given of a 25-inch vertical drilling machine built by the Weigel Machine Tool Co., Peru, Ind. The accompanying illustration shows this machine with an improved type of mechanical belt shifter and a geared motor drive. The driving gear of the lower cone pulley shaft is driven from the bottom so that the motor is brought close to the base with a view to eliminating vibration. The cone pulley is guarded by a steel cover, and when a tight and loose pulley drive is furnished, the cover is adjustable to permit the belt to run at any angle.



Vertical Drilling Machine manufactured by the Weigel Machine Tool Co., equipped with an Improved Belt Shifter

The mechanical belt shifter is readily operated from the side of the machine without the necessity of the operator touching the belt. When a tight and loose pulley drive is furnished, the belt need not be shifted except when starting the machine. The spindle of the machine may be started stopped, and thrown into high or low speed by a single lever at the front of the machine. The friction back-gears are of an improved type having a double grip friction to make them as nearly positive as possible. All gearing is entirely covered to bring the machine in compliance with state laws.

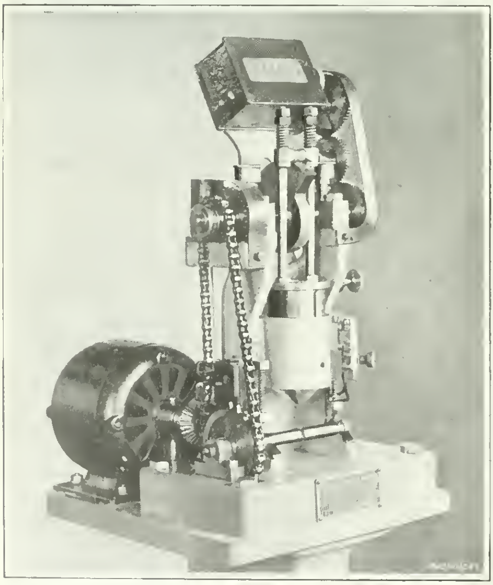
The machine can be furnished with an improved friction tapping attachment built as an integral unit. It is mounted directly on the spindle, and has a reverse motion of 2 to 1; when used in connection with the back-gears, it has a reverse of 12 to 1. Round or square tables with oil channels, or a compound table with an adjustable jack to insure rigidity, can be supplied. A cast oil-pan base having a depth of 8 inches to give ample tank capacity can also be provided.

PITTSBURG IMPACT TESTING MACHINE

In the selection of iron, steel, and alloys for parts of machine tools, automobiles, airplanes, etc., which will be subjected to continuous shocks and stresses, the material should be tested in such a way as to closely conform to actual working conditions. For the purpose of testing the elasticity and resistance to shock of such materials, the Pittsburg Instrument & Machine Co., 40 Water St., Pittsburg, Pa., has developed the continuous and alternating impact testing machine here illustrated. This machine subjects the material to a series of fatigue and impact fatigue tests in such a way that the test piece is not destroyed by one blow. The number of blows required to break a test piece are recorded on the counting device mounted at the top of the machine. Different kinds of steel vary greatly in the number of blows required to establish the breaking point, and for this reason the principle upon which the machine is based is a practical one for determining the homogeneity of the metal and its resistance to shock.

The piece to be tested should be turned to a diameter of ½ inch and have a round or sharp notch. When placed on the machine, the test piece rests on two bearings so that the ram is central with the notch. A feeding attachment revolves the specimen one-half a revolution for alternating tests, or by means of a special attachment, one twenty-fifth of a revolution for continuous tests. Alternating tests are employed for materials used in making eccentric shafts, automobile and railway axles, airplane parts, and parts used under similar conditions of service, while continuous tests are especially useful on building material.

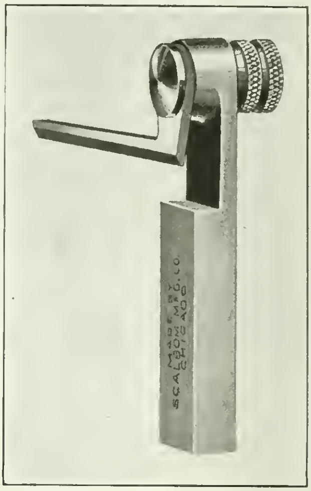
The machine is set to deliver from 85 to 100 blows per minute. The ram is of a given weight, is raised by a cam driven from an electric motor, and then released to fall on the test piece. The ram is supported by two sliding rods connected by a roller cross-piece against which the lifting cam operates. The main body casting is provided with a vertical slide for guiding the ram during the up and down movements of the latter. The ram has a hardened anvil which strikes the center of the test piece, this piece being prevented from moving sidewise by a special arrangement. As soon as the test piece breaks, the machine is stopped, because the ram drops beyond a certain point and shuts off the electric current. The number of blows required to break a test piece, of course, depends upon the quality of the material being tested, its structure and the heat-treatment that it has received.



Impact Testing Machine built by the Pittsburg Instrument & Machine Co.

SCALBOM DIE SQUARE AND BEVEL GAGE

The die square and bevel gage shown in the accompanying illustration is essentially a diemaker's tool, but it will also be found useful by toolmakers and machinists. It is made by the Scalbom Mfg. Co., 11 S. Desplaines St., Chicago, Ill. The tool consists of a body, a thin blade which can be swiveled to any desired angle relative to the axis of the body, and an arrangement for clamping the blade after it has been set. This construction renders the tool suitable for laying out angular lines on a surface at right angles to the one against which the body is held. The tool also will be found convenient for ascertaining the taper of a hole. When the blade is inserted in a hole, the recess in the body permits a view of the blade edge for its entire length. Blades of different thicknesses can be furnished. All parts are made of steel, and are hardened and ground.



Die Square and Bevel Gage made by the Scalbom Mfg. Co.

NEW MACHINERY AND TOOLS NOTES

Crane: New Jersey Foundry & Machine Co., 90 West St., New York City. A hand type traveling crane developed to facilitate handling molding machine and pouring work in foundries or work of a similar nature.

Torch-burner: Clayton & Lambert Mfg. Co., 1371 Beaubien St., Detroit, Mich. A double needle-point burner, designed to burn low-grade gasoline or kerosene or a mixture of both. This burner is supplied with torches made in quart, pint, and two-quart capacities.

Box-tool for Screw Machines: Cruban Machine & Steel Corporation, 63 Duane St., New York City. A box-tool for use on screw machines, known as the "Micro," which is provided with a 1-inch shank and is adapted for handling bar stock up to 1 inch in diameter. Micrometer adjustment, reading to thousandths of an inch, is provided for adjusting the tool. The work can be guided by V-guides or bushings.

Combination Boring Machine: K. R. Wilson, 10-16 Lock St., Buffalo, N. Y. A machine intended for work on automotive engine cylinder blocks and crankcases. It serves as a motor bench for holding the motor while assembling, grinding valves, or babbitting bearings, and is adapted for boring, reaming, and running-in main bearings. A belt-driven head and work-holding carriage are provided for boring cylinders and similar work.

Industrial Tractor: Reliance Trailer & Truck Co., Inc., 30 Eighth St., San Francisco, Cal. A gasoline motor-driven industrial tractor of practically all-steel construction which can be used for either pushing or towing. The truck is capable of carrying two tons. The over-all length is 6 feet 6 inches, and the over-all width 50 inches. The tractor will turn in a circle 12 feet in diameter, and will tow a 5- to 6-ton load; heavier loads can be drawn by placing ballast under the box seat.

Disk Sander: Syracuse Sander Mfg. Co., Inc., Syracuse, N. Y. A motor-driven portable disk sander especially adapted for use in pattern shops and woodworking shops. The machine is also adapted for handling light work in a machine shop, such as grinding small metal parts, especially those of brass and aluminum. Garnet paper disks are used for wood work and emery cloth disks for metal work. The table can be adjusted to 45 degrees below the horizontal, and 15 degrees above.

Pocket Calculator: Small, Small & Co., Waltham, Mass. A pocket calculator intended primarily for performing such calculations as are ordinarily performed on a slide-rule. It consists essentially of a 6-inch logarithmic slide-rule with the scales bent into a circle so as to form a compact instrument. The calculator is made in two models; the No. 1 has the ordinary slide-rule scales, while the No. 2, which is intended for architects and structural engineers, has scales for determining the strength of steel and wooden beams.

Die-heads: Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. Several new sizes of the H. & G. line of self-opening die-heads. The new sizes include 2½- and 3-inch Style A die-heads, with capacities of 1½ to 2½ inches, and of 2 to 3 inches, respectively, which are for use on automatic screw machines. The new products also include 2-, 2½-, and 3-inch Style C die-heads having a total range of from 1 to 3 inches, which are intended for use on turret lathes where the die-head does not rotate. Another die-head intended for use on Brown & Sharpe machines is made in a 7/16-inch size.

PERSONALS

Eugene F. Fagan, formerly general superintendent of the Federal Electric Co. and subsidiaries, Chicago, Ill., has become associated with the Lyon Metallic Mfg. Co. of Aurora, Ill., in the capacity of purchasing agent.

Donald S. Michelson, who became general manager of the Globe Machine & Stamping Co., Cleveland, Ohio, in September, 1920, was elected president of the company at the annual meeting held on February 1.

Charles H. Richards, formerly with the Remington Arms, Inc., has been appointed general manager of the Warren F. Fraser Co., of Westboro, Mass., manufacturer of semi-automatic and full automatic universal and plain grinders.

Joseph L. Holstein, formerly salesman for the National Tool Co., Cleveland, Ohio, has joined the selling force of the Shields Cutter Co., Cleveland, Ohio, and will cover the northern sections of the states of Indiana, Ohio, and New York.

Dyer Smith, at one time assistant editor of Machinery, has associated himself with S. Mortimer Ward, Jr., and Gorham Crosby, under the firm name of Ward, Crosby & Smith, to engage in the practice of patent and trademark law, with offices at 233 Broadway, New York City.

S. T. Thompson, purchasing agent of the Duplex Engine Governor Co., Inc., Brooklyn, N. Y., has been made director of sales of the company. The vacancy left by Mr. Thompson has been filled by C. F. Guttzeit, who was formerly assistant purchasing agent. The Duplex Engine Governor Co., Inc., manufactures the "Duplex" and "Simplex" governors for internal combustion engines.

George C. Winchel, for several years associated with various Cleveland and Akron industries as special machine designer and engineer, and for two years experimental engineer for the B. F. Goodrich Co., has opened offices at 304 Everett Bldg., Akron, Ohio, as a designing engineer of special, automatic, and production machinery, including general plant lay-out and design.

Robert M. Eames has been appointed general sales manager of the Bryant Electric Co., Bridgeport, Conn., to fill the vacancy made by the resignation of Frank V. Burton. Mr. Eames has been active in the sales organization of the company for fifteen years, and for several years has been its export manager. He is thoroughly familiar with the sales policy as well as with the complete line.

Robert M. Carter has joined the Kempsmith Mfg. Co., Milwaukee, Wis., as manager of sales. Mr. Carter has had a wide experience in the machine tool line, having been connected with the Gisholt Machine Co. of Madison, Wis., and more recently with the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., as manager of sales. He succeeds Peter Lowe, who has resigned due to illness.

George Lahusen, Jr., formerly of the E. L. Essley Machinery Co., Chicago, Ill., has become associated with the Badger-Packard Machinery Co. of Milwaukee, Wis., representing the company in the southern Wisconsin territory. Mr. Lahusen has had extensive experience in the machine tool industry at Cincinnati, and for several years has been traveling regularly through the southern Wisconsin territory for the E. L. Essley Machinery Co.

George J. Blanton, who for the last four years has been connected with the engineering sales department of Chain Belt Co., Milwaukee, has been made New York district manager, with headquarters at 50 Church St., New York City. Before joining the company in 1917, he was associated with the General Electric Co. for eight years, three years of which were spent in Schenectady, N. Y., and the other five in the Milwaukee office. Mr. Blanton has had a wide experience in engineering sales work and has comprehensive practical knowledge of the chain industry.

Lawrence Wilkerson Wallace was elected secretary of the American Engineering Council at the meeting of the executive board in Syracuse, N. Y., on February 14, succeeding L. P. Alford of New York, who has been acting secretary since the formation of the council in Washington on November 19, 1920. Mr. Wallace was born in Austin, Texas, August 5, 1881. He was graduated from the Agricultural and Mechanical College of Texas in 1903 with the degree of B.S. in Mechanical Engineering. In 1912 he received the degree of M.E. from Purdue University. From 1903 to 1906 he served a special apprenticeship with the Santa Fé Railway Co., and was a member of the Purdue faculty during 1906-1907 becoming head of the department of railway and industrial management. Mr. Wallace also brings to the secretaryship of the council the experience of a manufacturing executive. He was formerly assistant general manager in charge of production of the Diamond Chain & Mfg. Co. of Indianapolis, and more recently was director of the Red Cross Institute for the Blind in Baltimore, which provided vocational training to the blinded men of the military forces.

OBITUARIES

Melville P. Hayward, for some time assistant purchasing agent at the plant of the American Bosch Magneto Corporation, Springfield, Mass., died in Springfield after a short illness from pneumonia, on January 4.

George R. Randolph, Pittsburg sales representative of the Warner & Swasey Co., Cleveland, Ohio, died February 3, aged twenty-six. Mr. Randolph had been in the Pittsburg district only about seven months, but had been associated with the Warner & Swasey Co. for six years.

* * *

PROPOSED WORK FOR FEDERATED AMERICAN ENGINEERING SOCIETIES

The Federated American Engineering Societies is now actively at work furthering the purposes for which it was formed. The committee on plan and scope made a report and proposed that subjects for consideration for the American Engineering Council may be initiated by either the board itself or by outside sources. The committee also proposed the following topics as coming within the present scope of the work of the Federated Engineering Societies: (1) To serve the public interest by investigation and advice to all public governmental and voluntary bodies dealing with national economic problems; (2) department of public works; (3) conservation of national resources; (4) cooperation with other national organizations—technical, industrial, and commercial; (5) technical education; (6) transportation, particularly highways; (7) advice to state, regional, and local societies; (8) national bureau of economic research; (9) public fire protection; (10) patents; (11) national board of jurisdictional awards; (12) international affiliation of engineers; (13) state organization of local affiliations; (14) licensing professional engineers; (15) classification and compensation of engineers; and (16) engineering societies' service bureau.

* * *

CHINA ESTABLISHES TRADE SCHOOLS

A model trade school has been organized by the inauguration of a method of cooperation between the Chinese Government Normal School at Peking and the Peking University. China is coming to realize, as other nations have done, that industrial progress requires technical training, and that modern industries can be established only by the development of skill and knowledge. In 1918 a trade school was opened in Shanghai, and this school has proved so successful that arrangements have been made for the establishment of similar schools in other sections of the empire. The Shanghai school is said to be run on such thoroughly modern lines that it would be a credit to any American city. Many American educators have been active in the establishment of these Chinese industrial schools, and there is no doubt that it would greatly benefit American industries, especially in the machine-building fields, if the efforts being made to educate the Chinese along industrial lines were actively aided from the United States.

BROWN & SHARPE
FOR HEAVY

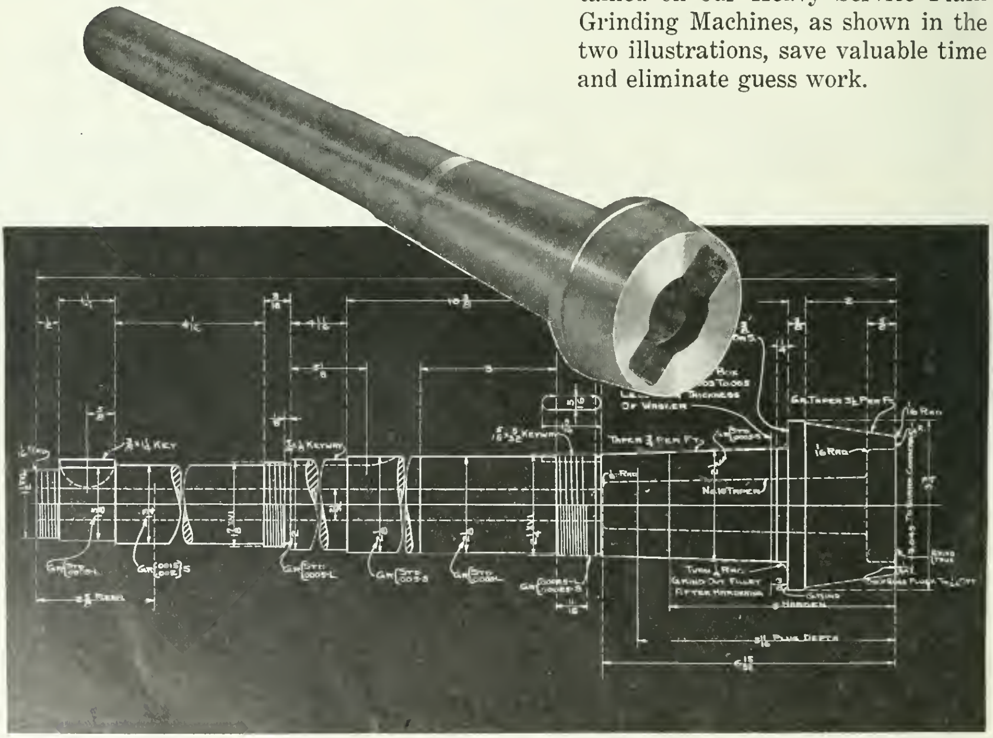
Changing Work Speeds

The wide range and complete separation of speeds and feeds on

BROWN & SHARPE
Plain Grinding Machines

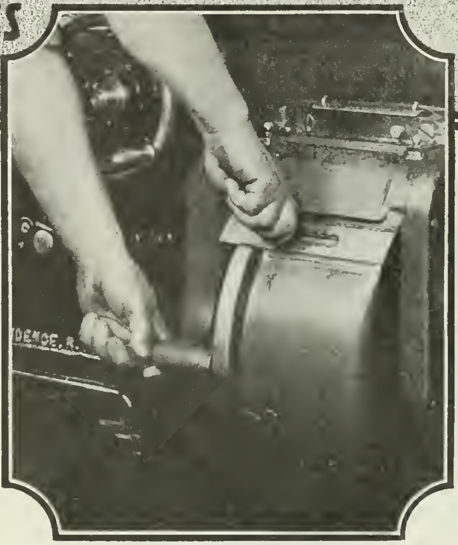
provide a combination that will assure any desired result as to finish or rate of production.

The remarkable ease and simplicity with which speeds and feeds are obtained on our Heavy Service Plain Grinding Machines, as shown in the two illustrations, save valuable time and eliminate guess work.



BROWN & SHARPE MFG. CO.

PLAIN GRINDING MACHINES SERVICE



Changing Table Feeds

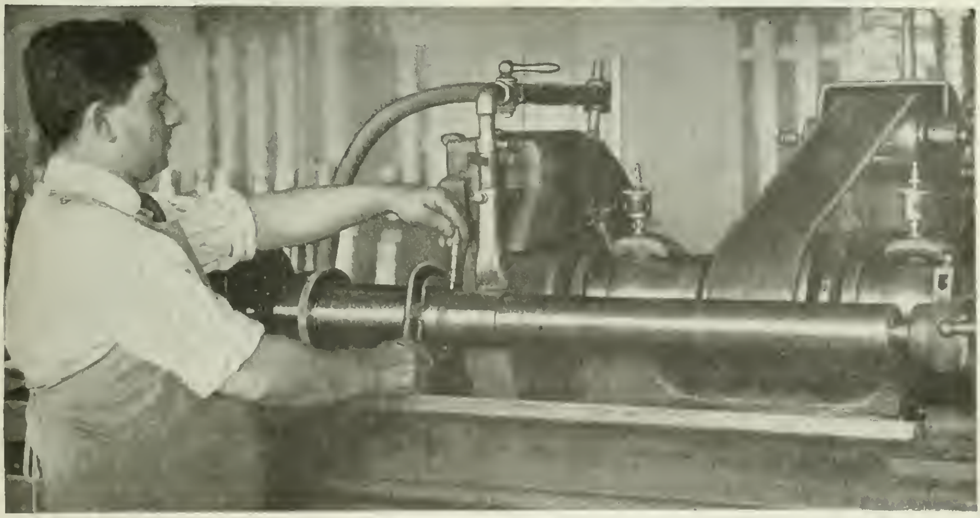
The grinding of the spindle shown in the illustrations is adequately taken care of by

BROWN & SHARPE

Plain Grinding Machines

The speed and accuracy with which the pieces are produced instantly appeal to both the operator and the production man. Work of large or small diameter, straight or taper grinding is all the same to the operator of one of these machines.

Send for Catalog 137, describing our complete line.



PROVIDENCE, R. I., U. S. A.

MACHINING STEERING ARMS ON DANIELS AUTOMATICS

To provide for the rapid performance of turning, facing, threading, drilling, boring, reaming, tapping, and other similar operations on parts that are to be made in sufficiently large quantities so that an investment in a fairly complex set of tools is fully justified by the economies that are made possible through their use, the McDonough Mfg. Co., 1500-1600 Galloway St., Eau Claire, Wis., has recently developed the Daniels vertical automatic chucking machine. In Figs. 1 and 2 this equipment is illustrated engaged upon the performance of a combination straight and taper turning and threading operation on two types of steering arms for use in motor cars built by the Olds Motor Works, in Lansing, Mich.

It will be seen that the two pieces which are handled on these machines are of the same design, in so far as the end to be machined is concerned. This consists of a tapered bearing with a straight threaded fit at the end of it. The portion of the work below this machined section differs in the two types of arms which will be seen hanging in two groups on the oil-pan of the machine. Each type of arm is held for machining by a special vise of suitable design, which is furnished with a set of vertical jaws that hold the end to be machined in place under the spindle, while the other end of the work is gripped between a pair of auxiliary jaws to secure it in a permanent position.

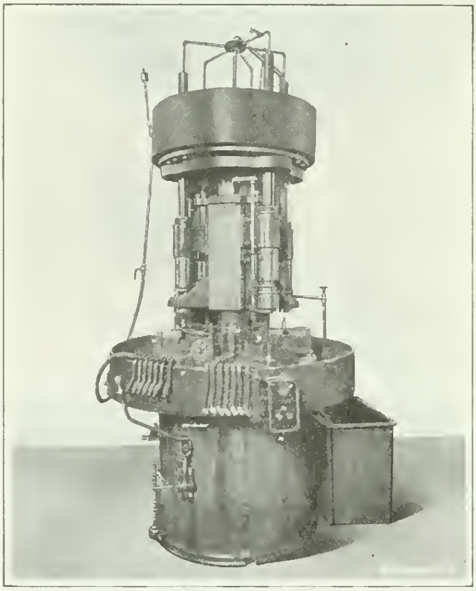


Fig. 1. Daniels Vertical Automatic Chucking Machine built by the McDonough Mfg. Co. and equipped for machining Two Types of Steering Arms

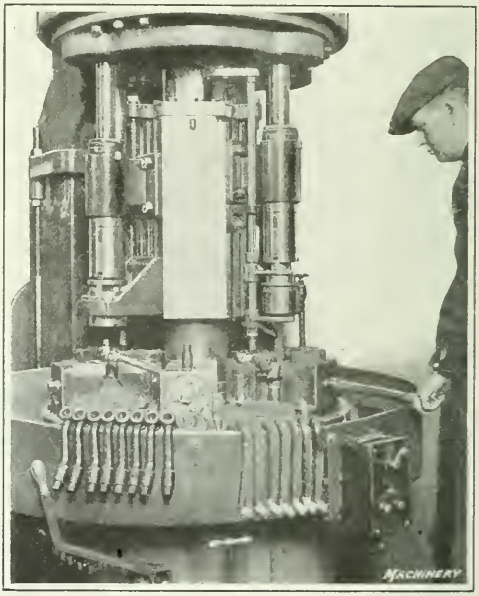


Fig. 2. Close-up View of the Daniels Vertical Automatic Chucking Machine showing more clearly the Arrangement of the Tools and Fixtures

On the Daniels vertical automatic chucking machine, there are five spindles by which a sequence of cutting tools is carried. Distributed around the table, there are six stations, five of which provide for holding the work beneath the spindles, so that five forgings may be simultaneously machined; and while this work is in progress, the operator's time is occupied in removing a finished piece and setting up a fresh forging at the sixth or so-called "loading" station. It will be evident that this machine works on the progressive principle, so that every time the table is indexed, each piece of work is brought into place under a tool which performs an operation that brings it one step closer to the finished condition. Such being the case, it will be apparent that one finished piece is obtained for each table movement.

In machining these steering arms, the sequence of operations performed is as follows: Station No. 1, load; station No. 2, rough-turn the thread fit and half way down the taper; station No. 3, rough-turn the remainder of the taper; station No. 4, finish-turn the thread fit; station No. 5, finish-turn the taper; station No. 6, cut the thread. It will be apparent that suitable box-tools are used on four of the spindles to provide for handling the rough- and finish-turning operations, while a self-opening die-head made by the Murchey Machine & Tool Co., of Detroit, Mich., is furnished on the fifth spindle to enable the thread to be cut on the work. Following the usual procedure, this die-head opens automatically after completing its operation, so that it may be withdrawn by simply raising the spindle without reversing the direction of rotation.

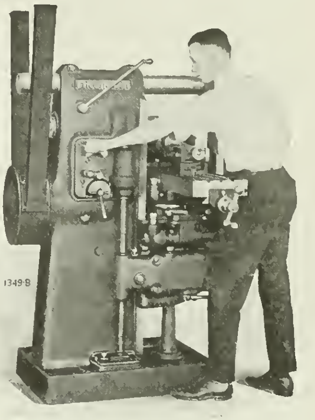
There are two of these Daniels vertical automatic chucking machines in operation in the Olds Motor Works, and mention has already been made of the fact that they are engaged in the machining of two different types of steering arms. Each machine is equipped with four fixtures for holding one type of arm and two fixtures for holding the other type, because there is a demand for twice as many pieces of one kind as there is of the other. Such a method of equipping the machines is satisfactory, owing to the fact that although the work is of two different kinds, the shape and size of the ends of the arms that have to be machined are identical. While operating on both of these, the rate of production is 120 pieces per hour per machine equaling with two machines and two men, the production previously obtained from twelve machines and twelve operators.

* * *

An effort is made in Brazil to develop both the coal mining and the steel industry of the country to a point where it may become of national importance, and to this end the Brazilian Congress is considering the payment of subsidies to the steel industry as well as to the coal mining companies for a period of three years.

Without Leaving His Position

The operator can start the
machine—
Change the feeds—
Change the speeds—and
Stop the machine—
When working on



The operator can usually reach the speed change levers without leaving his position. The belt is guarded 6 feet above the floor. This meets the usual factory safety requirements.

Plain, Universal or Vertical

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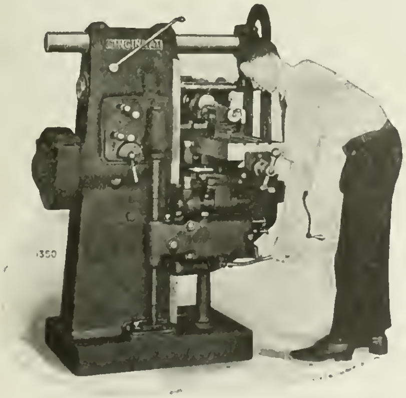

Feed changes are all made at the front of the machine from the operator's normal position.

They are handy, compact, durable machines with unusual strength and power for their size.

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THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI, OHIO, U. S. A.

COMING EVENTS

March 10—Annual exhibit of the evening work of the students at Pratt Institute, held in the School of Science and Technology of the institute from 7:30 to 9:30 in the evening.

April 18-21—Convention of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples Gas Bldg., Chicago, Ill.

April 27-29—Convention of the Society of Industrial Engineers in Milwaukee, Wis. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel.

May 23-26—Spring meeting of the American Society of Mechanical Engineers in Chicago, Ill.; headquarters, Congress Hotel. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

The March sectional meetings of the American Society of Mechanical Engineers are as follows: **March 4**—Metropolitan Section at the Robert Treat Hotel, Newark, N. J.; **March 10**—Tricities Section at the Rock Island Chamber of Commerce, Rock Island, Ill.; **March 14**—Waterbury Section at Waterbury, Conn.; **March 17**—Bridgeport Section in the Chamber of Commerce Rooms, Bridgeport, Conn.; **March 17**—Toledo Section at the plant of the Toledo Railways & Light Co., Toledo, Ohio; **March 22**—Atlanta Section at the Carnegie Library, Atlanta, Ga.; **March 22**—Baltimore Section at the Engineers' Club, Baltimore, Md.; **March 22**—Philadelphia Section at the Engineers' Club, Philadelphia, Pa.; **March 25**—Colorado Section at the Metropole Hotel, Denver, Colo.; **March 25**—Metropolitan Section in the Engineering Societies' Building, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

Human Engineering. By Richard H. Mulliner. 367 pages, 5 by 7 inches. Published by Mulliner Bros., Syracuse, N. Y. Price, $5.

The author presents in the present work what is termed a text-book for manufacturing and business engineers, designed, as stated in the preface, for the development of man and business. The book makes a special plea for idealism in business and engineering education, and in business life. It is largely made up of quotations from noted writers and from statesmen. The author, who is a member of the American Society of Mechanical Engineers and president of Mulliner Bros., consulting engineers, makes a comparison between the action of the mind and the properties of the electric current. The book is divided into fourteen chapters, as follows: Miracles of Nature; History of the Mind; The Brains and Nervous System; The Mind Generators; The Mind Degenerators; The Mind Faculties; The Individualistic Predominating Mind Faculties; Human Engineering; Direct Mind Engineers; Alternating Mind Engineers; Mind Cultivation; Mind Studies for Manufacturing and Business Engineers; Electrical Facts; and Incidences in the Formation of Human Society.

Smithing and Forging. By Joseph G. Horner. 222 pages, 5½ by 8½ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 8s. 6d., net.

This book deals with present-day methods of forging by hand and by machine. The subject matter is of wide scope, including hand methods, those associated with the use of dies under power hammers, and of squeezing machines, with the numerous appliances that are necessary for the performance of the various operations. In addition, attention is given to the methods of heating, covering such points as fuels, kinds of furnaces, temperature regulation, measurement of temperature, etc., the last chapter being devoted to the subject of heat-treatment. The text is illustrated with line drawings wherever they are needed to clarify the description. The book contains eleven chapters, and an idea of the contents will be gained from the following list of headings: The Shop and its Equipment; the Tools and Appliances; the Operations; Examples of Anvil Work; Examples of Stamped Work; the Forms of Dies; Stamping under the Steam Hammer; Drop-hammer Work; the Work of Forging Machines; Methods of Heating-furnaces; and Heat-treatment.

Water Power Engineering. By Frank F. Fergusson. 116 pages, 4 by 6½ inches. Published by Isaac Pitman & Sons, 2 W. 45th St., New York City. Price, $1.

This book, which is one of a series known as Pitman's Technical Primer Series, treats of the basic principles of water power engineering, describing types of water turbines, their applications and operation. Fundamental formulas relating to water power engineering are developed, and examples are included from practice. No claim is made for originality in the present work, but the aim has been to give a more concise and orderly presentation of the data than has hitherto been available for students. The book is elementary in its treatment, and covers the theory, selection, design, and operation of water turbines, with brief reference to their principal accessories. The material is divided into seven chapters headed as follows: Types of Turbines and their Applications; The Turbine Runner (Francis Type) and the Theory of its Design; Specific Speed—Conditions in the Turbine Runner—Formulas and Constants; Pelton Wheels; Water Velocities in Hydro-electric Plants; the Pipe Line, and Regulation of Speed and Pressure Rise.

Crain's Market Data Book and Directory of Class, Trade, and Technical Publications. 462 pages, 6 by 9 inches. Published by G. D. Crain, Jr., 417 S. Dearborn St., Chicago, Ill. Price, $5.

This is the first edition of this work, which comprises a market data book and a directory of publications in the United States and Canada. It is unique in that it forms a reference book for advertisers, containing basic information regarding each trade, industry, and profession, as well as a list of special publications devoted to each industry. The book is intended to give an idea of the characteristics, extent, and possibilities of markets in the different fields, as well as a knowledge of the specific mediums through which the buyers in the fields may be reached. The list of publications gives the circulation, subscription price, size of type page, advertising page rates, frequency of publication and closing dates, as well as agency or cash discount when allowed. There are two general indexes, the first being an index of classification of the trades and industries analyzed in the text pages, and the second an alphabetical list of all the publications about which information is presented. Canadian publications are indexed separately.

Labor Maintenance. By Daniel Bloomfield. 530 pages, 5½ by 8½ inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $5.

This book is intended to fill the need for a handbook of employes' service work. As the author is a consultant in employment management and industrial relations, his experience enables him to give definite suggestions along these lines. The book deals extensively with industrial housing plans, financial aids, and other welfare systems. The aim throughout has been to give as many practical examples of successful work as possible, so that employers, employment executives, and service workers will have at hand the experience of other concerns, combined with information and discussion as to the best practices. The organization and function of a service department are outlined, and the subject of training the workers is discussed, several training systems that have been in successful operation being described in this connection. The problem of Americanization is considered, and health, sanitation, recreation, and safety work receive attention. Such important subjects as housing, and financial aids, including mutual benefit associations, group insurance, and profit-sharing systems are adequately treated.

How to Keep Invention Records. By Harry A. Toulmin. 85 pages, 5½ by 8 inches. Published by D. Appleton & Co., 35 W. 32nd St., New York City. Price, $2.

This book emphasizes the grave necessity of keeping adequate records of inventions. The author's experience as a patent counsel points to the fact that when proof of the prior right of a party can be produced in readily available form, much litigation can be avoided. Where litigation cannot be avoided, thousands of dollars are lost annually by the failure of inventors and their assistants to keep proper records of their inventions, their development and reduction to practice, and early commercial history. This experience is unnecessary if records are kept of the essential steps and their dates in connection with inventions. It is the purpose of this book to show how such records can be kept. In the first part of the book, the general nature of industrial property and monopolies granted to protect it are discussed; this section covers patents, trademarks, labels, prints, copyrights, and foreign protection. The second chapter gives a series of a dozen forms for recording the dates and other necessary data relating to inventions, as well as instructions for making the entries. The final chapter treats of the methods of patent investigations.

The Slide-rule. By C. N. Pickworth. 132 pages, 5 by 7 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City and by Emmott & Co., Ltd., 20 Bedford St., W.C., London, England. Price, $1.50.

This is the seventeenth edition of a work treating of the construction and use of the slide-rule. The new edition contains some slight revisions and a description of new types of slide-rules. The book contains a brief resume of the principles of logarithmic calculation on which the slide-rule is based. It describes the mathematical and mechanical principles of the slide-rule and gives an outline of the development of the modern slide-rule from the primitive type. A detailed description of the slide-rule is given, as well as instructions for using it on the following operations: Multiplication, division, proportion, finding squares and square roots, cubes and cube roots, miscellaneous powers and roots, trigonometrical application and special calculations. One section of the book gives examples of technical calculations made by use of the slide-rule, such as finding the velocity in feet per second of a falling body, finding the centrifugal force of a revolving mass, finding the piston speed of steam engines, etc. A number of special types of slide-rules are also described. The appendix contains descriptions of new types of slide-rules, solution of algebraic equations, screw-cutting gear calculations, and gage points and signs on slide-rules.

Training Industrial Workers. By Roy Willmarth Kelly. 437 pages, 5½ by 8½ inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $5.

The author of this book is manager of industrial relations of the Associated Oil Co. of California, and the subject matter is therefore based on actual experience in training labor, as well as on visits which the author has made to business concerns and schools in many different parts of the United States, numerous conferences with employment managers and school officers, and experience gained as principal of a technical high school and director of part-time courses in employment management. The book describes and explains vocational education, specialized work, apprenticeship, rating systems, and many other problems relating to the training of industrial workers. It points out the great need for industrial training at the present time, and shows the economic and social losses resulting from lack of this training. Successful accomplishments in vocational education are reviewed and reasons for their success are given. The volume presents a survey of various types of schools and classes, and gives illustrations of their work. Emphasis has been laid upon training which can be accomplished within plant and cooperative schools, minor attention being given to continuation schools and trade schools. A chapter is devoted to the educational value of democratic participation in management, in which are discussed such points as collective bargaining, employe representation, cooperative activities, etc.

Heat Engines. By D. A. Low. 592 pages, 6 by 9 inches; 656 illustrations. Published by Longmans, Green & Co., Fourth Ave. and 30th St., New York City. Price, $6.50, net.

The subject of heat engines embraces a wide field and it would not be possible to cover the whole ground adequately in a single volume. The author has attempted in the present work to present sufficient material for a two years' course in the subject. The text has been written on the assumption that the student will spend considerable time in working out the numerous exercises which are given. An attempt has been made to combine the theoretical and practical sides of the subject, but attention is called to the fact that it is necessary for the student to supplement the material presented with practical experience and a knowledge of the details of construction of heat engines and their accessories. Such experience can, of course, be gained in the engineering laboratories of schools and colleges. The material is presented in twenty-four chapters covering the following subjects: Heat and Work; Expansion and Compression of Gases; Properties of Steam; Ideal Heat Engine Cycles; Combustion and Fuel; Steam Boilers; Steam Boiler Details; Steam Boiler Mountings; Steam Boiler Accessories; Natural and Artificial Draft; Performance of Steam Boilers; Reciprocating Steam Engines; Reciprocating Steam Engine Details; Hypothetical Indicator Diagram Problems; Indicators and Indicator Diagrams; Crank Effort Diagrams and Flywheels; Governors; Valves and Valve Gears; Performance of Reciprocating Engines; Steam Turbines; Condensers and Air Pumps; Internal Combustion Engines; Theory of Internal Combustion Engines; and Performance of Internal Combustion Engines.

Elements of Mechanism. By Peter Schwamb, Allyne L. Merrill, and Walter H. James. 372 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.50.

The main material of this work which is now in its third edition, was written in 1885 by Peter Schwamb, and has been in use since that time in the Massachusetts Institute of Technology, as a basis for instruction in mechanism. Professor James, who has charge of the instruction in mechanical engineering drawing and machine drawing at the institute and who has also been an instructor in mechanism for many years, has had charge of the present revision of the book. The revised edition embodies many changes suggested by instructors who have made use of the second edition during the last sixteen years. The subject matter is not original, having, of course, been covered by previous writers, but a careful selection has been made of the most essential material, and the aim has been to present it in a systematic, clear, and practical manner. The last section of the book contains 152 problems

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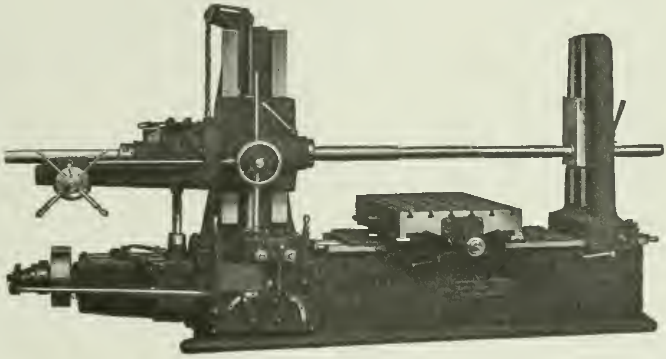

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for the student to work out in order to gain a more comprehensive idea of the principles expounded. The following chapter headings will give an idea of the points covered: Revolving and Oscillating Bodies; Belt, Ropes, and Chains; Transmission of Motion by Bodies in Pure Rolling Contact; Gears and Gear Teeth; Wheels in Trains; Epicyclic Gear Trains; Inclined Plane, Wedge, Screw, Worm and Wheel; Four-bar Linkage—Relative Velocities of Rigidly Connected Points; Linkwork; Straight-line Mechanisms—Parallel Motions; Miscellaneous Mechanisms—Aggregate Combinations—Pulley Blocks—Intermittent Motion; Problems.

NEW CATALOGUES AND CIRCULARS

Monarch Machine Tool Co., 109 Oak St., Sidney, Ohio. Circular containing illustrations and specifications for Monarch 10-, 12-, 14-, 16-, 18-, 20-, 24-, 26-, 28-, and 30-inch engine lathes.

Nicholson Power Devices Co., 28 N. Clinton St., Chicago, Ill. Circular descriptive of Nicholson steam engines; internal combustion motors; and air motors, pneumatic tools and pumps.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular giving dimensions of Cleveland rivet sets made in the following types: Button head, steeple head, pan head, Liverpool, and flush rivet sets.

Scalbom Mfg. Co., 11 S. Desplaines St., Chicago, Ill. Circular showing a die square and bevel gage for the use of diemakers and toolmakers in such work as transferring angles or taper holes.

United States Blue Print Paper Co., Inc., 327 S. La Salle St., Chicago, Ill. Circular showing a number of the drawing instruments of the Richter line, including compasses, dividers, drawing pens, etc.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating installations of Ingersoll drum type continuous milling machines, which have been made to meet special intensive production problems.

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Circular containing specifications and a list of special features of the Giddings & Lewis No. 25 horizontal boring, drilling and milling machine of the table type.

Dyneto Electric Corporation, Syracuse, N. Y. Pamphlet illustrating and describing the Dyneto Type UM-D "Utility" motor, having a rating of ¼ horsepower, for operation on a 32-volt current, at 350 to 2000 revolutions per minute.

Pittsburg Instrument & Machine Co., 40 Water St., Pittsburg, Pa. Pamphlet descriptive of a continuous and alternating impact testing machine for use in testing airplane, automobile, and other machine parts that are exposed to shock.

O. K. Clutch Machinery Co., Columbia, Pa. Circular containing descriptive matter, tables of dimensions, and price lists of O. K. friction clutch pulleys for gasoline and oil engines, O. K. friction clutches, and O. K. cut-off couplings.

Norton Co., Worcester, Mass. Catalogue of Norton alundum and crystolon refractories for scientific and industrial work. The booklet gives data concerning the properties of alundum and crystolon, and contains tables of dimensions, prices, etc.

Whiting Corporation, Harvey, Ill. Catalogue 156, illustrating and describing the construction of "helical-worm" geared crane ladles, truck ladles, and other types of foundry ladles made by this company. Copies of the catalogue will be sent upon request.

Wagner Electric Mfg. Co., St. Louis, Mo. Bulletin 124, descriptive of Wagner instrument transformers for application to switchboards and other alternating-current instruments. Bulletin 125, of Wagner single-phase motors, containing instructions for ordering and adjusting repair parts.

Frontier Machine Tool Co., Inc., Buffalo, N. Y. Catalogue illustrating and describing the Frontier "Super-drill," which is equipped for either belt or motor drive and has a swing of 20 inches. The pamphlet also gives specifications for the Frontier power hacksaw machine and tool grinder.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Booklet 850, treating of Cutler-Hammer shoe brakes for direct- and alternating-current service. Tables give dimensions and ratings of each type of brake, and it is explained how the correct size of brake for any particular installation may be calculated

Diamond Machine Co., Providence, R. I. Catalogue of the Diamond surface grinding machine, containing a large number of illustrations showing typical examples of work for which this machine is adapted, and giving information concerning the materials, grinding times, limits of accuracy, etc.

Firth-Sterling Steel Co., 310 Hudson St., New York City, manufacturer of "Blue Chip" high-speed steel and other tool and die steels, is distributing a card showing heat-treatment colors and the approximate temperatures at which they appear. The back of the card contains a decimal equivalent table.

Crouse-Hinds Co., Syracuse, N. Y. Circular showing installations of conduit outlets known as "Condulets," which are made in a number of types for a wide variety of uses. These "Condulets" are equipped with covers designed to protect push-button switches against vapor, gas, dust, moisture, etc.

N. B. Payne & Co., 25 Church St., New York City. Circular of material-handling machinery, including overhead electric cranes and hoists, portable elevators, conveyors, pilers, and car loaders, showing twenty-seven views illustrative of the labor-saving possibilities of these different types of equipment.

Miller & Crowningshield, Greenfield, Mass. Circular containing description and specifications for Miller & Crowningshield multiple-spindle index-centers, used for production work in fluting and squaring taps, reamers, etc. The various centers for fluting and squaring index-heads are shown in diagrammatic form.

Neil & Smith Electric Tool Co., Cincinnati, Ohio. Drill bulletin No. 9, giving specifications for the different sizes and types of universal current single- and two-speed portable electric drills, and single- and two-speed direct-current drills. Several portable grinders and grinding attachments are also illustrated.

Northern Engineering Works, Detroit, Mich. Catalogue 28, containing views of a large number of installations of Northern electric traveling cranes, bridge and gantry cranes, and other electric, pneumatic, and hand power types of cranes. Several types of electric crane trolleys and electric traveling cranes are illustrated and described.

Gould & Eberhardt, Newark, N. J. Bulletin 78, illustrating the use of Gould & Eberhardt shapers in railroad shops. The circular shows several views of these machines engaged on typical railroad shop work, and gives a list of special features of the high-duty 16-, 20-, and 24-inch shapers and "Invincible" 28-inch shapers, which are made with either belt or motor drive.

Tem-Pro Steel Co., Plymouth Bldg., Cleveland, Ohio. Booklet treating of "Tem-pro" compound—a patented compound for use in hardening high-speed and carbon steels. The book treats of the characteristics of the compound, and contains suggestions for treating high-speed and carbon tool steels, as well as directions for using "Tem-pro" compound in hardening both high-speed and carbon tool steels.

Hanson Clutch & Machinery Co., Tiffin, Ohio. Catalogue C-3 of Hanson friction clutches. The booklet shows applications of this type of clutch to meet different conditions of speed and other requirements of machine design and transmission of power. Tables are given listing the dimensions of the different sizes, their horsepower, weights, etc. Dimensions and other data are also given for Hanson countershafts, countershaft clutch pulleys, and machine clutches.

Frank D. Chase Co., Inc., Chicago, Ill. Booklet entitled "Factories that Fit," illustrating forty representative plants in various parts of the country designed by this company. The purpose of the book is to show the manufacturer the necessity of having his plant so fitted to the work it is to do that the processes of manufacture can be accomplished in an orderly fashion and with the least labor cost. Copies will be sent upon request.

W. B. Knight Machinery Co., St. Louis, Mo. Circular entitled "What Others Think of Knight Millers," illustrating the No. 3 Knight milling and drilling machine, and showing its application for tool and die work, pattern work, and production manufacturing work. The pamphlet contains facts concerning the actual operation of this machine in various plants, information being given concerning the work accomplished and the production attained.

Stanley Belting Corporation, Department A, S. Clinton St., Chicago, Ill. Booklet entitled "A Saving for Every User of Belting," treating of the characteristics of Stanley solid woven cotton belting. A list of typical installations for which this type of belting is especially well adapted is given, and its use on different classes of machines is illustrated. Figures are also given covering tensile strength for single, double and triple belts running at from 200 to 5000 feet per minute.

Davis-Bournonville Co., Jersey City, N. J. Pamphlet containing a paper entitled, "Oxy-acetylene Welding on Refrigerating Apparatus," by Fred E. Rogers, read before the December meeting of the American Society of Refrigerating Engineers. The paper describes the use of the oxy-acetylene welding process in making refrigerating apparatus, giving information on preparing work for welding, manipulation of torch and welding rod, penetration, reinforcement of welds, etc.

Smalley-General Co., Bay City, Mich. Circular illustrating the Smalley-General No. 23 hollow-spindle thread and form milling machine, designed for milling either internal or external, right- or left-hand, straight or taper, single or multiple threads of any form. Leaflet containing twelve time studies of jobs performed on Smalley-General thread milling machines, giving data relating to the material operated upon, dimensions of part being machined, time, etc.

Skelton Tool Co., Syracuse, N. Y., manufacturer of reamers and special tools, has issued a catalogue describing taper reaming tools, including the Skelton patent roughing reamers, helical finishing reamers, taper pin reamers, and bridge reamers. The catalogue explains the new method of taper-reaming made possible by the Skelton taper reamers, and contains instructions for grinding helical reamers and roughing reamers. The reamers described are new departures in reaming practice and have proved very efficient as production tools.

National Tube Co., Pittsburg, Pa. Bulletin 150, devoted to the use of National pipe in the oil industry, as casing for oil, gas, water, etc. The book gives a brief outline of the development of well sinking from the earliest period, discusses improvements in drilling equipment and modern drilling methods, and contains an article on the rotary method of well-drilling. The advantages of National pipe for drilling purposes are listed, and information is given on the characteristics of National pipe, threading operations, construction of joints, etc.

McCrosky Tool Corporation, Meadville, Pa. Catalogue 8, illustrating and describing McCrosky adjustable reamers equipped with carbon and high-speed steel blades; "Wizard" quick-change chucks and collets, and variable-speed and reversing attachment; turret attachments for lathes; steadyrests; milling machines; and "Searchlight" lamp brackets. The catalogue shows a number of important improvements in the McCrosky tools and describes several new tools which have been recently added to the line. Price lists are also given of the various products.

Griscom-Russell Co., 90 West St., New York City, has recently published a 29-page illustrated booklet entitled, "The Cooling of Quenching Oil in the Heat-treatment of Steel," by Kenneth B. Millett. The book describes the necessity for heat-treatment, the various quenching mediums and systems commonly used, the advantages of continuous circulation of the medium, and the adaptability of the "Multiwhirl" cooler to the cooling of quenching oil. Typical installations are featured, showing the lay-out of the piping with recommendations for the proper size and number of coolers to meet the requirements.

Velco Mfg. Co., Inc., Greenfield, Mass., has prepared and is distributing a booklet entitled "The Use and Care of the Broach," the purpose of which is to educate the broaching machine operator and foreman in the proper use of the broaching machine and broaching tools. Among the subjects treated are the following: Broach Terminology; Selecting the Proper Broach; Preparing the Work for the Broaching Operation; Setting up the Broach in the Broaching Machine; and Lubrication. A number of broaching kinks developed in actual practice are given, and the foreman will find the section devoted to successful broaching jobs and production obtained particularly interesting. Copies of the booklet will be sent to mechanics upon request.

Skinner Chuck Co., New Britain, Conn. Booklet entitled "Chucks and Their Uses," intended to offer the machinery buyer, machinery salesman, student, apprentice, and mechanic a compact easily understandable and authoritative fund of information on standard types of chucks and their uses. The booklet begins with a history of chucks and the story of their development, which is followed by a detailed description of the various types of chucks and their uses. Suggestions are made regarding the proper way to fit a chuck to a lathe and the care of the chuck, and a number of "don'ts" are given for chuck users. It is the intention of the company to distribute these booklets without charge to anyone interested in chucks. Copies will be sent to factory managers and superintendents for distribution in their shops, upon request.

Taft-Peirce Mfg. Co., Woonsocket, R. I. Bulletin 112, giving detailed instructions concerning the use of the Martell aligning reamer, for line-reaming and sizing crankshaft bearings. A general description of the reaming equipment is given and standard and special sizes are listed. The working instructions cover the care of the aligning reamer, setting up, adjusting centering bushings, adjusting the reamer, the reaming operation, and general rules. Bulletin 113 of Taft-Peirce thread gages, containing tables of dimensions for the various standards. The subject of measuring threads is discussed, attention being given to both the three-wire and three-ball methods. The last section of the book contains a reproduction of the National Screw Thread Commission's report on screw thread standards, including tables of allowances and tolerances.

Edward R. Ladew Co., Inc., 428 Broadway, New York City, manufacturer of Hoyt's "Flintstone" belting, and other leather products, has published a book entitled "The Proof Book," containing an outline of the history, standards, and policies of the concern, which has been in business since 1835. The booklet also contains a brief discussion of the belting problem and some of the fundamentals of belting economy. The illustrations show actual installations of Hoyt belts, which have been in service for varying

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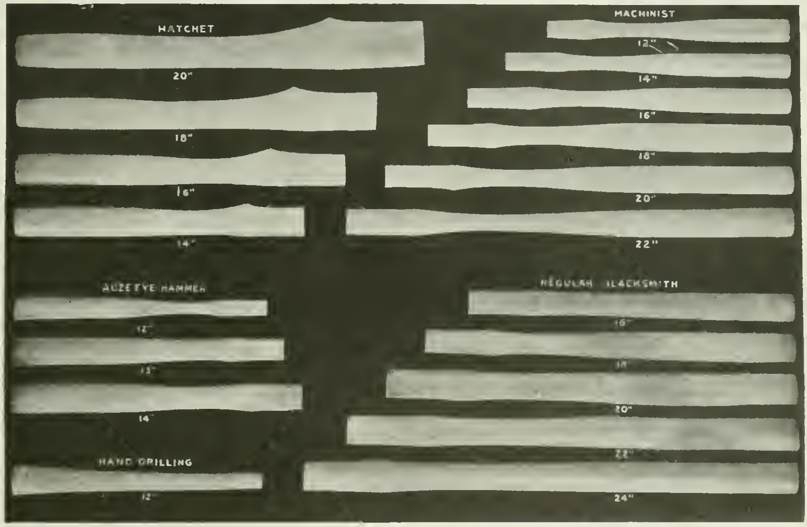

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4th Avenue and 13th Street NEW YORK (Since 1848) periods up to forty-four years. Catalogue of leather belting, containing eighty pages descriptive of the manufacture of Hoyt leather belting from the rough hide to the finished product. Belting rules and tables are given, together with a data sheet for the analysis of belt drives to secure the highest economy. Data relating to helting accessories are also included.

Pratt & Whitney Co., Hartford, Conn. Circular 259, descriptive of the curvex milling cutter—a formed milling cutter with spiral teeth and eccentric relief. A brief description and specifications for the curvex cutter grinder are included. Catalogue 260—Operators' Handbook for the curvex cutter grinder. This book is published to assist users of the Pratt & Whitney curvex cutter grinder in the operation and maintenance of the machine, and to insure that they obtain the quality of work of which the machine is capable. A detailed description of the construction and operation is given, together with instructions for setting the machine for grinding. The repair part section of the catalogue contains line illustrations of the various parts of the machine, which are numbered so as to facilitate ordering when replacement of any of the parts becomes necessary. There are eleven pages of tables giving the proper change-gears to use for the entire range of leads.

Vulcan Crucible Steel Co., Aliquippa, Pa. Catalogue 6, showing the various classes and types of steels manufactured by this company, as well as interior views of the plant, illustrating some of the steps in the production of steel. Information is given relating to the hardening, drawing, and special uses of each brand, and fracture photographs are reproduced showing the effects of correct and incorrect hardening. The book also treats of the tempers of the various tool steels produced. One section relates to hardening furnaces and pyrometers. Other subjects treated are drawing baths, hardening baths, fractures, and effect of time on drawing. A list is given of a large number of tools, such as cutters, dies, lathe tools, reamers, taps, etc., and the grade of steels recommended for making them. The catalogue concludes with tabular matter, such as weights of carbon steel, weights of high-speed steel, and physical tests on steel, showing elastic limit, tensile strength, elongation, reduction in area, etc.

Hendey Machine Co., Torrington, Conn., has published for free distribution to users of Hendey lathes, an operator's handbook, treating of the construction of these lathes and containing instructions relating to their operation. A view of the lathe is shown on the first page, with the various parts numbered, the designation of the parts being given on the page opposite the illustration. Then follows an illustrated description of the head spindle and bearings, geared drive head, apron, and related mechanism. The next section entitled "Helps on Change-gearing and Thread-cutting," contains a description of the change-gear mechanism and the standard index-plates, showing range of threads and feeds, and gives formulas for figuring gears for thread-cutting. Special index charts are given, showing a series of different pitches obtained with extra change-gears through the whole thirty-six change combination, for the different sizes of lathes. The relieving attachments for use on Hendey lathes are described, and special directions are given for various classes of relieving, such as the relieving of taps, formed cutters, angular cutters, counterbores, etc. Copies of the book can be obtained either from the main office, or from any of the branch offices or agencies.

TRADE NOTES

American Emery Wheel Works, Providence, R. I., manufacturer of corundum and carbolite wheels, has increased its capital stock from $100,000 to $1,000,000.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., announces that an approximate reduction of 10 per cent on all controller prices was effected February 14 by a change in discounts.

Delta File Works, 3231 Frankford Ave., Philadelphia, Pa., has outgrown its present quarters and moved into a new plant at Tacony and Bockius Sts., Bridesburg, Philadelphia, which will afford four times the previous floor space.

Rotterdamsche Machinehandel, Esmeijer & Co., Rotterdam, Holland, announce that during the past year they have extended their show-rooms and warehouses to a considerable extent, so that the floor space now covers over 60,000 square feet.

Cleveland Machine Tool Co., Cleveland, Ohio, has given up its leased factory on Superior Ave. and moved into its own plant at 18511 Euclid Ave., which will afford increased facilities for manufacturing the Cleveland horizontal boring machine.

Precision & Thread Grinder Mfg. Co., Inc., 1 S. 21st St., Philadelphia, Pa., announces that the multi-graduated precision grinder of its manufacture has been arranged to give two grinding wheel spindle speeds, of 6000 and 12,000 revolutions per minute.

Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill., has opened a Detroit office for the sale of Stewart furnaces and to give service and advice in heat-treating problems to customers in that territory. The new office will be located at 601 Kerr Bldg., and will be in charge of George P. Beck.

Adamson Mfg. Co., East Palestine, Ohio, manufacturer of Adamson vulcanizers, automobile accessories and specialties, has added a new department for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensers, and a large line of arc-welded products.

Promptitude Machine Works, 1000 W. Randolph St., Chicago, Ill.—a partnership formed by Fred E. Cutter, Charles J. Hosmer, and Charles G. Norberg—has been dissolved, and it is announced that Charles G. Norberg of 553 W. Lake St., Chicago, has assumed full responsibility for all assets and liabilities of the company.

Purves Mfg. Co., Syracuse, N. Y., maker of oil-cups, special tools, and machinery, has just moved into its new shop at 311 Almond St. The new shop is of concrete block construction, with excellent light, and will materially increase the company's manufacturing capacity and enable it to meet the growing demand for its products.

Greenfield Tap & Die Corporation, Greenfield, Mass., has bought the interests of the **Lincoln Twist Drill Co.** and has now included the line made by the latter company as part of its regular product. Ralph Barstow, formerly sales promotion manager, is now general sales manager for the Greenfield Tap & Die Corporation industries.

Landis Tool Co., Waynesboro, Pa., manufacturer of cylindrical grinding machines, announces that beginning March 1 the company will make a general reduction in prices on all its machines, with the exception of the crankshaft grinding machine. The reduction will average 15 to 20 per cent on the company's entire product, with the exception noted.

Edward R Ladew Co., Inc., 428 Broadway, New York City, tanner and leather belt manufacturer, has closed its sales office at Charlotte, N. C., and transferred its southern headquarters to 95 S. Forsyth St., Atlanta, Ga. An ample stock of belting and leather specialties will be carried, with the usual facilities for special work and engineering service.

Hooven, Owens, Rentschler Co., Hamilton, Ohio, manufacturer of Hamilton engines and machinery, has appointed the John Fensom Co., Richmond, Va., as its representative in the Virginia territory; the Sunderland Machinery & Supply Co., Omaha, Neb., as representative in the Omaha district; and Walter T. Paine as representative in the Boston district.

Austin Machinery Corporation of Louisiana, Inc., 1020 Maison Blanche Bldg., New Orleans, La., announces its incorporation under the laws of the state of Louisiana as sole distributor for the products of the Austin Machinery Corporation, manufacturer of earth-moving and concrete mixing machinery, in the states of Louisiana, Arkansas, Mississippi, and Tennessee.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., has opened a new branch office and service station at 75 Fremont St., San Francisco, Cal., to take care of the business in the Pacific coast territory. A complete stock of parts will be carried in the new office, and a factory trained mechanic will be on hand to give service to users of Black & Decker products in that territory. M. A. Johuson will be in charge of the new office.

Hubbard Machine Co. announces that it has entered into an agreement with the S K F Industries, Inc., under the terms of which the sales of Hubbard products will hereafter be conducted by the S K F Industries, Inc., 165 Broadway New York City, to whom all correspondence relating to the business and engineering service should be addressed. The factory of the Hubbard Machine Co. has been moved from Worcester, Mass. to Hartford, Conn.

Cincinnati Milling Machine Co., Cincinnati, Ohio, announces that it has become financially interested in the **Cincinnati Grinder Co.** It is purposed to manufacture the latter company's line of universal and plain cylindrical grinding machines and internal grinding machines in the plant of the Cincinnati Milling Machine Co., to which extensive additions have recently been made. The marketing of the grinding machines will be carried on as heretofore through the Cincinnati Grinder Co.

N. B. Payne & Co., 25 Church St., New York City, dealers in electric cranes and hoists, have extended their lines of material-handling machinery to include the portable conveyors made by the A. C. Warner Co., Philadelphia, Pa., Chicago automatic coal elevators, and McKinney-Harrington package pilers and car loaders. Edmund Otto, for several years secretary of the Hardware & Supply Co. of New York City, and prior to that associated with Manning, Maxwell & Moore, Inc., also of New York City, is now connected with N. B. Payne & Co., in this branch of their business.

Consolidated Instrument Co. of America, 461 Eighth Ave., Printing Crafts' Bldg., New York City, has been organized to render engineering and sales service in connection with all types of speed indicating and recording instruments and devices. The company controls exclusively the entire American distribution of the Jones tachometers, and also distributes exclusively throughout the United States the Hasler speed indicator and "Tel Speed" recording devices. All correspondence with reference to the Hasler products should be addressed direct to the Consolidated Instrument Co.

Weigel Machine Tool Co., Peru, Ind., manufacturer of the Weigel upright drilling machine, has recently been reorganized. The new officers are H. B. Fox, president; C. E. Redmon, vice-president; G. E. Meck, secretary; C. L. Weigel, assistant secretary; and H. P. Sullivan, treasurer and general manager. C. L. Weigel is also production manager and purchasing agent. The capital stock has been increased to $145,000. This line of drilling machines was originally designed by Alfred L. Weigel, who died in September, 1919; the original Weigel design has been maintained and several improvements have been made in the new line now offered.

Standard Machinery & Supply Co., Inc., 924 First Ave. South, Seattle, Wash., has purchased the assets and stock of the **Chicago Machinery & Equipment Co.** of Seattle, which has been prominently identified with second-hand machinery lines for a number of years. It is the plan of the company at present to continue the second-hand wood- and iron-working machinery lines, and in addition new machines will be featured. Mr. Buchner, the president of the company, has been for the last nine years sales manager of the Perine Machinery Co. of Seattle. Charles M. Weinberg, previously associated with the Dodge Sales & Engineering Co., has joined the company.

Reed-Prentice Co., Backer Milling Machine Co., and **Whitcomb-Blaisdell Machine Tool Co.** announce that their executive, sales, purchasing, and accounting departments are now located at the Reed-Prentice plant, 677 Cambridge St., Worcester, Mass. On account of present business conditions the Becker plant at Hyde Park, Boston, is operating with reduced force, but production will be increased as soon as conditions warrant. The Becker cutter department business showed a marked increase in volume during January, and it is expected to be running full capacity shortly. The Worcester plants of the Reed-Prentice Co. and the Whitcomb-Blaisdell Machine Tool Co. are completing orders on hand and also building machines for stock.

Toledo Crane Co., Bucyrus, Ohio, has been duly chartered under the laws of Ohio as successor to the **Toledo Bridge & Crane Co.** of Toledo, builder of Toledo cranes. The company expects to have completed by March 15 a building, 120 by 320 feet, for erecting and assembling, which, together with a machine shop, 60 by 300 feet, a structural shop, 90 by 300 feet, a pattern shop, 60 by 140 feet, and a forge shop 40 by 100 feet, will give the company adequate facilities to continue the same service to its customers as it has rendered in the past. The officers are C. F. Michael, president; W. F. Billingsley, vice-president and general manager; A. G. Stoltz, treasurer; and C. Gallinger, secretary. The main office will be located at Bucyrus, and sales offices will be maintained in New York City and the other principal cities of the country.

McKay & Sherman, 741 Monadnock Block, Chicago, Ill., is a new partnership formed by Charles W. McKay and P. C. Sherman for the practice of the engineering evaluation of industrial and public utility properties. The firm will also specialize in the preparation of valuations and financial reports for investment bankers. Mr. McKay is the author of a book entitled "Valuing Industrial Properties," published in 1918. During the past year he has written over 100 articles for technical and trade journals on the general subject of valuation. He is a member of the advisory council of the Industrial Extension Institute, and during the past two years has supervised the appraisement of over $100,000,000 worth of industrial and public utility properties. Mr. Sherman, the vice-president of the company, is president of Sherman & Associates, Inc., of New York City.

Meldrum - Gabrielson Corporation. Syracuse, N. Y., has been formed by Alexander Meldrum, Carl Gabrielson, and A. J. Littlejohn, who have taken over the entire ownership of the Meldrum-Semon-Greiner-Lowry Co., Inc., of Syracuse, which business will henceforth be conducted under the name of the Meldrum-Gabrielson Corporation. The new corporation has also arranged with the Gabrielson Mfg. Corporation for the exclusive manufacture and sale of the Gabrielson milling machine, a new departure in manufacturing milling machines. The company will also continue to manufacture the Syracuse adjustable limit snap gages, and will also devote itself to the building of special machinery and tools, for which purpose its plant is particularly equipped. A designing department is added as a new feature of this branch of the business. Mr. Gabrielson will serve as consulting engineer, and Mr. Meldrum will continue as general manager, while Mr. Littlejohn will take charge of the sales of the company's products.

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FOREIGN MACHINERY MERCHANTS PAGES, 374-375 ADVERTISERS INDEX, 405-406 PRODUCT INDEX, 376-402

The Editor's Monthly Talk

GENERAL industrial prosperity in the United States is impossible unless the railroads are in a position to handle the traffic of the country efficiently. The railroads are the arteries of this great industrial country, and unless they can function adequately no other activities, commercial or agricultural, can prosper.

The vital factors in the efficient operation of the railroads are capable management, efficient personnel and modern equipment. The traffic management of American railroads, on the whole, has proved its ability. The personnel is efficient and capable, unless through ill-considered rules governing working conditions, its initiative is decreased and its ambition deadened. The equipment, generally speaking, is away below par and has been deteriorating for years. Efficiency in the repair of locomotives and cars is therefore of vital importance, and for this, up-to-date machine tool equipment is a necessity in every railroad repair shop. Costs must be reduced, and the railroad equipment must render full service.

The series beginning in April MACHINERY on "Railway Machine Shop Practice" deals with the necessary factors for attaining railroad shop efficiency. The first article shows the methods used for repairing locomotives in the shops of three important railroad systems.

Satisfactory shop equipment, however, is not the only requirement. It is also necessary for ambitious and efficient workers to see encouraging prospects ahead. Recognition of merit and the promise of early promotion are necessary factors in the railway industry. The so-called "National Railroad Labor Agreement" can hardly be said to stimulate efficiency and ambition among the men in the shops. It ties the individual down, whether he is working at a simple task, or is a foreman, or a higher executive. Some of the objectionable rules in the agreement that the railroads are now trying to have modified are pointed out in an article on "The National Railroad Labor Agreement." Everyone interested in the prosperity of the railroads—and every man engaged in the industries is affected, for his own prosperity depends upon it—will be interested in the definite information upon the National Agreement contained in this article.

Management Problems

A highly developed system for controlling production based upon the principles of the well-known Taylor System is employed by the H. H. Franklin Mfg. Co., Syracuse, N. Y., and applied to their entire automobile plant. This system has been carefully worked out and thoroughly tried for several years. It insures that production of the numerous parts of the Franklin car will be sufficient at all times to take care of the demand of the assembling departments; and that production of the different lots of parts will be started and completed on predetermined dates, based not only upon the total number of cars required in a given time, but also upon the relative order of assembling the various units entering in the construction of the complete car.

The details of this system, described in the article "Central Control System in the Franklin Plant" in the April number, will prove of interest to every manager, production engineer, superintendent or other shop executive upon whom the responsibility for production rests.

Modern Inspection Methods

An interesting series of articles beginning in May MACHINERY, will cover modern inspection methods, and will describe the principles of inspection, the organization of modern inspection departments and the maintenance of the gaging equipment. There will be included a description of modern gaging fixtures and methods with ample illustrations. These articles are based upon the successful practice of one of the most highly organized plants for interchangeable manufacture and quantity production in this country—the Delco plant in Dayton, Ohio—but the fundamental principles may be applied with but slight modifications to small as well as large shops.

One of the interesting points made in this series is that inspection should deal not only with the finished product ready to leave the plant, but, to be completely effective, should concern itself with everything that enters the plant as well. The castings, the steel, the taps and reamers, the machine tools, the micrometers and other equipment entering the plant for use in production should be as carefully inspected upon arrival as is the finished product that leaves the plant.

Efficiency in Assembling Work

Years ago the mechanical world became greatly interested in the methods for assembling automobiles employed at the Ford plant in Detroit, where the progressive assembling method was installed and developed well-nigh to perfection by employing the conveyor principle. Since that time, this method has been installed in a number of plants and for a great variety of products, some notable examples being in the assembling of phonograph motors, gear-cases, stoves and sewing machines. An article in May MACHINERY will deal with progressive assembly conveyors, explaining the principles involved and the advantages to be gained whenever the product lends itself to their use.

Among other articles of interest to the wide circle of MACHINERY readers in the May number may be mentioned "Dynamic Balancing Stand," "Products of a Modern Tool-Room," "Car and Car-and-Ball Furnaces," and "Machining Motor Pistons."

Railway Machine Shop Practice

By EDWARD K. HAMMOND

Methods Employed in Railway Repair Shops for Machining Locomotive Parts—First of a Series of Articles

ABLE management, efficient workmen, and modern machinery are the vital factors in successfully operating a railway machine shop. The repairing and overhauling of locomotives and cars bears a closer resemblance to the work done in jobbing shops than to the work of manufacturing plants, because, in even the largest railway shops, there is a relatively small number of duplicate parts to be machined. Hence a mere machine operator who may be as efficient as the experienced machinist on repetition work in a manufacturing plant, is likely to be of less value in the railroad shop where each job differs from the last, and where a man is depended upon to put into each piece of work which he handles the dexterity and knowledge that have been acquired through years of experience.

To get the best results from the type of men needed for repairing locomotives and cars, it is necessary to foster the idea that each man in the shop is depended upon "to do his bit" in helping to keep the railroad's rolling stock out on the tracks. This is one of the problems of management that enter into the operation of a railway machine shop. The capable superintendent or foreman has learned to give a merited word of encouragement which causes each mechanic in the shop to feel that it is known when he does a really good job. Equally important with efficient men is the provision of modern shop equipment, for without good tools at his disposal the workman is unable to produce satisfactory results.

In the operation of railroad equipment, just as in the case of machine tools in a shop, or any other similar proposition, it is a point of vital importance to reduce non-productive time to a minimum; and with railroad cars and locomotives, one of the serious items of idle time is covered by those periods during which equipment is in the shop for repairs. In the present series of articles, methods that have proved to be successful in doing repair work on railway rolling stock will be described.

Efficiency in the repairing of locomotives and cars is a matter of vital importance both to the men who are responsible for railroad operation and to those who use the railroads either for travel or for the shipping of merchandise. Able shop management, thorough mechanics, and proper shop equipment are necessary factors for obtaining such efficiency. The present article deals with methods used in the shops of three important railroad systems for the making of repairs on locomotives. These methods have been thoroughly tried out and have proved to give satisfactory results both as regards the quality of the workmanship and the time required.

Slotting Locomotive Frames

Men who have had experience in the building or repairing of railway locomotives know that the upper part of the structure is supported by two parallel frames which extend for practically the full length of the engine at either side. These members are made of steel, and in the process of machining it is necessary to finish the so-called jaws in which the driving-boxes are held by the shoes and wedges; also, it is required to machine the front ends which support the engine cylinders and to perform various other machining operations that differ according to the type of engine of which the two frame members form a part. Productive efficiency is always an important matter, but in the handling of railroad shop work it is of unusual importance, because the urgent demand for equipment on the railroads makes it imperative that an engine which is sent in to the shop for repairs shall be put back into service at the earliest possible moment.

In Fig. 1 is shown the method of machining engine frames, which is employed in the Burnside shops of the Illinois Central Railroad Co., in Chicago, Ill. Many time- and labor-saving methods are employed in this plant, of which the present is a typical example. It will be seen that four frames are stacked on the table of a duplex traveling-head slotter built by William Sellers & Co., Inc., of Philadelphia, Pa. This slotter has a table of ample length to hold the longest engine frames, and the heads of the machine, which face each other, can be moved along the bed so that the cutting tools carried by the rams may be brought into the correct position to reach any part of the work on which a machining operation is required.

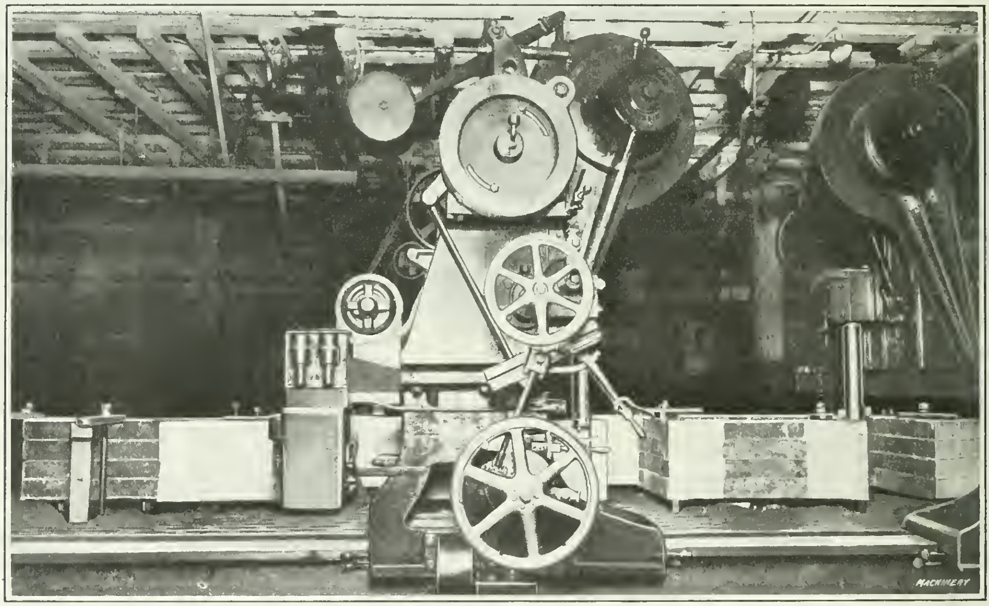

Fig. 1. Duplex Traveling-head Slotter that provides for simultaneously machining a Stack of Four Locomotive Frames

In setting up this job, the first frame is blocked up sufficiently to afford enough clearance on the under side to allow the tools to plane right down to the bottom of the work. The design of this slotter has been developed in such a way that provision is made for obtaining angular settings for planing the openings between the jaws to make the required adjustments for the driving-box fits; and all straight surfaces running transverse or parallel to the sides of the slotter table can be finished by the regular feed movements provided for that purpose. Four frames can be completed on this machine without requiring any change in the setting of the work; and as a result, the job is handled with maximum efficiency.

Drilling Operations on Engine Frames

After the frames have been planed on the slotter illustrated in Fig. 1, it is necessary to drill a large number of holes in them. Special multiple-spindle drilling machines are built for this purpose, and such equipments give very efficient results. However, for a shop devoting the greater part of its attention to the maintenance of engines (although a few engines are built as more or less of a side line), it will be evident that there is not enough frame drilling to be done to keep a single-purpose drilling machine employed for a sufficient part of its time to earn a satisfactory rate on the investment. For that reason, the management of the Burnside shops decided to do this work on a battery of four radial drilling machines built by the Cincinnati Bickford Tool Co., of Cincinnati, Ohio.

In working out the design of supplementary equipment for use with these machines, a special auxiliary table was provided for supporting the work in either a horizontal or a vertical position, so that the drills carried by the radial heads would be able to reach any desired position on the engine frames. This group of machines is shown in operation in Fig. 2; and there is a substantial advantage accruing from the fact that when there are no frames to be drilled, each of these radial drilling machines is capable of operating at its full efficiency on other work.

Attention is called to the fact that for the drilling of holes at the top or bottom of the frames, two frames are set up together on the vertical face of the table, as experience has shown that when handled in this way, the work can be completed in less time. For those types of engine frames which are frequently drilled in this shop, jigs have been provided, which are made of sheet steel with the bushings pressed into place. These jigs facilitate the performance of drilling operations and assure accurate location of all of the drilled holes; they also eliminate the time required to lay out the work preparatory to drilling.

Boring Engine Cylinder Castings

In the machining of most large castings, laying out of the work becomes a matter of exceptional importance, because of the possibility of cores slightly shifting their positions or of the molds settling in such a way that the castings will not be of exactly the required form. Errors resulting from such causes are guarded against through having the work carefully laid out to protect against contingencies of the kind which have been mentioned. In handling such work preparatory to the machining of locomotive cylinder castings at the Burnside shops, the first step consists of marking with chalk over those surfaces on which the different fixed points are to be machined, and then scribing the outlines of the valve chamber, the cylindrical segmental seat for the smokebox, etc.

With the work laid out in this manner, the casting is set up on a horizontal boring machine built by the Niles Tool Works Co., in Hamilton, Ohio. In setting up one of these castings, use is made of the outlines which have been laid out on the work to assure obtaining an accurate location, and when this has been done the cylinder is bored and faced. On the machine used for this purpose there is a rotary cutter-head that slides on a hollow bar and is fed through the work by means of a screw contained inside of the bar. After the boring operation has been completed, a facing head is mounted on the bar at each end of the casting. These heads are secured to the bar and furnished with cutter bits carried by cross-slides. Each of these cross-slides has a screw with a star feed at its end, which comes into contact with a stop on the frame of the boring machine at the conclusion of each revolution. In this way, the cutter bit is fed across the face at each end of the cylinder and provides for finishing it to the required length and accuracy.

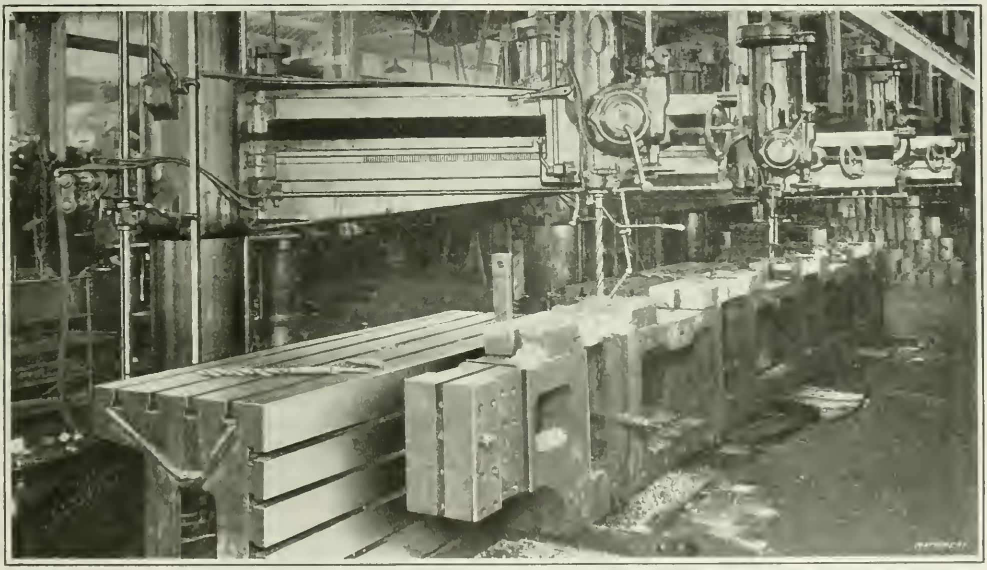

Fig. 2. Battery of Four Radial Drilling Machines equipped with a Special Table for Locomotive Frame Drilling and Miscellaneous Work

Subsequent Machining Operations on Cylinder Castings

After the cylinder has been bored and faced, the casting is sent to a traveling-head planer built by the Morton Mfg. Co., of Muskegon Heights, Mich., which is employed for planing the connection between the two cylinder castings, for finishing the upper and lower frame slots, and for boring and facing the valve chamber. Fig. 3 shows a close-up view of this job while the planing of the connection is in process. As the work comes to this machine, advantage is taken of the fact that the cylinder has been accurately bored and it is used as a locating point. There is a three-jaw universal chuck on the machine, which enters the bored cylinder and engages the faced end of the casting, thus serving the double purpose of holding the work from a definite locating point and bringing it into a position where the planed surfaces will be perpendicular to the previously faced ends.

With a preliminary setting accomplished in this way, the next point is to level up the work, using the previously scribed lines as points of reference. This result is accomplished with a surface gage that is employed to measure from the planer table to the horizontal scribed line representing the level to which the connection fit *A* must be finished. This line is leveled up by testing its height from the table at opposite ends of the work, and regulating the jacks *B* and *C* that support the work as occasion demands. When the necessary adjustment has been made, the clamp *D* is tightened to hold the casting securely in this position, after which the planing of the connection can be started. For the machining operations on cylinder castings while held on this machine, two settings of the work are required. At the first setting, shown in Fig. 3, the connection and the lower frame slot are planed; and after this work has been completed, the casting is reset to provide for planing the upper frame slot. Then the cylinder boring-bar is set up on the machine to provide for boring and facing the valve chamber, which completes the sequence of operations.

Milling the Cross-head Key-slot in Piston-rods

The handicaps under which the railways have been operated during recent years have hindered the purchase of much of the equipment that is really needed for use in their shops. As a result, some rather clever special machines have been developed for the performance of certain minor operations on locomotive parts. A case in point is illustrated in Fig. 5, which shows a special machine developed for use in the Burnside shops of the Illinois Central Railroad Co. for milling the key-slot in a piston-rod, that provides for holding the cross-head in place. Reference to the illustration will make it apparent that this consists of a bed supporting a screw-operated carriage, to which the piston-rod is clamped in such a way that by turning a handwheel at the right-hand end of the machine, or by rotating the feed-screw by power, provision is made for feeding the work to the milling cutter.

Extending up from the bed there will be seen a framework that supports an air drill. This tool is employed to furnish the power feed by means of a belt running to a pulley carried on a vertical shaft *A* that drives a worm meshing with a worm-wheel at the end of the feed-screw. Also, it will be seen that the air drill is directly connected to the milling spindle *B*. After the job is set up on this machine, a hole is drilled through the piston-rod *C* in a

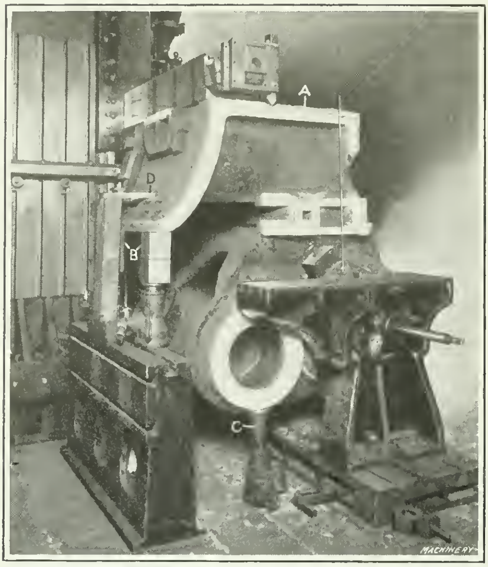

Fig. 3. Planing Connection Fit of Cylinder Casting on Draw-cut Planer, which also finishes Frame Slots, and bores Valve Chamber

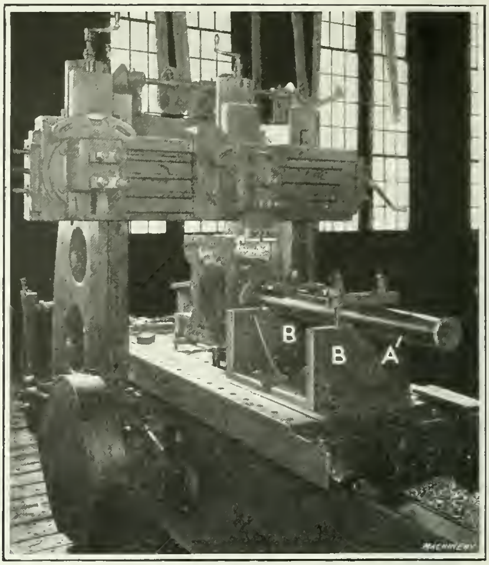

Fig. 4. V-block Fixtures and Special Mandrel that are used for holding Cross-head while the Guide Bearings are being planed

position corresponding to one end of the key-slot, this being done by the air drill without any horizontal movement of the machine table. This hole receives the milling cutter. Then as the cutter is rotated by the air motor, the work is fed up to the cutter in the manner previously described. A machine of this type is inexpensive to build, and it has been found to give very satisfactory results in the performance of the operation for which it was designed. With this machine a key-slot measuring 3¾ by 1⅛ by 4½ inches can be cut in a forged steel rod in 1½ hours.

Method of Supporting Cross-heads for Planing the Guide Bearings

In the Chicago, Rock Island & Pacific Railway shops at Silvis, Ill., the method illustrated in Fig. 4 is employed for holding cross-heads while replaning the guide bearings after they have been rebabbitted. The arbor *A* by which the cross-head is carried is not the piston-rod, although it is of about the same diameter and length. One end of this arbor is machined to enter the fit in the cross-head, and it will be seen that at the opposite end the arbor is held in two V-blocks *B*, in which it is held down by straps. After a preliminary setting has been effected in this manner, the cross-head is squared up with the planer table and supported by means of clamps and straps of the usual kind. It is then ready for planing, this operation being accomplished by means of a broad-faced tool that is of sufficient width to shape out the whole guide bearing without requiring the planer head to be fed transversely across the work. In cutting a soft metal like babbitt, it will be apparent that a method of this kind can be employed without danger of damaging the tool.

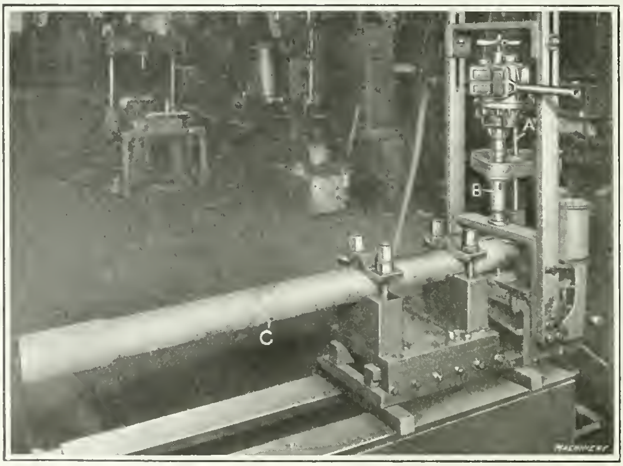

Fig. 5. Special Machine developed for Use in milling the Cross-head Key-slot in a Piston-rod

Boring Wrist-pin Hole in the Cross-head

Fig. 6 illustrates a cross-head in which the wrist-pin bearing hole is being bored. This operation is performed on a vertical boring mill built by the Niles Tool Works Co., and used in the shops of the Chicago & Northwestern Railway Co. in Chicago, Ill. As the cross-heads come to this machine, they have been previously planed, so that there are finished faces which may be employed as locating points in setting up the work. It will be seen that an angle-plate fixture *A* is provided on the machine used for the performance of this operation; and there is a shoulder on the plate against which the work rests to assure accurately locating it under the boring spindle.

The operation to be performed consists of boring the two wrist-pin holes and of facing the inner sides of the bosses surrounding these holes, an offset tool being used for doing the latter part of the work. On the fixture, which is centrally located on the table, there is scribed a reference line that indicates the proper setting for the work on the fixture, in order to bring it into the correct position under the spindle of the boring machine. The same fixture is used for boring different sized

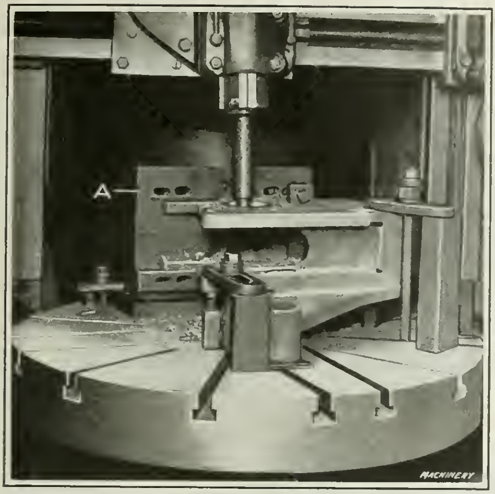

Fig. 6. Boring the Wrist-pin Hole in a Cross-head

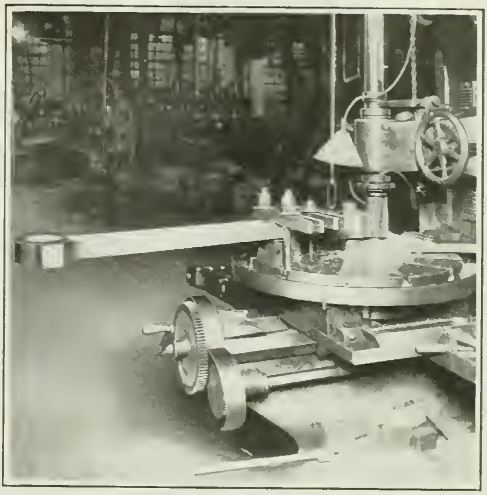

Fig. 7. Milling End of Side-rod to Required Form

cross-heads, and to accommodate various pieces of work a suitably placed locating line is scribed for use in locating each size of head, shims being employed between the work and the shoulder on the fixture to pack the cross-heads of different sizes so as to assure that they will be properly located and rigidly supported.

Planing Operation on Side-rods

Practice in the machining of main driving rods and side-rods naturally varies according to the shop in which the work is done. However, it is the average practice to either plane or mill the side faces of the enlarged section at each end of a rod, while the usual procedure is to mill the ends and the flute that is cut at each side. Later in this article, an explanation will be given of subsequent work on these members of a locomotive, including methods of boring the holes in the rods, pressing the bearing brasses into place, and rough- and finish-boring these brasses. However, we are at present interested in the finishing of straight flat surfaces on the rods, and in Fig. 8 there is shown a method used in the Chicago, Rock Island & Pacific Railway shops at Silvis, Ill., for planing the side faces of the heads of side-rods. Reference to the illustration will make it apparent that this is done on a planer built by the Niles-Bement-Pond Co., 111 Broadway, New York City, which is equipped with two opposed sets of housings and cross-rails, so that with two pieces of work set up on the planer table as illustrated, the tool carried by each head on each cross-rail can be employed for planing one end of each side-rod forging.

Obviously, if a planer of ordinary design were employed for doing this job, it would be necessary to short-stroke the work to provide for first planing one end of the forgings, and then to re-position the stroke of the planer table for operation at the opposite end Otherwise, the procedure would be to handle the entire job at one continuous stroke of the table, which would result in loss of time during that period of each stroke for which the tool was "cutting air" during both the forward and return movements of the table between the two areas on the forgings which have to be planed. These troubles are avoided through using a double-head planer, because the table can be operated on a short stroke, and on the so-called forward stroke the work is being planed at one end, while at the return stroke it is being planed at the opposite end by the two tools on the cross-rail at the other end of the planer. From this description it will be apparent that the two sets of tools work alternately, so that there is no idle stroke and no loss of time by having the tool unemployed during a considerable part of the stroke. As a result, the use of a machine of this kind would appear to be the means of approximating the maximum degree of efficiency in the performance of this operation.

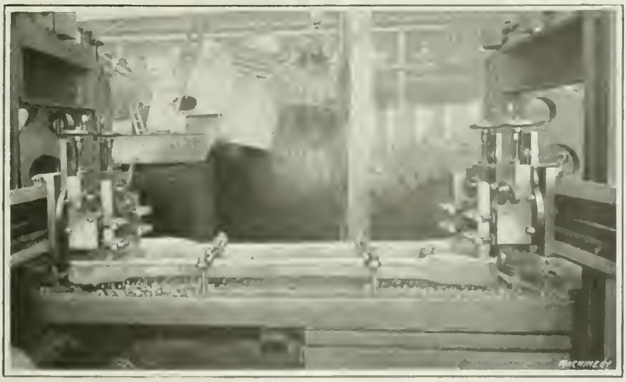

Fig. 8. Duplex Planer equipped with Two Sets of Housings, Cross-rails and Rail-heads for simultaneously planing Opposite Ends of Locomotive Side-rods

Milling the Ends of Side-rods

In the Chicago & Northwestern Railway Co.'s shops there are many locomotive side-rods to be machined, which are made with their ends of the form clearly shown in Fig. 7; and here there is also illustrated a method of milling the ends of these forgings to the required form. It will be seen that the contour of the work reverses the direction of curvature three times, and a very simple method is used for obtaining the desired result. The vertical-spindle milling machine is equipped with a plain cutter, the radius of curvature of which is made equal to the curvature of those sections of the end of the rod which join the part of the milled surface that is concentric with the bore of the bearing to the straight shoulder at each side. This milling cutter is operated on a machine

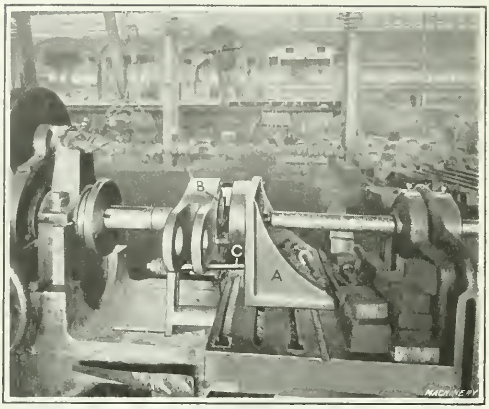

Fig. 9. Boring the Bearing Brass of a Locomotive Main Connection Side-rod

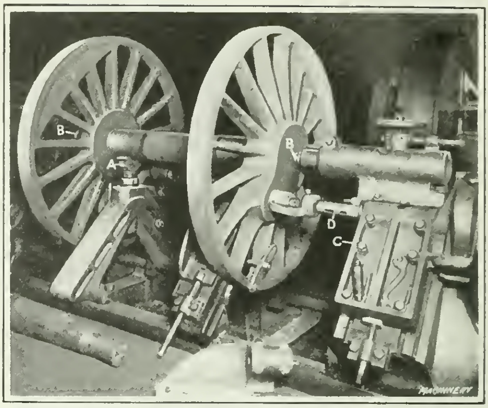

Fig. 10. Quartering Machine equipped for re-turning Crankpins of Driving Wheels

furnished with a table having longitudinal, transverse, and rotary feed movements.

The work is strapped on the table, with a pilot that is located at the center of table rotation fitting into the finish-bored bearing hole in the work. Care is taken to have the rod placed at right angles to the transverse feed movement. Then the cut is started by feeding the work transversely up to the milling cutter, to provide for finishing the flat shoulder and the radius that joins this shoulder to the portion of the contour that is concentric with the bearing. Having accomplished this result, the transverse feed movement of the table is stopped and the rotary feed movement substituted, in order to provide for swinging the work past the milling cutter to mill the concentric portion of the contour. When this has been finished, the transverse feed is once more brought into action, to complete the second shoulder on the rod. This method is then employed a second time to mill the opposite end to the same form, after resetting the work. The job is performed on a milling machine built by the Niles Tool Works Co.

Boring Bearing Brasses in Side-rods

In machining side-rods, the method of procedure is to bore the bearing hole at each end, after which the brass bushings are pressed into place and then rough- and finish-bored. Fig. 9 illustrates a horizontal boring machine built by the Niles Tool Works Co., which is used in the Silvis shops of the Chicago, Rock Island & Pacific Railway for the performance of this operation. So far as the actual boring operation is concerned, this job is of relatively small interest; but the tooling up of the machine is worthy of mention. It will be seen that an angle-plate *A* is provided on the boring mill table, with a three-jaw chuck carried by it to provide for gripping the shoulder *B* of the bronze bushing that extends out beyond the hole in the side-rod. This method enables the work to be located with the required degree of accuracy, and after a preliminary set-up has been obtained in this manner, the work is held back in the chuck by means of clamping bolts *C*, extending forward from the angle-plate, that are used in conjunction with suitable straps.

"Quartering" Locomotive Driving Wheels

It is the practice to have crankpins on locomotive driving wheels located at 90 degrees from each other. This makes it impossible for the pins to be stalled on dead centers and obviates the occurrence of interruptions of service from that cause. As the design of an engine is based upon a 90-degree spacing of the pins, it will be evident that efficient operation is dependent upon the maintenance of such an angular relationship. After a locomotive has been in service for a considerable period, it may be found that one or both of the pins have become slightly misplaced, either in regard to the stroke or the angular position.

When an engine is being overhauled or when a set of old driving wheels is being trued up, the location of the crankpins in relation to each other is tested with an equipment

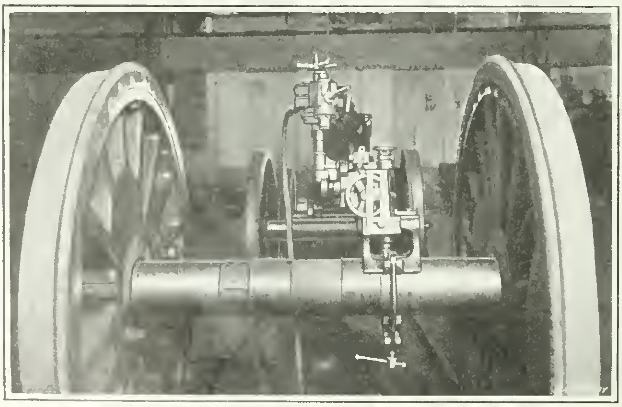

Fig. 11. Air-driven Keyseating Machine cutting Keyways for the Operating Eccentrics of the Stephenson Valve Gear

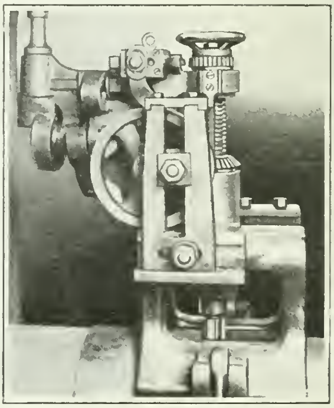

Fig. 12. Close-up View of Keyseating Machine shown in Fig. 11

known as a "quartering" machine, which is shown in operation in Fig. 10. This machine was built by the Niles-Bement-Pond Co., and it is shown in use in the Chicago & Northwestern Railway Co.'s shops. Reference to this illustration will make it apparent that the machine is furnished with two jacks *A*, by means of which the wheels are supported from the turned journals on the axle, after which centers *B* are entered into holes in the ends of the axle. The crankpins have also been accurately centered, and on the quartering machine there are two centers properly located for entering these holes. It will be evident that to adapt a machine of this kind for operation on wheel centers of various sizes, the auxiliary centers that engage the pins are mounted on slides *C* so that their positions may be adjusted for cranks of different lengths.

If the spacing of the crankpins is accurate, it will be evident that with centers *B* in place in the ends of the axle, the centers carried by the auxiliary spindles in slides *C* will enter the holes in the crankpins. However, it may be found that there is an error in this spacing, and such being the case, either of two methods of procedure may be followed in making the necessary correction. If the inaccuracy is not too great, a rotary cutter-head is mounted on one or both of the quartering machine spindles *D*, depending upon whether only one or both of the crankpins are misplaced, and the outside of the pin is returned to properly center it in relation to the pin carried by the opposite wheel. In cases where there is a greater amount of error to be corrected, the procedure is to send the wheel centers to a hydraulic press, which is used to force out the crankpins. Then, the wheels come back to the quartering machine to have the crankpin holes accurately rebored in the proper 90-degree relationship to each other, after which new pins are pressed into place. The reboring of the holes is done by boring tools carried by spindles *D*.

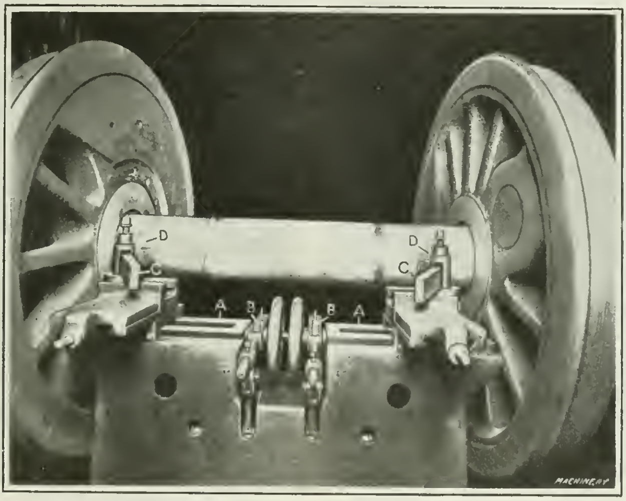

Fig. 13. Burnishing the Journals of a Locomotive Driving Axle after re-turning

Milling Keyseats for Eccentrics of Stephenson Valve Gears

Men who are familiar with locomotive design know that Stephenson valve gears are operated by eccentrics keyed to the driving axle at points just inside the journals. Figs. 11 and 12 illustrate a general view and a close-up view of a portable air-operated equipment built by Joseph T. Ryerson & Son, 16th and Rockwell Sts., Chicago, Ill., to provide for efficiently milling the keyseats in an axle, without requiring the wheel centers to be removed. It is shown in use in the Central of Georgia Railway Co.'s shops, engaged in milling the reverse eccentric keyway. This machine is operated by either an air drill or an electric motor, to which it is direct-connected by means of a tapered shank. Both the vertical and the horizontal feeds are entirely automatic, so that no attention is required beyond placing the tool in position. It is claimed that the use of this equipment avoids all possibility of the keyseat in the axle and the eccentric not corresponding, which may be the case when keyways are cut before the wheels are pressed on the axle.

For handling repair work where an old driving axle is retained, it frequently happens that the keyways in the eccentrics and the axle do not correspond, making it necessary to resort to the use of offset keys. This machine will recut the keyways in the axle to correspond to the slots in the eccentric. With the keyway cutting machine here illustrated, the valves can be set on the assembled driving-wheel center and the positions of the keyways transferred from the eccentrics to the axle, after which it is an easy matter to perform the keyseat milling operation. As compared with this procedure, consider the difference of time that would be involved if it were necessary to set up an "old man," in conjunction with which a hand- or an air-operated drill would be used to sink a hole at each end of the keyway, after which the intervening metal would be chipped out by hand or with a pneumatic chisel. It is claimed that with this Ryerson equipment, the time for cutting a keyway 1 by ½ by 6 inches in size should never exceed thirty-five minutes.

Re-turning Journals of Locomotive Axles

At a time when a locomotive is being completely overhauled, it may be found necessary to re-turn the journal bearings, and Fig. 13 illustrates the method of procedure of the Chicago & Northwestern Railway Co., in handling work of that kind. There are two points of interest in connection with this job: First, the design of the special machine on which the work is done; and, second, the method of obtaining the required finish. In setting up the work on this machine, attention is called to the fact that both the head- and tail-spindles are stationary, and the drive is accomplished by a pinion meshing with an internal gear at the back of the faceplate, which is loosely mounted on the headstock spindle, so that it is free to rotate and drive the work. The claim is made that with an equipment of this kind, the accuracy of alignment of the centers is maintained more perfectly, and as a result, a higher degree of precision is secured in turning the journal bearings.

This lathe was built from an old wheel lathe, and reference to Fig. 13 will show that the two tool-blocks are mounted on slides *A* that provide for traversing the tools along the journals which are to be turned. Inside the bed that carries these tool-blocks, there are two feed-screws which are turned by the ratchet and pawl mechanisms *B* that derive motion from a suitable arrangement of links connected to the same motor drive which delivers power to the main faceplate. A point of especial interest in connection with this job is the means used for securing the required degree of accuracy on the turned journal. This is done by first rough- and finish-turning, after which a burnishing operation is performed. It is done by the use of tools *C* that consist of holders, at the end of which ordinary steel burnishing rollers *D* are mounted in place of tool points. By applying a high pressure with these rollers and feeding them along the work just as an ordinary tool would be handled, the rollers smooth down the slight inequalities left by the finish-turning tools and impart a finish to the work that gives it a high luster.

Repair shops maintained by the Chicago & Northwestern Railway Co., in Chicago, Ill., are depended upon to serve this company's entire system, in so far as the handling of important engine repairs is concerned. However, many minor repairs or the substitution of parts are made in various division shops provided for that purpose. For instance, consider the case of re-turning locomotive wheel tires. All such work is done in the main shops, but it would be an excessively expensive procedure to send an engine all of the way to Chicago to have the tires changed. Hence, to avoid such a procedure, the method is to have tires of different sizes in stock in the various division shops, so that when a change is required, the worn tires can be removed from the wheel centers and sent to Chicago to be returned, while tires held in reserve for that purpose are substituted on the engine.

Special Expanding Chuck for Re-turning Engine Wheel Tires

As the tires come to the shop, provision must be made for holding them in such a manner that the tread will be turned concentric with the bore; otherwise, the tire would be eccentric when shrunk on the wheel center, and thus be unsuitable for service. To avoid such a condition and still make it unnecessary to resort to the time-consuming and expensive method of shrinking the tires on the wheel centers for re-turning, a special expanding chucking device has been developed, that enables an accurate location of the tires to be obtained from the bore. This device consists of a pair of wheel centers which are of a slightly smaller diameter than the bore of the tires to be turned.

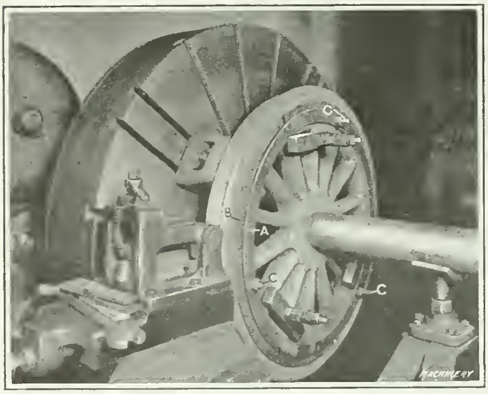

Fig. 14. Close-up View of Special Expanding Arbor used for re-turning Locomotive Wheel Tires

Between each wheel and its tire there is placed a pair of collars, each collar having a tapered surface which contacts with an opposed taper on the other collar of the pair, that is to say, the outside of one collar is turned tapered to engage the inside of the collar which is bored with a taper running in the opposite direction. Hence, it will be apparent that by forcing these two collars in opposite directions, provision is made for their expansion, thus serving the double purpose of centering the tire on the wheel and clamping it firmly in position. This method is the means of enabling tire-turning operations to be accurately and rapidly performed, to put them back into condition to be returned to distributing points along the line, from which they will be drawn for use as the occasion for so doing presents itself.

In Fig. 14 there is shown one end of a Niles-Bement-Pond wheel lathe equipped with an expanding chucking device of the type which has just been mentioned. It is in use in the Chicago & Northwestern Railway Co.'s shops in Chicago. In this illustration, the two tapered collars are shown at *A* and *B*. Three bolts *C* slide through collar *A*, and are provided with hooks at their opposite ends, which engage the projecting edge of collar *B*. By tightening the nuts, bolts *C* pull collar *B* across collar *A*, thus causing the opposed tapered surfaces to expand the chuck and grip the work in the manner previously described. Aside from the chucking, there is nothing unusual about this operation.

Re-turning Treads of Engine Wheels

In re-turning the treads of engine wheels, it is required to reduce all of the wheels to a uniform diameter; but, it is equally important to do this work in such a way that a minimum amount of metal is removed. With this object in mind, the method of procedure followed in the Burnside shops of the Illinois Central Railroad Co., is to carefully measure the thickness of the tires on all of the wheels in a set, and after the pair of wheels has been found on which wear has reduced the tires to the greatest extent, this pair is taken to a wheel lathe illustrated in Fig. 15, to provide for re-turning the tires to obtain the necessary degree of accuracy. This machine was built by the Putnam Machine Co., Fitchburg, Mass. After the first set of wheels has been finished, the gages *A*, carried on an over-arm *B* on the lathe, are set to just contact with the turned treads of the wheels, and then each successive pair of wheels on the engine is brought to this lathe and the treads are re-turned until the same gages just come into contact with their finished surfaces. Handled in this manner, assurance is obtained that all wheels are brought to the same size. The time is one hour and twenty minutes from floor to floor.

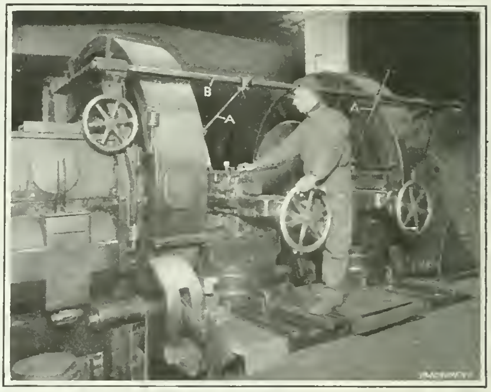

Fig. 15. Re-turning the Treads of a Set of Engine Wheels. Gages A test Uniformity of Size

Boring Locomotive Wheel Tires

There is nothing unusual about the work of boring a locomotive wheel tire, but in Fig. 16 there is illustrated a special machine built by the Niles-Bement-Pond Co., for use in the Chicago & Northwestern Railway Co.'s shops, which is furnished with a chucking device that enables the work to be set up with a minimum loss of time. On the boring machine table there are four universal chuck jaws that are operated by turning a single lever *A*, these jaws being depended upon to center the work from the outside diameter of the tire. However, the grip of the jaws could not be depended upon to hold the work down, especially in view of the toughness of the steel to be turned, unless special means were provided for that purpose.

In the present instance, this is accomplished by means of four independent hooks *B*, each of which is carried by a block secured to the boring machine table. Each of these hooks is pivoted in such a way that after it is swung up to engage the top of the tire, a key *C* may be quickly driven into place to hold the hook in engagement with the top of the work. The merit of this boring machine equipment is that the location of the tire by means of the universal chuck jaws and the holding down of the work by the four independent hooks can all be accomplished in a very short period of time by an unskilled laborer employed to help the boring machine operator; and after the tire has been bored, the same man can remove it from the machine without delay.

Special Micrometer for Fitting Tires to Wheel Centers

In fitting a tire it is necessary to have the bore of such a size that it can be shrunk on the wheel center and held with the proper degree of tension. Fig. 17 illustrates a set of special inside calipers used for testing the bore of a tire to assure having it of the proper diameter to fulfill such conditions. These calipers were developed in the shops of the Chicago & Northwestern Railway Co., and they are used to assure fitting tires in accordance with the American Railway Master Mechanics' standard of practice, which was adopted in 1909.

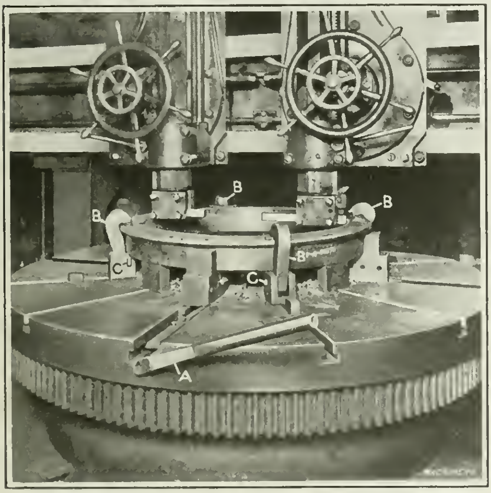

Fig. 16. Locomotive Wheel Tire-boring Machine with Universal Chuck having Quick-acting Jaws for centering the Work

In fitting tires on locomotive wheel centers, there are two contingencies which require consideration: First, where a new tire is being especially bored to fit a given wheel; second, where it is required to ascertain the thickness of a shim which must be placed between a wheel center and a tire, the bore of which is slightly too large. The calipers illustrated provide for making the necessary measurements in handling both of these classes of work.

It will be seen that there are a number of different caliper bars contained in a rack in the cabinet, each bar being threaded at one end to receive the special measuring head. Obviously, the allowance which must be made in the bore of a tire in order to obtain the desired result in shrinking it on a wheel center will vary according to the diameter of the wheel. At *A* is shown a set of shrinkage gages, of different thicknesses. Each gage is marked with the diameter of the wheel for which it is used in setting the inside caliper to obtain the proper compensation in the diameter of the bore, in order to shrink the tire on the wheel center and have it held with the required tension. The use of these gages and of the inside calipers will be best understood by briefly describing the two conditions under which tires have to be fitted to their wheels.

Considering first the case in which a new tire is being bored to fit a wheel center, the method of procedure in using the inside caliper is as follows: The diameter of the wheel center is measured with a large pair of outside calipers; and with the proper shrinkage gage *A* between the base of the hub of the graduated dial *B* and the knurled nut *C* that is carried on the threaded diameter of this hub, the length of the inside caliper is carefully adjusted to be exactly equal to the diameter of the wheel center. Then the shrinkage gage *A* is removed from beneath nut *C*, which allows this nut to be screwed down, thus reducing the length of the inside caliper by an amount equal to the thickness of gage *A*. This sets the caliper to the size to which the tire must be bored in order to be properly shrunk on the wheel center.

Where it is required to ascertain the proper thickness of sheet iron from which to make a shim for use between a wheel center and a tire that has been bored over size, in order to provide for shrinking such a tire on the wheel center in accordance with the American Railway Master Mechanics' standard of practice, use is made of the graduations which are furnished on dial *B* for that purpose. As in the previous case, the first step is to use a pair of outside calipers for measuring the diameter of the wheel center and then, with the zero graduation on dial *B* under the finger *E*, the inside caliper is set to this size. The caliper is then taken to the tire that is to go on the wheel center, and nut *C* is turned back until the length indicated by the caliper has been increased sufficiently so that its ends contact with opposite sides of the bore in the tire. The operator then observes the number on dial *B* which is beneath finger *E*. This dial has been graduated in such a way that it shows the gage of sheet iron which must be used in making a shim, in order to shrink the tire on the wheel in conformity with standard practice.

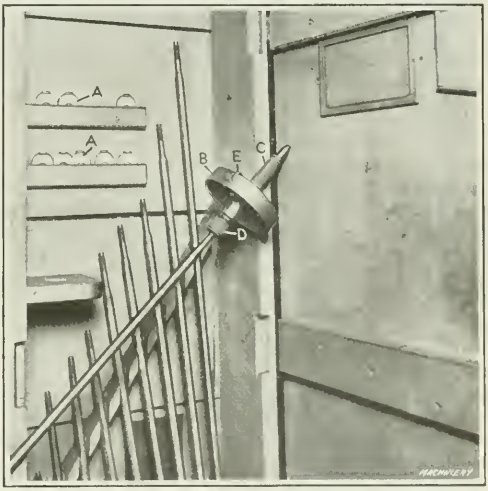

Fig. 17. Special Micrometer Calipers for fitting Rebored Tires to Wheel Centers, making Allowance for the Required Shrinkage

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SPRING MEETING OF THE A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers will be held in Chicago, May 23 to 26, with headquarters at the Congress Hotel. The Chicago sub-committee will arrange for one special session devoted to the engineering development of Chicago as a traffic gateway to the Middle West. The technical program will include important sessions arranged for by the professional sections on aeronautics, fuels, machine shop, management, materials handling, ordnance, power and railroads.

Industrial Conditions in Germany

From MACHINERY'S Special Correspondent

Berlin, March 5, 1921

AT the end of 1920, the situation in the iron and steel industry of Germany was decidedly better than it had been earlier in the year. The factors that hampered production in the early part of the year were not entirely removed, however, and the difficulties due to the lack of coal cannot be minimized. A generally pessimistic tone prevails. In the machine building industries, coal continues to be very scarce, although the supply of other raw materials, especially iron and steel, has been sufficient. The automobile, motor truck, engine, and boiler industries are suffering from lack of orders. The same is true of the watch industry. But the shipyards, having been supplied with raw materials to a sufficient extent, are very busy. The optical and fine mechanical instrument fields report slight improvements. The machine tool industry leaves much to be desired, but the small tool industry shows a decidedly better status than that of machine tools. The file factories are well employed.

Machine tools are being offered at low prices. It is said that shapers with 18-inch travel of the ram have been offered at less than 10,000 marks (present exchange, $160). On the average, precision lathes are being offered at a price slightly over 6 marks per pound (present exchange, 10 cents per pound). The special export tax that was imposed during the past year was removed on December 25 on metal-working machinery.

General Industrial Situation

According to official statistics, covering over 15,000 plants with nearly 1,200,000 workmen, about 85 per cent of the plants were fully employed at the end of the year. About 8 per cent of the plants were working short time, while the remainder appear to have been shut down. Of the plants working short time, the number of working hours varied from less than 24 a week to 45. The number of men in the union of metal workers entirely out of employment was 2.2 per cent, while 8.53 per cent were working on short time.

The lack of employment is caused in most cases by lack of orders and not by lack of raw materials. The industrial depression has been particularly noticeable in Chemnitz, Giessen, Dortmund, Karlsruhe and Mittweida, the great centers of the machine tool industry. Lack of raw materials is reported from a few places only, and in these cases it is mainly lack of coal.

The combinations and consolidations going on in the German industry, whereby the producer of raw materials combines with the builders of the finished product, are still going on. The latest report is the combination of the machine building plants of the Augsburg-Nuremberg with the Gutehoffnungshuette, from which great advantages are expected for both companies.

Foreign Business Placed in Germany

Some big orders have been placed by foreign buyers in Germany, notably a large order from Japan, and an order for 100 locomotives from Russia. Rumania has placed repair orders for 300 locomotives with German shops, the Prometheus Werke, of Hanover, being chiefly interested. The American Steel Engineering & Automotive Products, Ltd., of Berlin has obtained orders from the United States for the German hardware industry amounting to 30,000,000 marks. The same firm imported from the United States in 1920, 16,000 tons of steel for shipbuilding purposes. Otto Wolff, of Cologne, has obtained from the Hungarian Government an order for supplying railway material to that country to an amount of 200,000,000 marks.

Figures covering the imports and exports of machine tools are being compiled, but it is not yet known when these will be available for publication. There appears to be some reason for keeping these figures confidential, and it is not yet known if they will be published at all.

Labor Conditions

Strikes appear to have lost their vigor. A strike at the Ludwig Loewe works was settled by a compromise after three weeks. The workers in general seem to conceive the seriousness of the country's situation and are fulfilling their tasks with greater willingness. Investigations into the labor efficiency in the iron and steel industries have shown that the yearly output of a workman in Germany in 1920 was less than 50 per cent as compared with 1913. At the same time, wages, as expressed in marks, have increased ten to fifteen times per unit of production. Considering the high prices for raw materials, it may be said that the present actual costs of German products, as expressed in marks, are from twenty to forty times the costs in 1913. Expressed in dollars, these costs would be from 25 to 150 per cent higher than the costs in 1913.

Present Wages in Germany

In Berlin, lathe-hands are paid 7 marks (present exchange, 11 cents) per hour. (All equivalents in American currency in the following are figured at the exchange rate at time of writing: 1 mark equals 1.6 cents.) Leipzig machinists receive from 5.10 to 7.50 marks (from 8 to 12 cents per hour; the higher figure applies to piece-workers). Unskilled workers in Leipzig receive from 4.40 to 5 marks (from 7 to 8 cents per hour). The working hours are 46 per week, and the men are allowed from three to eight days annually with pay. The wages in other parts of Germany are generally around 5 marks (8 cents) per hour, with an additional 0.5 mark (approximately 1 cent) per hour paid to workmen of more than twenty-four years of age, and a small addition amounting to about 1 mark (about 2 cents) a day, for each child.

Workers in the industries not employed by the hour but by the month are receiving wages as follows (these examples are taken from Lübeck): Office employes—clerks, from 540 to 760 marks per month (present exchange from $8.60 to $12.20). The more highly paid office employes, who carry on independent work, are paid from 700 to 1050 marks per month (from $11.20 to $16.80); while those in leading office positions are paid from 1050 up to 1230 marks per month (from $16.80 to $20). Chief engineers receive 350 marks ($5.60) per month additional.

In the shops, the simplest work paid for by monthly wages, varies from 540 to 950 marks monthly (from $8.60 to $15.20); while higher classes of work are paid for at the rate of from 950 to 1360 marks per month ($15.20 to $22). Foremen receive from 950 to 1325 marks per month (from $8.60 to $21.25); and other executives about 1500 marks per month (about $24). In addition, all employes more than twenty-five years of age, receive an additional 400 marks per month ($6.40) if married, and 275 marks per month ($4.40) if unmarried.

News of the German Machine Tool Industry

The Fritz Werner Machine & Tool Works, of Marienfelde near Berlin, is said to be the best equipped factory for the manufacture of machine tools and small tools in Berlin. This factory has been hard hit by the crisis, and is now working on stock only. The Wandererwerke of Schoenau, near Chemnitz, are able to give a better report. The sales in the fiscal year 1919-1920 of milling machines, bicycles, and typewriters amounted to ten times the capital stock, and made possible a dividend of 35 per cent; the capital has been increased to 21,000,000 marks.

The Zimmermannwerke of Chemnitz, the oldest machine tool plant of Chemnitz, had a better business year during the past year than the year previous. The sales of machine tools increased considerably, and it is said that orders amounting to 40,000,000 marks are on hand. Favorable prices for raw materials have been obtained from abroad, and two large boring mills at a price amounting to several millions of marks, have been shipped to foreign buyers.

The Defrieswerke of Cologne have expanded during late years and are now establishing large warehouses for machine tools and tools in general in Vienna and Budapest in order to supply the Balkan countries from these places. It is said that a very good business is expected from the Balkan countries, especially in tools of various kinds. The Defries firm handles not only the products of the Defrieswerke, but is also selling machine tools built to Defries designs by other firms. For example, Borsig of Tegel, near Berlin, is said to be executing an order for the Defries interests for machine tools; this is interesting, inasmuch as the Borsig works are locomotive builders, and this is the second case where a German locomotive builder turns to the building of machine tools. The well-known locomotive builder I. A. Maffei of Munich, recently took up the building of machine tools.

The Borsig concern was for more than eighty years an individually owned business, but a few weeks ago it was reorganized as a corporation with a capital of 30,000 000 marks. The Borsig works of Upper Silesia have also been incorporated with a capital of 35,000,000 marks. The shares of both the companies remain in the hands of three members of the Borsig family.

As to the results obtained by other machine tool builders in Germany, it might be mentioned that the last dividend of Reinecker, Ltd., of Chemnitz, was 20 per cent; that the machine tool works of Gildemeister of Bielefeld report satisfactory business, although they are somewhat uncertain as to the future; and that the well-known manufacturer of automatic screw machines, the Leipziger Werkzeugmaschinenfabrik, vorm. W. v. Pittler, was able to pay a dividend of 15 per cent last year in spite of the great difficulties in the German machine tool industry. These firms, which must be considered among the leaders in the industry, are in a much better financial condition than the large number of the machine tool builders, who have suffered greatly from lack of business.

* * *

SPRING CONVENTION OF THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

At the meeting of the National Machine Tool Builders' Association, held in Cleveland February 24, 25, and 26, it was decided to hold the regular spring convention of the Association in Atlantic City, May 19 and 20, notwithstanding the fact that at first it was believed that the meeting in Cleveland might take the place of the spring convention. The general consensus of opinion was that at the present time machine tool builders ought to come together again in a few months to discuss the important problems now facing the industry; and in accordance with this sentiment, a vote was taken to hold the spring convention in Atlantic City on the same dates as originally planned.

BELT-DRIVEN FORGING HAMMER

Our attention has been called to the fact that the belt-driven 200-pound forging hammer described on page 658 of the March number of MACHINERY, as having been shown at the recent British exhibition, is an exact duplicate of the Beaudry "Champion" type of hammer which is manufactured by Beaudry & Co., Inc., 45 Bromfield St., Boston, Mass. The machine as shown in the March number, and designated by the British concern building it as a 200-pound forging hammer, is identical with the Beaudry No. 6, 150-pound hammer of which we are informed that it is an exact copy.

We are further informed that this is the second time that the Beaudry machine has been copied by a British concern. The first instance occurred in the early nineties. As the British patents were then in effect, the imitation was stopped after the expenditure of a considerable amount of time and money. There has been much complaint in the past about German and Japanese concerns copying American machine tools, but there has been but little attention paid to the copying of American models that has taken place in England as well as in France. Honor to whom honor is due is particularly adaptable to developments in machine tools, and we are pleased to be able to correct the impression created by the article in the March number, and to give credit to Beaudry & Co., Inc., the originators of the design.

* * *

THE EFFICIENCY OF INDUSTRIAL WORKERS

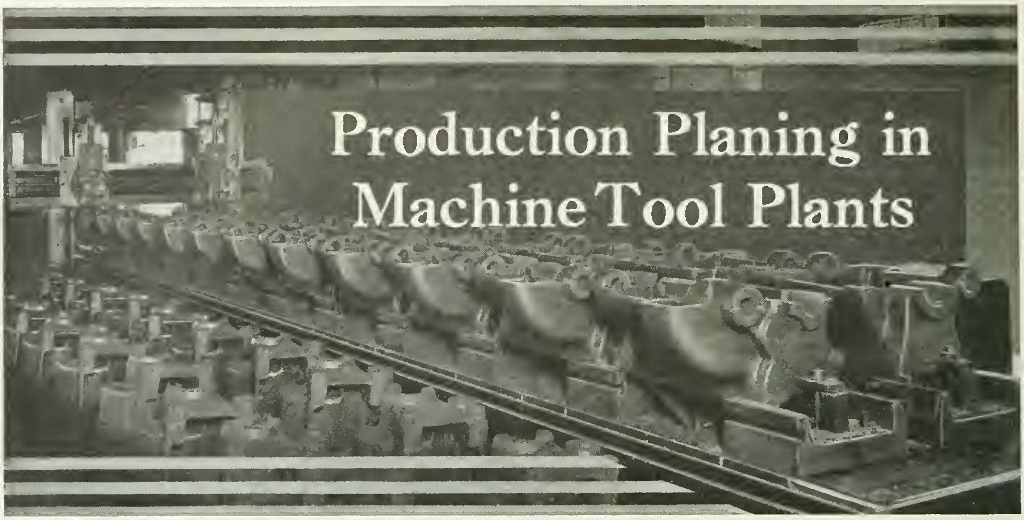
An interesting contribution on the subject of the efficiency of industrial workers is made by H. D. Thweatt, of the Van Dorn & Dutton Co., Cleveland, Ohio, in a recent number of *Industrial Management*, from which the following is taken: At a recent meeting of production engineers in Cleveland the question was raised as to whether or not the average workman of today is really producing less than he was before the war. The speaker of the evening commented on the large amount of space in current magazines devoted to the problem of greater production, and said that it would be interesting to obtain an expression on the subject from those present. As a result, the chairman requested that each one give his opinion of the matter as obtained from his particular class of manufacturing. The men present represented textile, foundry, and metal-working trades, and their statements were similar but apparently at variance with the present consensus of opinion.

The discussion had not proceeded very far before a sharp line had been drawn between the piece-workers, or the men with direct incentive, and the unskilled workman, who in most places has no incentive beyond his straight day wage. Nearly everyone stated that, as far as his experience was concerned, the piece-worker was producing more than ever before and that the increased production was not due to improved factory methods entirely, but that in their opinion the piece-worker was really working harder than ever. On the other hand, everyone was agreed that the laborer had fallen from his former place. One man was able to present figures showing that the output per man had increased more than 2 per cent, but did not state what proportion was due to the workman's effort alone. In connection with this it is interesting to study the statement of the White Motor Co. to the effect that the number of trucks produced per man has increased from 1.785 in 1913 to 2.751 in 1920. Of this increase the workman is credited with one-third.

* * *

The principal constituent of aluminum solder is tin. There are many different soldering compositions which have been used with varying success for aluminum ware, but the following composition is said to have been found satisfactory for this work: Tin, 68 per cent; zinc, 29 per cent; antimony, 2 per cent; and phosphorus, 1 per cent.

Production Planing in Machine Tool Plants



Practice of Shops Engaged in the Manufacture of Drilling and Boring Machines and Heavy Lathes—Fourth of a Series of Articles

In the building of drilling and boring machines and heavy-duty lathes, a number of planing operations are required in the process of finishing the columns, beds, and other large castings used in the construction of these types of machine tools. The accompanying illustrations show examples of the practice of several well-known plants engaged in the production of such machines, and the examples which have been selected for discussion will prove of interest both because of the ingenious fixtures and tools that have been developed, and because of the possibility of employing similar methods of planing on many other classes of work besides the parts of machines to which specific reference is made.

Planing Columns of Cincinnati Bickford Vertical Drilling Machines

In Fig. 1 is shown the work of planing, on column castings, the dovetail bearing for the sliding head of vertical drilling machines built by the Cincinnati Bickford Tool Co., Cincinnati, Ohio. It will be seen that this job is done on a planer built by the Cincinnati Planer Co., two of the drilling machine columns being set up side by side so that they can be planed simultaneously. As these castings come to the machine they have been rough- and finish-turned and finish-ground, and this accurate cylindrical surface is used as a locating point for the performance of the planing operations. From the illustration it will be evident that each casting is held by two V-blocks *A*, which engage the forward and rear ends of the ground cylindrical part of the work. The castings are held down in the V-blocks by means of two straps *B* which straddle the space between the work, and provision is made against the thrust of the tools causing lateral movement of the work by means of end-stops *C*. At the end nearest the planer cross-rail, the work is held down by means of a strap *D*, which enters the cored opening in each drilling machine column. It will also be noticed that under this end of each casting there is a small jack-screw *E* that supports the overhanging portion of the work.

Arrangement of Tool Equipment on the Planer

Two rail-heads are provided on this machine, and they are used simultaneously, the tool in each head operating on one of the two castings that are set up side by side on the table of the planer. Carried by two brackets *F* (not clearly shown in the illustration), there are tool-setting gages of the familiar form, consisting of templets of the same size and shape as the finished work, against which the planing tools can be set to provide for finishing the work to the required dimensions. Such an arrangement is the means of greatly facilitating tool setting, and thus not only reducing labor costs but also cutting down the idle time of the planer during the setting up period, which is often a very important factor in expediting production. The operations performed at this setting of the work consist of rough- and finish-planing the horizontal top face of the bearing, rough- and finish-planing the inclined sides of the dovetail, and rough- and finish-planing a groove at the center of the bearing that receives the rack for adjusting the position of the head on the machine column.

There is nothing unusual about the work done on this planer.

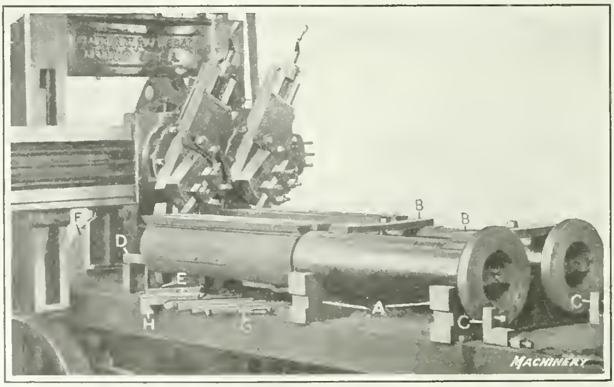


Fig. 1. Simultaneously planing Dovetailed Bearing for Sliding Head on Two Upright Drilling Machine Columns

The tools used on the horizontal top face and in the guiding groove of each casting are shown lying on the planer table, and the double-ended tools for rough- and finish-planing the inclined sides of the dovetail are shown in place in the rail-heads of the machine. Each of the tools is forged and ground at one end to the shape required for roughing out the dovetail, while the opposite end of the tool is made for performing the finish-planing operation. A high degree of accuracy is necessary on this job, and in the illustration there is shown a plug gage *G* for testing the width of the tongue groove that is planed at the center of the bearing, and a gage *H* for inspecting the form of the dovetail.

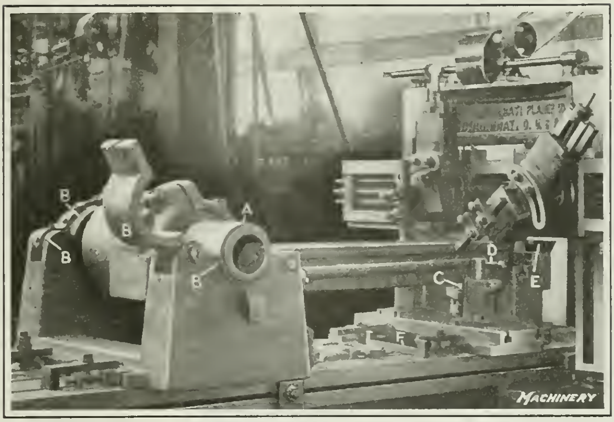


Fig 2. Fixture with Mandrel and Bearings for supporting Radial Drill Arm while planing the Dovetailed Bearing for the Drill Head

Planing Arms of Cincinnati Bickford Radial Drilling Machines

On Cincinnati Bickford radial drilling machines, the arm is supported by a vertical bearing in a boss at the left-hand end of the arm. The first operation performed on these castings is the boring and reaming of the bearing, which is subsequently employed as a locating point for the performance of other machining operations. Fig. 2 illustrates how this finished cylindrical opening in the work is utilized in setting up the arm casting for performing the necessary planing operations for the drill head bearing on the rail. From this illustration, it will be apparent that an arbor *A* is made to fit the finished bearing accurately, and this arbor is slipped into place and held in bearings *B* provided on a planer fixture for that purpose.

Prior to the time that the work is set up, care has been taken to square the fixture properly with the line of travel of the planer table, and hence it will be evident that the casting is held in such a way that the drill head bearing on the radial arm will be properly planed in relation to the finish-bored bearing by which the arm will subsequently be supported on the column of the drilling machine. Under the forward end of the work there is a jack-screw *C* that provides for leveling up the casting ready for performing the planing operations, and at each side there are two posts with screws *D* that hold the work against sidewise deflection. Also there is a strap which enters a cored opening at the end of the work nearest the planer cross-rail, to provide for holding it against lifting while it is being operated upon.

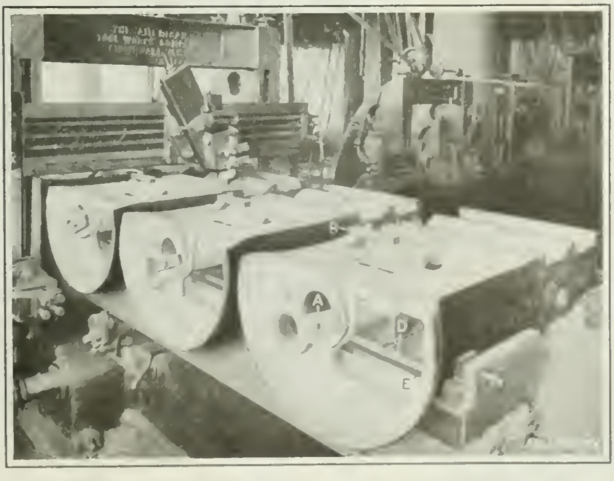


Fig. 3. Planer equipped with a String of Fixtures for supporting Castings for Radial Drill Heads while planing the Arm Bearing and the Tapered Gib Seat

As in the previous case, a tool-setting gage *E* is provided at the back of the planer table to facilitate locating tools for taking successive cuts. The planing operations performed on the dovetail bearing for the radial drill head are of approximately the same nature as the corresponding operations on the column of the vertical drilling machines, previously described. The form of the finish-planed work is tested with gage *F*, and the spacing between the sides of the dovetailed bearing is measured with a micrometer caliper. From the illustration of the set-up of the Cincinnati planer used for the performance of this job, it will be apparent that two rail-heads are employed simultaneously, one of which carries a tool that operates on the horizontal face of the work, while another tool is utilized on one of the inclined faces of the dovetailed bearing. For the performance of the sequence of operations required on these castings, the time consumed in setting up the job and doing the planing is 3½ hours.

Planing Heads for American Radial Drilling Machines

Fig. 3 shows a 54- by 36-inch planer built by the American Tool Works Co., of Cincinnati, Ohio, which is used in the plant of this company for planing the arm bearing in head castings of American radial drilling machines. Six castings are set up on the planer table in independent fixtures; and as they come to the machine, the cover fit has been planed on these castings and this finished surface is used as a locating point. The cover fit is flat with a shoulder at the left-hand end of the work as it is shown, so that one of these castings can lie on the planer fixture with its planed shoulder drawn up against the finished edge of the fixture, thus locating the work ready for planing. Provision is made for holding each casting in place on its fixture by means of a strap and bolt *A*, which pulls the shoulder on the work up against the fixture, while provision is made for holding the work down by means of two other straps, one of which is shown at *B*. The third strap, which is not shown, bridges the gap between two adjacent castings so that it exerts a clamping pressure on each.

By referring to the illustration Fig 4 it will be seen that there is a tool-setting gage *C* of the type commonly used for locating each of the tools employed for the performance of a sequence of planing operations. In setting tools for taking the

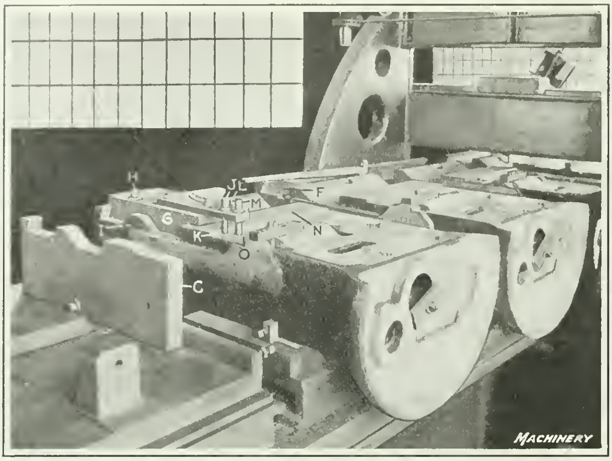


Fig. 4. View of Planer shown in Fig. 3 from the Opposite Side of the Housings. Here are shown Gages provided for testing the Accuracy of the Planed Surfaces

roughing cut, a practice is made of leaving 0.010 inch of metal for removal by the subsequent finishing cut. The cuts taken on horizontal, vertical, and inclined faces are done with tools of the forms which have been discussed in connection with descriptions of previous planing operations. A cutting speed of 45 feet per minute is employed in all cases, while roughing cuts are taken with a feed of 1/16 inch and finishing cuts on horizontal surfaces with a feed of ¾ inch per table stroke. On vertical and inclined faces, the commonly used rate of feed is ¼ inch.

Application of a Tapered Work-setting Strip

There is a principle employed in the performance of this sequence of planing operations, which is used in various ways where it is required to plane one side of a piece of work at a specified angle to another side that is finished at the same setting. In the present instance, the use of this principle is made necessary through the need of first planing the inclined side of the dovetailed bearing and then planing the seat for a tapered adjusting gib at a specified angle to the inclined side of the bearing. This result is accomplished in a very simple manner. It has already been explained that the casting is located by abutting a previously planed shoulder on the drill head cover fit against a finished edge of the fixture, the work being held back in this position by means of strap *A*, Fig. 3. Such a setting holds the work in place for planing the dovetailed bearing, and after this has been finished it is necessary to loosen the three clamps that hold each piece of work, and to reset the casting at such an angle that it is held in the proper position for planing the angular surface which constitutes a seat for the tapered gib.

This result is accomplished by the following method: For planing the straight side of the dovetailed bearing, the shoulder on the planed under side of the work is clamped against face *D* of the fixture. Then to reset the work for planing the tapered seat for the adjusting gib, the clamps are released and a tapered strip *E* is inserted between the edge of the fixture and the shoulder on the work, after which the straps are tightened by first screwing home the nut over strap *A* and then tightening up strap *B* and the third strap, which is not shown. It will be evident that locating strip *E* must have the same taper as the gib that will subsequently be used in adjusting the fit of the finished drill head bearing on the radial arm; and to plane the work in a way which fulfills this condition, it must be inclined from its previous position at an angle equal to the taper of the gib. The operator can then proceed to plane the gib seat in the radial arm bearing in the drill head.

Gages Used for Testing the Finished Work

In the performance of planing operations on these radial drill head castings, it is required to have a definite relationship between the positions of individual faces planed on the work. Fig. 4 illustrates a set of gages for determining the accuracy of the results which have been obtained. At *F* there is shown a gage-block used for determining the accuracy of form of the dovetailed bearing, this block being used with a film of red lead to ascertain whether the bearing has been properly finished. For checking up the relative positions of the various surfaces which have been planed on the casting, use is made of a gage *G* that carries a number of plugs which afford means of ascertaining the accuracy of the dimensions on which limits are specified.

Plug *H* measures from the top surface of the work to the bottom of groove *I*. This plug is of a diameter equal to the width of a rack which will be assembled in slot *I*; and to assure the rack entering its seat, plug *H* is required to turn freely in slot *I*. Plug *J* slips down in contact with the side of shoulder *K* to ascertain the accuracy of its position relative to other fixed points on the work; and plugs *L* and *M* are used for determining the respective positions of faces *N* and *O*. This gage is used in conjunction with a feeler 0.0015 inch in thickness. There must not be room for such a feeler to enter the space between plug *J* and shoulder *K* with the gaging plug in place; and on all horizontal surfaces, the feeler must be held under the base of the plug, but it must not be held between the plug flange and the body of the fixture with the plug pushed down as far as it will

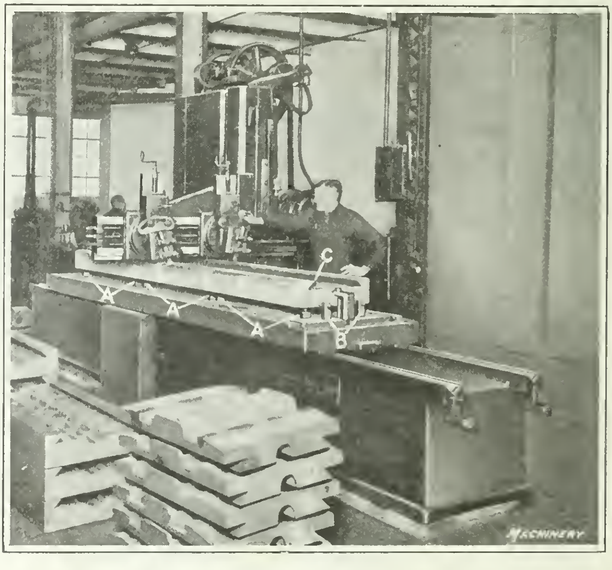


Fig. 5. Open-side Planer equipped for machining a String of Three Castings for Tables of Horizontal Boring Machines

go. The latter condition would indicate that the bottom of the plug failed to reach the work; otherwise, the flange would not hold the feeler against the frame of the fixture. A further test of the accuracy of the planed work is made by bringing a dial indicator successively into contact with the four corners of the finished top surface. To pass inspection, it must not show a variation of over 0.002 inch. For the performance of this planing operation, the time is thirty-one hours for planing six castings.

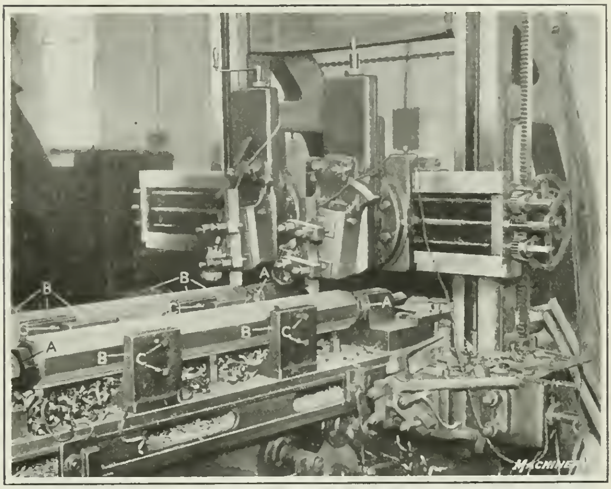


Fig. 6. Method of planing Octagonal Bars for Boring Machines. After planing Each Successive Side the Work is reset from the Previously Planed Side

Planing Tables for Cleveland Boring Machines

In building horizontal boring machines, the Cleveland Machine Tool Co., Cleveland, Ohio, uses open-side planers built by the Cleveland Planer Co., for machining many of the larger parts of its product. Fig. 5 shows the work of planing a string of three table castings, the operation here illustrated being the first one performed on these pieces. The method of setting up the castings for planing is so simple that it hardly calls for a description. It will be seen that there are three castings set up end to end, and that they are carried on small jacks *A* which level up the castings, while the end pressure is supported by two stops *B* of a commonly used type, straps *C* being employed to hold the castings down. The operation performed at this time consists of planing the sides of the table and the top surfaces and dovetailed bearing for the table on the saddle, by which it will subsequently be secured to the bed of the boring machine.

Corners of Square-nosed Tools Used as Single-point Tools

It will be noticed that two rail-heads are provided on the planer in order that provision may be made for operating simultaneously on two faces of the work, thus reducing the time required to complete the sequence of machining operations. In the illustration are shown the tools used for planing the sides of the tables, the top faces, and the clearance space between the dovetailed bearings. It will be seen that these tools are held at an angle, so that the vertical feed of the heads can be utilized for running the tools down the sides of the castings, the cuts being taken with the corners of the tools. By feeding the heads horizontally along the rail, the opposite corners of the tools can be used for rough-planing the two top faces of the work and the clearance space between the dovetailed bearings.

Next, the heads are set at an angle of 45 degrees, and single-point tools are used for rough-planing the inclined sides of the dovetailed bearings; and with the same tool setting, but using a horizontal feed of the planer heads along the rail, provision is made for roughing the horizontal faces of the dovetailed bearings. Finishing cuts on all horizontal surfaces of the work are then taken with broad square-nosed tools of the gooseneck type, and the sides of the tables are planed with side finishing tools, while the inclined faces of the dovetailed bearings are finished with dovetail finish-planing tools. The time required for performing these operations on three table castings is 5½ hours.

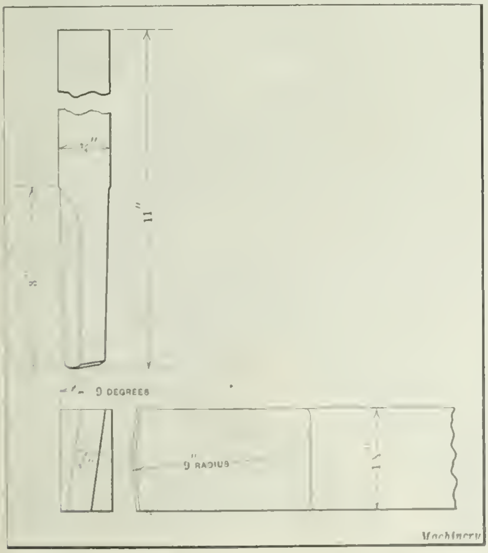


Fig. 7. Shearing Type of Tool used for the Performance of Finish-planing Operations on Steel

Planing Boring-bars for Niles Boring Mills

On vertical boring mills built by the Niles Tool Works Co., in Hamilton, Ohio, the boring-bars are machined from steel forgings which come to the machine shop in a rough octagonal form. In the condition in which they are delivered to the planer, the ends of these forgings have been cut off, faced, and centered, so that they may be set up on centers as shown in Fig. 6. There are four bearing faces on these bars that are rough- and finish-planed, and four intermediate faces that are also rough- and finish-planed. In setting up this job, the method of procedure is to first plane one surface of the work, which is used in effecting locations for the performance of subsequent planing operations. As previously mentioned, and as shown in the illustration, the work is supported on centers *A*, and it will be seen that there are eight posts *B*, four of which extend up at the side of each boring-bar forging to be planed; and these posts carry two set-screws *C* each. After the desired position of the forging has been obtained by means of a square or 45-degree angle gage, these set-screws *C* are tightened against the work to hold it in that position.

In performing the planing operations on these forgings, the method of procedure is to first rough-plane all eight sides of the bar and then finish-plane three of the intermediate faces between the bearing faces, and the rack face, after which the work is removed from the planer and sent to other departments of the machine shop, where rack teeth are cut to mesh with the pinion that will provide for raising or lowering the boring-bar as required. Next, the end of

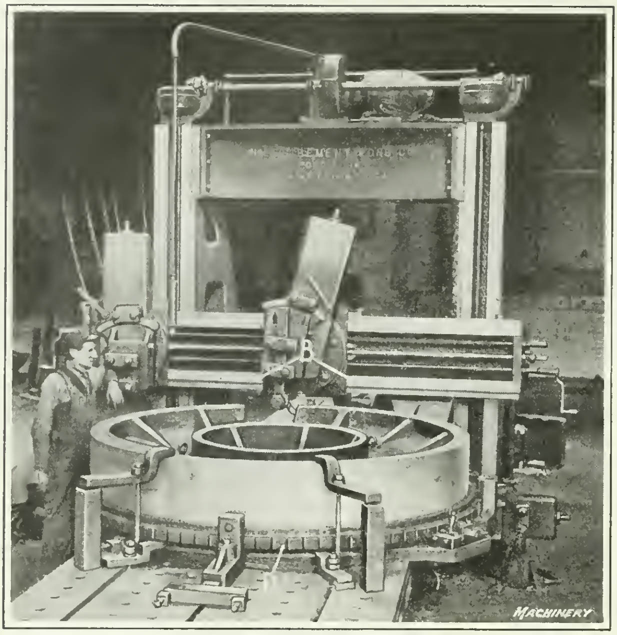


Fig. 8. Planer equipped for machining the Seat for the Removable Segment of a Car-wheel Driving Gear

the bar is bored and all necessary lathe work is completed, after which the bar is returned to the planer where a second roughing cut and a finishing cut are taken over the four bearing surfaces. The rough-planing cuts are taken with a round-nosed tool, as shown at the front of the illustration, at a speed of 45 feet per minute; and approximately ¼ to ½ inch of metal is removed, with a feed of 1/32 inch per stroke. The second roughing cut removes 1/32 inch of metal, the operation being performed under the same conditions of speed and feed as the first cut.

For performing the final finishing cut, a shearing tool is employed, which is of the form shown in operation at the rear of Fig. 6, and in detail in Fig. 7. This tool has the cutting edge inclined at an angle of 9 degrees to the line of travel of the planer table, and there is a 6-degree clearance at the back of the cutting edge, which is curved to a radius of 9 inches. Tools of this kind are frequently employed for the performance of finish-planing operations on steel, and they are found capable of attaining a high degree of accuracy and perfection of finish. In the present instance, the depth of cut is from 0.003 to 0.004 inch, with a cutting speed of 45 feet per minute and a feed of 1/64 inch per stroke of the planer table.

Planing Seat for Removable Segment of Niles Car-wheel Lathe Driving Gear

On car-wheel lathes built at the Niles Tool Works Co., provision is made for setting up the wheels while they are still mounted on the car-wheel axle, thus affording a convenient means of turning the treads of the tires when they become worn. These lathes are designed to drive the work from the middle of the axle by means of a chuck carried at the center of a herringbone gear through which the drive is transmitted. For setting up the work, it is required to be able to roll the two car wheels and their axle into position to be gripped by the chuck at the center of this gear, and for this purpose there is a removable segment *A* in the rim, Fig. 9, which can be taken out to admit the axle. The seat *B* for the segment in this gear and also the sides of the segment are planed to the required form, so that the contacting surfaces will come into uniform engagement.

Fig. 8 shows a general view of a 72- by 72-inch planer built by the Niles-Bement-Pond Co., 111 Broadway, New York City, which is equipped for handling this job, while Fig. 9 illustrates a close-up view of the work and the gages *C* used for setting the tool-head for planing the angular sides of the segment seat in the gear. These car-wheel lathe driving gears are made of cast steel, and it will be seen that they are set on the planer, Fig. 8, on an indexing fixture *D* that has notches cut around its periphery so that provision may be made for first planing one side of the seat for the segment and then rotating the work sufficiently so that it is accurately located for planing the opposite side of the seat. The sides of this opening are both radial, and the indexing of the work is easily accomplished by specifying the included angle between the radial sides of the opening to be planed in the work, so that indexing may be accomplished by turning the work through a specified fraction of a circle.

As shown in Fig. 9, the rail-head is set at such an angle that the point of the cutter bit in the tool-holder contacts uniformly with the angular tool-setting gage *C* at the two extreme ends of a side of this gage, which corresponds to one side of the work being planed. In this illustration, there is also shown the segment *A* of the gear rim which has been

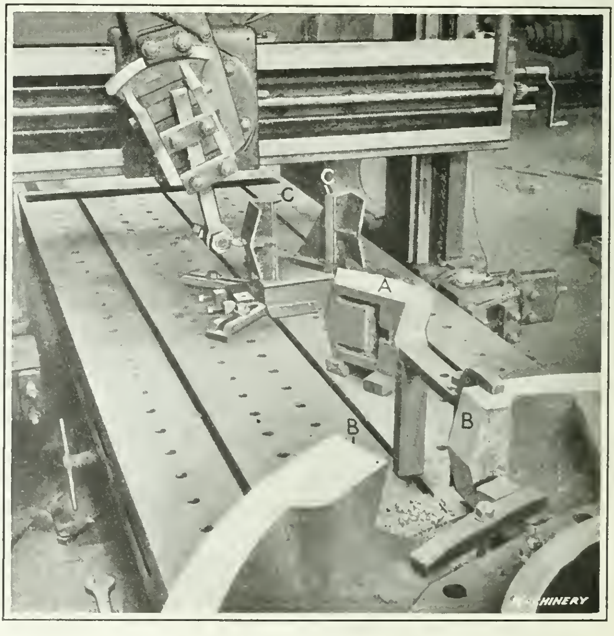


Fig. 9. Close-up View of Work shown in Fig. 8 and of the Removable Segment

planed to the proper form to fit the planed seat in the rim. The method of procedure in handling this job is similar to that on the rim of the gear, except that the angles of inclination are reversed, that is to say, a male fit on the segment engages a female fit on the rim of the gear and vice versa. This work is done on a smaller planer. Each of the surfaces to be planed on the gear and on the removable segment is 5 inches wide by 12 inches total length, and twenty hours are required to complete planing the rim of the gear.

Use of a Reach-bar for T-slotting a Sellers Faceplate

In discussing methods used for the performance of planing operations in the shops of machine tool builders specializing in the construction of planers, descriptions were given of the use of open-side planers and of independent housings for supporting auxiliary side-heads used in conjunction with the heads carried on the cross-rail and housings of planers of the usual design. Both of these equipments are especially adapted for planing work that is of such a size that there is not sufficient capacity to allow it to pass between the housings of an ordinary planer. There is still another way in which work of this general character may be handled, and in Fig. 10 this method is shown in use at the plant of William Sellers & Co., Inc., in Philadelphia, Pa., where a 90-inch faceplate is illustrated during the process of planing the under-cut portions of the T-slots. This casting would not pass between the planer housings, but use is made of a tool known as a "reach-bar" that projects out a sufficient distance from the planer cross-rail so that the work can be traversed under the tool for the necessary distance and then have the direction of table travel reversed before the work strikes the housings.

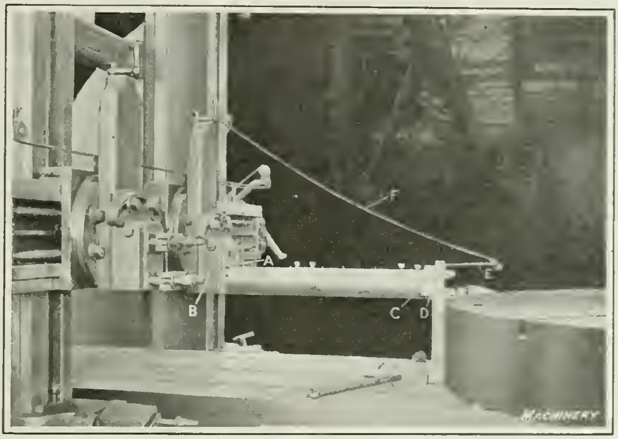


Fig. 10. Use of a Reach-bar for planing T-slots in a Lathe Faceplate which will not pass between the Planer Housings

The reach-bar is secured to an apron *A*, substituted in clapper-box *B* in place of the standard clapper. This bar is of the required length for the work to be planed. In the present instance, it is apparent that the T-slots are distributed radially around the faceplate, and that the reach-bar must be of a length approximately equal to that of the radius of the casting in which the T-slots are to be planed. It will be seen that an auxiliary clapper-box *C* and clapper *D* are provided at the front end of the reach-bar, and that a special form of tool-lifter is furnished with an arm *E* extending forward from the special clapper to give the required leverage, so that the apron may be easily lifted with a cord *F* that runs back to the operating position. Equipped in this way, the planer-hand can pull the cord to lift the tool clear of the work during the return stroke of the planer table. The cutting tool at the end of the reach-bar does not show well in the illustration; but it is of the familiar elling type used for T-slotting and other under-cutting operations.

* * *

A consular report from Mexico City states that the Minister of Finance of Mexico has signed a contract with American interests for a credit of $5,000,000 with which to purchase railroad equipment in the United States.

THE METRIC SYSTEM IN AN AMERICAN SHOP

In reply to Mr. Halsey's article in the March number of MACHINERY, entitled "The Metric Equivalent Scheme," I wish to state that when I prepared the article describing the use of the metric system in the De Laval Separator Co.'s plant, which appeared in the August number of MACHINERY, I did not intend to become involved in an argument as to which system is the better one, and I do not intend to do that at this time. I have too much else to do, even were I disposed to enter into what I consider would be a useless controversy.

My article was intended to show to other shop men just what had been done here in changing over from one system to the other and how it was done. It is an entirely frank and true statement, and I only thought it might be helpful to some others who, like myself, might be confronted with the necessity for the change for special reasons, and who might be troubled by anticipations of difficulties which in our case did not arise, and which I believe need not arise if our plan is followed and all prejudice thrown aside. The questions asked of me by Mr. Halsey might very easily be answered, but never to his satisfaction. The answers are available at our plant for anyone who sincerely seeks light upon this contentious question for actual use in machine construction; and it is perhaps sufficient for me to say that, if the formidable appearing difficulties suggested had really been encountered by us, then no result appeared from them in our cost accounts, which, though I am not personally responsible for them, I believe to be entirely reliable.

Poughkeepsie, N. Y. THEO. H. MILLER

Works Manager, De Laval Separator Co.

* * *

FOREIGN TRADE IN MACHINE TOOLS

The value of the machine tools exported from the United States during 1920 was over $25,000,000, or an average of $2,100,000 a month. Contrary to general belief, the exports of machine tools continued quite heavy during the last months of the year. In October they amounted to $1,775,000; in November, $1,950,000; and in December, $2,200 000. Of the total exports during the year, lathes of different types were exported to a value of $7,500,000; grinding machines to a value of $4,000,000; and other machine tools to a value of $14,000,000. In 1918 the total exports of machine tools amounted to $27,500,000, and in 1919 to $28,000,000. Metal-working machinery other than machine tools was exported in 1920 to a value of nearly $18,800,000, as compared with $24,000,000 in 1918 and over $30,000,000 in 1919. The United Kingdom took, in 1920, over $11,000,000 worth of metal-working machinery, and Canada nearly $6,000,000 worth. France took $7,600,000 worth and Japan $4,250,000 worth, while Belgium bought nearly $2,000,000 worth. Spain became an important customer during the year, taking $1,140,000 worth of metal-working machinery; British India, $1,375,000 worth; and China nearly $1,000,000 worth.

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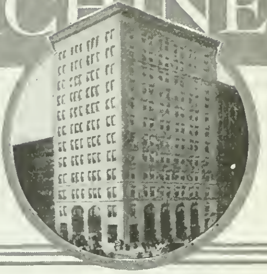

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SOME PROBLEMS AHEAD

The new era in production which we are entering will present many new problems for solution. During most of the past five years, demand has so exceeded supply that until within twelve months there has been little real competition in machine tools. But this condition is now definitely and permanently changed and we return to the prewar commercial conditions under which goods must be sold on merit and by effort in a keenly competitive market. Meanwhile, the general standard of living has been raised; people of all classes demand more from life and have come to consider as necessities many articles that were purely luxuries ten years ago. These higher standards of living require greater production and lower costs if they are to be maintained. To some extent greater production may be obtained by increasing the personal efficiency factor; but mainly by the use of more highly developed machinery, which manufacturers of machine tools and of all other kinds of productive machinery should be well able to supply. The call will not be for *any kind* of machine that will turn out a given piece of work, but for some specific type that will produce the piece of work required in the shortest possible time.

This tendency is already in evidence. The builders of machinery adapted to production in quantity are receiving more inquiries than at any time since the war, and these inquiries are not so much for prices as for time estimates and for explanations of the methods by which a certain part can be produced at the lowest cost. Even in the automobile field, where we have become accustomed to think that the highest development has been reached in productive capacity, we find a great deal of effort being made to reduce production costs further.

All this holds a promise for the machine tool manufacturer. The shops of the country are full of machine tools; but whoever can design a machine that will produce the same quality of work in greater quantity and at lower cost has a good chance to replace with his machine others that are too costly in operation to compete with the newer developments. This opportunity exists in foreign as well as in domestic markets, and constitutes one of the problems which our manufacturers are now working out.

* * *

IDEAS OFTEN REPRESENT VALUE

The real value of a machine tool is not expressed by simply adding the cost of materials, of labor and the overhead. Machine tools sometimes embody production ideas that are of incalculable value in dollars and cents, and for which the manufacturer often receives but a scant return.

To illustrate—a manufacturer brings out a machine capable of producing 50 per cent more than its nearest competitor. Mechanically the machine may be only a little more complicated and the labor and material represent only a small increase in cost over the former type, so the manufacturer sells it for 20 per cent more; but its increased production may pay for its cost in a single year and the increase for some years following may be pure "velvet." The buyer or user of such a machine is the beneficiary, rather than the designer or manufacturer who is really responsible for the increased production.

Machine tool builders generally have sold their ideas too cheaply. Their prices are usually based on cost of materials, labor and direct overhead, with almost nothing for the inventive ability and costly experiments necessary. We often hear of inventors of machines and appliances used in the manufacture of typewriters, munitions, shoes and other commodities, who have received large amounts for their ideas. One photographic invention, and not a revolutionary one, is said to have netted as large a return as $300,000 to the inventor.

The success of our most prominent machine tool firms has been a slow and laborious development, sometimes covering more than one generation, because they have been satisfied with very moderate profits, even on machines which embodied radical improvements. This liberal policy has done more than can be computed to reduce prices for the general public, and we do not suggest its reversal. We simply call general attention to the fact.

* * *

NOW IS THE TIME FOR READING

The experienced mechanic knows that it is not possible to learn his trade out of a book; it must be learned in the shop, and the teacher should be another experienced mechanic. But he knows also that good books on mechanical subjects enable the learner to acquire his trade more quickly and thoroughly. Books on machine shop practice, written by men who have had personal experience in the work they describe, will help the learner to grasp the principles underlying the methods he employs and to look beyond his daily routine. With their help he will be able to step upward on the ladder of success more rapidly.

The experienced mechanic knows also that no man, however well versed in his trade, has a complete knowledge of the ramifications of machine shop practice, and that publications treating of it are of the greatest value as works of reference even to those men who have had many years of experience.

Periods of depression like this afford time for men engaged in shop work to fit themselves for future responsibilities by the study of mechanical books. When their shop is running on short time, instead of spending their spare hours unprofitably a part, at least, should be invested in study that will return them big dividends in future years.

It will pay employers also to encourage their men, and particularly their younger men, to spend their time in mechanical study. The cost of good books on machine shop practice is insignificant compared with the increase in earning power of men who acquire the information they contain. One of the greatest mistakes a man can make is to limit his purchases of educational books because his earnings have decreased. Real estate depreciates, stocks and bonds shrink in value, but knowledge is an investment that the owner can never lose out on.

The National Railroad Labor Agreement

EFFICIENCY in the operation of railroads, both in the traffic and in the machine shop divisions, is of vital importance to the industries of the country; but, as was pointed out in an editorial in the March number of MACHINERY, efficiency in the operating of railroad repair shops cannot be obtained unless railroad executives have complete control of the shop management. As long as the so-called "National Agreement" between the railroads and their employes is in force, there is no hope for real efficiency.

On September 20, 1919, when the railroads were still under government control, an agreement was made between the Director General of Railroads and the railroad workers, represented by the Railway Employes Department of the American Federation of Labor. This agreement specifies working rules for men in the Mechanical Section of the railroads.

Loss in Efficiency and Increased Expense

The American Association of Railway Executives early in the year appealed to the United States Railway Labor Wage Board for an abrogation of the "National Agreement," pointing out that its continuation would put many of the railroads of the country into bankruptcy. The Labor Board took no action, ruling that the agreement should remain in force until representatives of the employes had been heard.

The figures submitted by the railroad executives before the Labor Board showed that in 1917, before the Government took over the railroads, they employed 302,828 machinists, boilermakers, blacksmiths, electricians, and other shop employes and apprentices. In 1920 there were 443,774 such employes, an increase of 47 per cent; but it was also stated that the number of locomotives and cars maintained by this increased shop force in 1920 was but slightly greater than the number handled in 1917. The wages of railroad shop employes in 1917 were approximately $318,000,000, while in accordance with the wage scale approved last July by the Railway Labor Board, the annual payroll of shop employes is approximately $890,000,000, or an increase of 180 per cent as compared with 1917. Comment upon an increase of 47 per cent in personnel and 180 per cent in amount of wages paid for practically the same amount of work done is unnecessary.

Objectionable Rules in the "National Agreement"

The decreased efficiency and the increased cost are partially due to objectionable rules included in the "National Agreement on Working Conditions," according to which it is impossible for the railroads to operate their shops efficiently or in a manner similar to the operation of other industrial undertakings. In the following, some of these rules are quoted.

Rule 8—Employes regularly assigned to work on Sundays or holidays, or those called to take the place of such employes, will be allowed to complete the balance of the day unless released at their own request. . . .

Rule 9—Employes required to work during lunch period shall receive pay for one hour straight time and be allowed necessary time to procure lunch without loss of time. . . .

Rule 8 makes it necessary to pay the Sunday rate for the full eight hours if any work whatever is required by a shop man on a Sunday or holiday. Rule 9 pays the employe at three times his regular hourly rate if he is required to work during the twenty-minute lunch period, and still gives him the privilege of obtaining his lunch later on the company's time with full pay.

Rule 16—When an employe is required to fill the place of another employe receiving a higher rate of pay, he shall receive the higher rate; but if required to fill temporarily the place of another employe receiving a lower rate, his rate will not be changed.

Rule 18—When new jobs are created or vacancies occur in the respective crafts, the oldest employes in point of service shall, if sufficient ability is shown by trial, be given preference in filling such new jobs or any vacancies that may be desirable to them. All vacancies or new jobs created will be bulletined. Bulletins must be posted five days before vacancies are filled permanently.

Comment on Rule 16 is unnecessary. Rule 18 introduces many loopholes for inefficiency. It necessitates the granting of a try-out at new jobs to all men that are older in point of service, involving loss of time and inconvenience; it requires the posting of a bulletin on vacancies five days before they are filled, in order to solicit applications from men who rank on the seniority list and are therefore entitled to a try-out; and it involves a waste of time by shop employes who take the position that as Rule 18 requires the posting of bulletins, the men are entitled to read these bulletins during working hours. This rule has made the railroad shop bulletin board far more effective as a time-waster than the well-known tool-room window.

Rule 27—When it becomes necessary to reduce expenses, the force at any point or in any department or subdivision thereof shall be reduced, seniority as per Rule 31 to govern; the men affected to take the rate of the job to which they are assigned. Five days' notice will be given men affected before reduction is made, and lists will be furnished local committee.

In the restoration of forces, senior laid-off men will be given preference of re-employment . . . and shall be returned to their former position. . . .

No shop can be efficiently managed by seniority rules. Ability and efficiency only should be the guiding principles. Rules 18 and 27 destroy the initiative of the workman, because he will be rewarded by promotion only in case of seniority. The most capable men cannot be given a responsible job when a vacancy occurs, and the whole organization deteriorates.

In addition to the rules quoted, there are Rules 35 to 38 inclusive, dealing with complaints. These rules provide for the handling of all cases by the foreman, general foreman, master mechanic, or shop superintendent, each in their respective order in conjunction with the duly authorized local committee or their representative. They further provide for a long chain of general committees and higher railroad officials being brought into the case.

These rules cause an almost unbelievable loss of time and deprive the shop management entirely of their proper executive authority. Briefly interpreted, they mean that the foreman or other shop official cannot discharge an employe without first conferring with a committee of three of the fellow-workmen of his craft. Even the slightest complaint may be carried from one deciding authority to another until time has been wasted by all executives up to and including the president upon trivial matters. Furthermore, all the conferences are held during regular working hours without loss of time to the committee men who, being human, may be expected not to hurry the proceedings.

Fair-minded men will realize that unless some changes are made in the rules provided for by the "National Railroad Agreement," real efficiency can never be expected in the railroad shops, and until there is efficiency in the railroad shops there can be no real efficiency in the management of the railroads; nor can there be a reasonable adjustment of the present freight rates and passenger fares which, with a decrease in other costs, ought to be reduced.

The Problem of Taxation in the Industries

By GEORGE E. RANDLES, President, The Foote-Burt Co., Cleveland, Ohio

THE writer was much interested in the article "Taxation and the Industries" published in the March number of MACHINERY; those who have not read this article should secure a copy and give it careful study. It deals with a subject that is of the greatest importance to all manufacturers at the present time. Faulty methods of taxation work a great hardship on the industries, and may be the cause of serious depressions and difficulties; whereas carefully thought out methods of taxation may aid the industries in overcoming the difficulties now facing them because of the abnormal conditions caused by the war.

While the writer does not profess to be an expert on the subject of taxation, he believes that the method advocated by Mr. Price is sound, and that it would supersede at least the excess profits tax and probably some of the other taxes.

Advantages Gained by the Proposed Method

There does not appear to be anything wrong with the method proposed by Mr. Price involving the payment, as a tax, of a certain percentage of the total amount of the monthly payroll of each employer. On the other hand, anyone who will examine this method carefully can clearly see a number of advantages:

1. In taxing the payroll, there would be no danger of duplicate taxation; and whatever the article might be, no matter how many hands it passed through before reaching the final consumer, it would only carry its tax on the actual labor put into it, and this tax would not be duplicated.
2. A tax assessed on the payroll would immediately become an item of cost, and would enter into the cost of production just the same as the direct labor cost. There would never be any question as to what the tax would amount to, and inasmuch as it would not be duplicated and as there would be no inclination to add to the price to cover the possibility of a high tax, unknown in advance, the price to the consumer would be lower.
3. The collection of the tax would be extremely simple. There is nothing in connection with bookkeeping systems in the different industries easier to find and audit than the payrolls. A tax of this sort would therefore effect a large saving in its collection, and its prompt payment would be assured, which would be an advantage to the Government.
4. This method of taxation would eliminate the doubt as to what the excess profits tax is going to be, and the manufacturer would know from day to day exactly what this tax amounts to; he would know this as accurately as he would know what his payroll for that day amounted to.
5. This method of taxation would encourage thrift in many cases. The farmer, for instance, who is industrious and willing to work himself and to apply to his work modern farm machinery, would have an added advantage over the farmer who used more hired labor.

Manufacturers Should Give Attention to Taxation Problems

Since the method of taxation proposed by Theodore H. Price was first called to the attention of the writer, he has given it considerable thought and has discussed it with a number of manufacturers; while some objections were raised in the beginning of the discussion, these have all been met by the advantages, clearly in evidence, when the method is carefully examined. The writer has yet to find anyone who does not think that the principle is good and sound, and that it would cure many of the evils of our present system of taxation.

Manufacturers, therefore, should give earnest attention to this matter. Having decided that the method proposed by Mr. Price is superior to any other method that has been advocated, they should immediately write to their Senators and Congressmen at Washington, calling to their attention that Theodore H. Price, publisher of *Commerce and Finance*, New York, has devised a substitute for the excess profits tax that combines simplicity with equity. They should also point out that it is believed to be the best method for furthering the prosperity of the industries and the country as a whole, and that it would be the means of easily collecting the amount of money now obtained through the taxes that have proved objectionable and injurious.

The System of Taxation Should be Simple and Direct

When taxes are raised by complicated methods that are difficult for the layman to understand, as during the past few years, they are to a large extent paid under protest. Under the system of taxation now in force there is no way in which a manufacturer can obtain even a fair idea of what his taxes are going to be until he has closed his fiscal year, no matter how complete his accounting and cost system may be. His books may enable him to obtain a very accurate idea of how his business is running, but the excess profits tax is always one of mystery and complication, and in order to be sure that he is on the safe side, the manufacturer finds that it is absolutely necessary to increase prices accordingly, to take care of any uncertainties. On the other hand, the tax proposed by Mr. Price would prove a valuable means for stabilizing prices, and it would, above all things, encourage thrift in the conduct of business. It should not be considered wrong to make a legitimate profit.

More Discussion by Manufacturers on Taxation is Necessary

One of the reasons why we have such a complicated system of taxation is, perhaps, partly due to the fact that business men and manufacturers in general have not in the past taken a decided stand in advocating any particular form of taxation. They have accepted from Congress whatever Congress has handed to them. They have paid the tax grudgingly, because the basis for the collection of the tax was unreasonable and unscientific, but they have never unitedly tried to impress Congress with the fact that there is a method that would overcome the objections to the present system. The opportunity is now presented to do this.

Everyone to whom the writer has spoken about the proposed method has become quite enthusiastic when its advantages were fully understood. Perhaps there are some objections from a fiscal point of view, but if so, these remain to be pointed out. Meanwhile, let every manufacturer who approves of the method, who can see its advantages, who wants to substitute for the present conglomeration of taxation methods a simple, direct, and effective scheme, write immediately to his Senators and Congressman, telling them that before anything is done to institute new methods of taxing commerce and industries, they should carefully investigate Mr. Price's proposed method, and if no serious objections, not yet pointed out, are found, it should be embodied in the new taxation laws. The congressional committee which will handle new taxation bills should also be advised to consult Mr. Price, who undoubtedly is an authority on the subject, and the new Secretary of the Treasury would also do well to familiarize himself with the proposed method before making any recommendations for taxation.

Readjustment of Living Costs and Wages

The industrial depression through which the country has passed and from which it is gradually emerging has been the direct cause of the reductions that have taken place in prices, and therefore also makes necessary an adjustment in wages corresponding to the reduced cost of living. When prices went up, wages went up with them; and naturally, now that prices are coming down, wages must also be adjusted to the new level that prices will assume.

OFFICIAL statistics show that food prices in March, 1921, were 32 per cent below corresponding prices in March, 1920, and wholesale prices of all commodities were 35 per cent below the high peak last year. Prices of clothing have been reduced by even greater percentages; but rents and the cost of fuel have not been reduced, and will not be until wages in the building and mining industries have been materially reduced. Consequently, the total cost of living has not been reduced by quite as great percentages as food and clothing, but statistics covering all items that make up the necessities of life indicate that the actual cost of living has been reduced about 20 per cent, with indications that the reductions will be still greater as soon as retailers generally price their goods in accordance with wholesale prices, and building activity increases, forcing rents down.

Readjustment of Wage Scales

The attendant reductions in wages throughout the country have varied in general from 10 to 20 per cent in the metal-working industries. Reports received from various metal-working centers throughout the country are given in the following paragraphs. Many machine tool builders have not reduced wages at the present time and state that they will do so only when forced to as a matter of business necessity. They state that the wages paid in the machine shop industries generally have been considerably lower than those paid in the textile, printing, building, public utilities, mining, and railroad industries. They therefore believe that wages in the machine building industries should be maintained as far as possible, individual adjustments being made when required, while wages in the other lines mentioned naturally would have to be readjusted to a level where labor of the same class and skill would receive about the same compensation. Some machine tool builders have carefully studied their shop and manufacturing conditions, and report that they have been able to make some surprising reductions in costs without reducing wages. It is evident that in carrying out this policy they require the thorough cooperation of the workers, who must be willing to aid in the reduction of costs whenever possible.

The New England States

The reductions in wages in Connecticut generally vary from 10 to 20 per cent, although there are a number of cases where no reductions have been made. In Bridgeport, the average wage reduction has been about 15 per cent, and in most cases extra pay for over-time has been eliminated. On March 1, about 60 per cent of the men in the shops were employed as compared with the number at work when the shops were running at capacity. Some plants have reduced wages 20 per cent, and it is expected that further reductions will take place. Instances are reported where reductions have been as high as 35 per cent, and where men are being hired at a reduction from the previous rate of pay of from 35 to 50 per cent; but these are special cases. Wages were unusually high in Bridgeport during the war period, and hence the reductions there are more drastic. Manufacturers having advertised for help have found that men are willing to work for from 35 to 50 per cent less than they were paid in their previous employment.

In New Haven, the reductions in wages in the metal-working industries have varied from 10 to 20 per cent, being generally nearer 20 than 10 per cent. Toolmakers and highly skilled men have been reduced, on an average, 10 per cent, while machinists and less skilled workers have been reduced up to 20 per cent. The reductions have been made partly by eliminating bonuses formerly paid.

In New London, three of the large plants have made no reduction in wages except that new men are hired at reduced rates. One large plant has reduced wages 12½ per cent and another 20 per cent. The average reduction for machine shops in general in the New London districts is from 15 to 20 per cent. In New Britain the average reduction of wages has been about 20 per cent.

In Hartford, the wage reductions have averaged 15 per cent. Some factories are running short time with reduced forces, and are still paying the old wage rates, but it is generally believed that when business improves and it becomes necessary to run full time, a wage adjustment will be made. In practically all the shops the reductions are made individually. During the period of advancing wages, very few of the Hartford shops made "horizontal" increases, and in like manner, the reductions, when necessary, are not general, but are applied to the individual, so that some men in the same shops are reduced less than others. Many of the Hartford manufacturers are not in favor of great reductions in the wages of skilled mechanics, because toolmakers and machinists, for example, have not been as highly paid, in comparison, as men employed in some other trades during the last few years. The wage readjustment doubtless will create a greater difference between the skilled and the unskilled worker. It is estimated that about 20 to 25 per cent of the workers in Hartford are out of employment. In other Connecticut centers, reductions of from 10 to 20 per cent are generally reported. There is a general tendency to eliminate bonuses and extra rates for over-time.

In Providence there has been a reduction of approximately 10 per cent in the wages in the machine tool industry, with many factories working on short time—approximately one-half the regular working schedule. In a few instances there have been no reductions as yet, and some reductions have amounted to only 5 per cent. In Pawtucket, one large concern has not reduced its wages although there is very little business on hand, while other manufacturers have reduced wages up to 20 per cent. Several of the metal-working shops in Rhode Island are running only 25 per cent of normal, and some are entirely closed.

In Boston, new men are hired for at least 20 per cent less than the previous rate. In Springfield, Mass., reductions vary from 12½ to 15 per cent. In Worcester, Mass., some reductions of from 10 to 20 per cent have been made; but in many other of the Massachusetts cities and towns there have been but slight, if any, wage reductions. New men, however, are hired at a somewhat lower rate than formerly.

New York, New Jersey and Pennsylvania

In the vicinity of New York City, wage reductions in the metal-working field have varied from 10 to 20 per cent, although some machine tool builders have made no reductions. In Philadelphia, wage reductions in the metal-working plants have amounted to approximately 10 and 15 per cent, except in the machine tool plants, where no material reductions have been made. Special bonuses, however, have been eliminated. The reason that reductions have not been made in the machine tool plants is said to be that the wages did not increase anywhere nearly in proportion to the wage increases in other lines of metal manufacture. Several of the machine shops in Pittsburg and Erie have made reductions of from 10 to 20 per cent.

In Syracuse, wage reductions varying from 15 to 18 per cent have been made in some plants and from 8 to 12 per cent in other plants, while still others have made no reductions as yet. In Rochester, only two concerns are reported as having made reductions in wages, these reductions varying from 10 to 20 per cent. There are very few men being hired, but those engaged are hired at from 10 to 15 per cent less than prevailing wages six months ago.

Ohio and Indiana

In Cleveland and Toledo wage reductions range from 10 to 15 per cent for hourly rates for skilled workers, and from 15 to 20 per cent for unskilled labor. A 20 per cent reduction has also been made in many instances on piece-work. There are a very few concerns who have not reduced wages, but some of these expect to have to do so sooner or later. From Akron it is reported that the general wage reductions average from 10 to 25 per cent for all classes of labor, the reductions for skilled machinists being from 10 to 17½ per cent. In Canton, a general reduction in wages of from 12 to 20 per cent has been made, but this reduction has taken place not by reduced wages directly as much as by hiring new men at reduced rates. Most of the Canton manufacturers are trying to maintain the wages of the men remaining in their employ.

In Cincinnati there have not been any general wage reductions in the machine tool shops up to this time. There have been a few cases where a 10 per cent bonus previously paid has been discontinued, and in one case a flat 15 per cent reduction has been made, but these figures are not applicable to the majority of the plants. One foundry has reduced wages 10 per cent and another 15 per cent, while working hours have been increased in one case from 48 to 50 hours per week, and in another from 48 to 54 hours per week, the daily earnings being the same, which is equivalent to a wage reduction of from 4 to 12½ per cent. While the machine tool builders in Cincinnati have not up till now reduced wages in general, it is the consensus of opinion that if business conditions continue as they are at the present time in the machine tool field, some wage reductions will most likely become necessary.

In Springfield, Ohio, hourly rates have been reduced from 10 to 12½ per cent, and the extra rate for over-time after eight hours has been discontinued. If this is taken into account as well, the wage reductions would amount to from 20 to 22½ per cent. The reductions in foundries have been from 5 to 10 per cent, with piece-rate reductions of from 15 to 20 per cent. Wages of unskilled labor have been reduced from 20 to 30 per cent. In Hamilton, average reductions of 15 per cent have been made, with 20 per cent in some cases; in Dayton the reductions have been from 10 to 18 per cent.

In Indianapolis the wage adjustment has been met thus far, mainly by hiring new employes at reduced rates in cases where plants had to lay off their men due to the lack of business a few months ago. There has not as yet been any general wage reduction for old employes, except in a few instances. In Elkhart, wage reductions of from 10 to 25 per cent have been made, the average being about 20 per cent; from Kokomo, Ind., reductions of from 10 to 30 per cent are reported.

Michigan, Illinois and Wisconsin

In Detroit, wage reductions have varied from 10 to 25 per cent, and piece-rates have been reduced as much as 50 per cent. Wages in Detroit were abnormally high as compared with other industrial centers, and naturally the reductions for that reason had to be greater. In the Grand Rapids district, wages have been reduced on an average of 15 per cent in the metal-working trades.

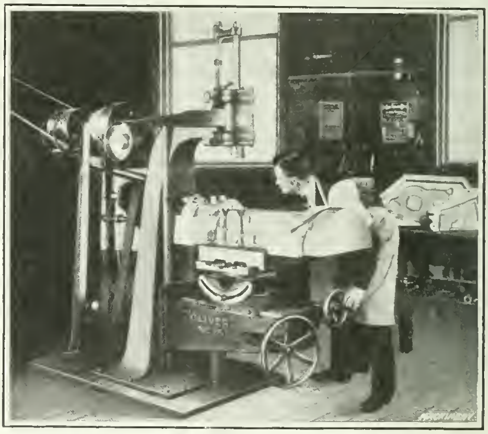
In Chicago wage reductions have averaged from 15 to 25 per cent, and from Rockford it is reported that nearly all the factories have eliminated over-time rates for work over eight hours, which amounts substantially to a 10 per cent reduction in wages whenever the factories go back to a ten-hour basis. Several of the shops, in addition, have reduced wages from 10 to 20 per cent, and a number of those who have not yet done so will have to follow this example in order to meet prevailing lower selling prices. In Moline, no reductions have taken place as yet, but a 15 per cent reduction is contemplated, and new men are hired at considerably reduced rates.

In Milwaukee, no uniform reductions have been made, but the tendency is the same there as elsewhere.

* * *

USING A WOOD PATTERN MILLING MACHINE ON METAL PATTERNS

A pattern milling machine originally intended for wooden patterns, of the general standard model built by the Oliver Machinery Co., Grand Rapids, Mich., is being used successfully for work on metal patterns. The illustration shows this machine as employed in the Racine Pattern Works, Racine, Wis., engaged in milling an aluminum pattern for an automobile crankcase of a four-cylinder truck engine. W. J. Simanek, proprietor of the Racine Pattern Works, states that in machining 400 sets of aluminum patterns for a well-known automobile manufacturer, he saved 66 2/3 per cent of the time formerly required by using the machine illustrated for metal milling. Regular milling cutters are used. Profiling and the milling of regular or irregular curves is accomplished at a rapid rate, and the machine has found particular application in the production of aluminum and other soft metal patterns and core-boxes. Being a woodworking machine and adapted for the high speeds for cutting in wood, it lends itself particularly well to the milling of patterns made from aluminum and other soft metals where high speed is possible and desirable.



Oliver Wood Pattern Milling Machine employed for machining Metal Patterns

* * *

The tractor production in 1920 in the United States totalled 285,000. At the end of the year there were 325,000 tractors in use in the country. In 1921, it is expected that 150,000 Ford tractors will be made.

Better Relations between Machine Tool Manufacturer and Dealer

By OGDEN R. ADAMS, Rochester, New York

THERE are three distinct periods in the relationship between the manufacturer and the dealer depending upon the conditions in the trade. First, there is the period of prosperity, when the manufacturer has all the orders that he can handle—often in excess of his capacity for production. During that period there is a great temptation to neglect the dealer, but the wise man remembers that there is another day coming when the wheels of industry will turn in the other direction.

The second period is that of restlessness, when prosperity is taking wing and the manufacturer realizes that the dealer has some worth after all, and will prove a valuable asset when the business that used to flow toward him easily has ceased to flow and has to be coaxed through the neglected dealer's activities.

The third period is that of readjustment. I believe that we have reached this period and that manufacturers are taking a new view of things. War and strife are things of the past, but we are feeling the after effects and looking for a readjustment. Manufacturers are not only looking for a dealer who can produce results but are also expecting results. They realize that concentration and intensified effort count and that the dealer is in a position to produce results. But the manufacturer does not always realize that the dealer, having previously been neglected because he was not needed, must now do his missionary work all over again in order to establish himself once more in a secure position.

The Service Rendered by Dealers

The dealer is here to stay, and I believe that manufacturers realize that he is a necessary adjunct to a successful machine tool industry. The dealer covers his territory constantly with a staff of salesmen who come into close relationship with the customer. The dealer's local standing, acquaintances, and friendships obtained through years of hard work in the interests of his customers make his advice sought when machine tools are needed; and the dealer is entitled to a satisfactory return for his labors, enabling him to build up his business and strengthen it, which is also in the best interests of the manufacturer.

The wise manufacturer selects a strong representative, firm in the knowledge that such a dealer will make good. After all, the dealer's business is merely a branch of the manufacturer's organization. The dealer is constantly seeking to maintain his credit on a sound basis, and without doubt the manufacturer prefers, and ought to have, a representative who is well established in his territory and upon whom he can depend to maintain his business connections.

Loyalty between Manufacturer and Dealer

We now come to one of the main requirements in the establishment of better relations between manufacturers and dealers—loyalty. The manufacturer should strengthen the relationship formed by loyalty to, and faith in, his agent. He should stand back of the agent with cooperation, not only in regard to mechanical aid and advice, but with substantial trade discounts that will make it possible for the dealer to build up and maintain a business that will have a standing in the community. The manufacturer should not consider it unreasonable if the dealer receives remuneration sufficient to keep him and his salesmen in the proper frame of mind and to enable him to look with optimism into the future and make it worth while for him to exert himself to the utmost on the manufacturer's behalf. Such a dealer will be loyal to the manufacturer and will put enthusiasm into his work. He will see new points of interest in the manufacturer's product that he may have never noticed before. He will have a new incentive to boost the manufacturer's product when he knows that he is receiving cooperation and loyal backing in every respect.

It is a well-known fact that during the past few years the discounts allowed the dealers by manufacturers have not been sufficient to make the dealer able to "stick to his last"; as a result many dealers have been forced to sell used machinery in order to maintain the necessary margin of profit to keep their business going. I believe that dealers as a whole prefer to sell new machinery because it means sales that are much more satisfactory all around. If the dealer can realize enough on such sales to keep his business going along progressive lines, he would be glad to leave the dealing in used machinery to those who make a specialty of this class of work.

Concluding Remarks

The object of these paragraphs is to point out the true relationship between the manufacturer and the dealer, and to show that the dealer—the middleman—is needed. The manufacturer must realize that the dealer who is skilled in the art of selling, who knows his customers, and is industrious and always on the job in the local market, is necessary. In return for his efforts, he should receive credit, a living wage, confidence, and assistance. Active dealers spread all over the country will be able to turn in orders even when the market is dull.

I believe that the time has come when manufacturers in general will recognize the truth of the statement that I have made, and that better relations will be established between manufacturers and dealers. This will strengthen the whole machine tool industry, and will build up a selling organization that in some degree, at least, might be able to prevent the serious fluctuations to which the machine tool industry has always been subject.

* * *

WORLD'S INDUSTRIAL EXHIBITION IN LONDON

Announcement has been made of an exhibition to be held at the Crystal Palace, London, from May to October, 1922, of the industries, products, sciences, and inventions of the leading manufacturing countries of the world. It will be on a cooperative basis, the capital being provided by the exhibitors and those otherwise connected with the exhibition, such as the guarantors of each nation who guarantee sufficient exhibits to warrant the preliminary work connected with the exhibition of their nations. The profits accruing from the various sources of revenue, such as contracts for advertising, catering, amusements, season tickets, gate receipts, etc., will be apportioned pro rata among the exhibitors in order to bring the cost of exhibiting to the lowest possible figure. Each country will elect its own exhibition committee which will be represented on the general committee. The management will be under the control of a committee representing exhibitors and guarantors.

The Machine Shop Industries in Holland

From MACHINERY'S Special Correspondent

Amsterdam, March 9

BEFORE considering the possibilities of importing American machine tools into Holland, it is necessary to review briefly the conditions of the domestic industry and markets in Holland during recent months. In pre-war years, there was no Dutch machine tool industry to speak of; but the impossibility of procuring machine tools during the war from the belligerent countries, and the difficulties of obtaining them from adjoining neutral countries, encouraged the starting of a number of enterprises for the building of lathes and grinding machines. Lack of suitable plants as well as of experience prevented any degree of success to be attained, either in quality or quantity. To the writer's knowledge no machine tools except lathes and grinding machines were built in Holland.

Industries Using Machine Tools

On the other hand, there are a number of industries in Holland that make use of machine tools, including some ten small factories for making woodworking tools, two factories for making cutlery—one in Amsterdam and one in Rotterdam—and a number of small shops making agricultural tools and implements; but the bulk of all the tools mentioned has always been imported from Germany. Dairy machinery and farm machinery have also been made successfully in a number of factories, which not only work for the home market, but which have also been able to develop an export trade to Belgium, Germany, Denmark, England, and even the United States; but the total product of these shops is small. In recent years, four plants making contractors' machinery have extended their works considerably, and are flourishing. They work principally for the trade in Holland, the Dutch West Indies, and South America. A considerable business has always been done by plants making machinery for the Java sugar cane industry. Three factories have recently been started for the making of automatic scales, and there is one building airplanes.

The machine building industry in Holland has never been highly specialized. Machinery of a special nature has largely been imported from Germany. According to the official statistics, during the last year before the war 60 per cent of the Dutch imports of steel and manufactures from steel came from Germany, 30 per cent from England, and 10 per cent from other countries. On account of the lack of imports during the war, the machine tool equipment in many shops became depleted, and there was a great shortage in machine tools for several years. It was expected that all this shortage could be filled by Germany. For some time, however, the inability of the German manufacturers to fill contracts, and the frequent changes in prices and uncertainty of delivery and quality made Dutch manufacturers hesitate to place their orders there.

The second-hand trade in machine tools which flourished during the war is now of much less importance. Most of the old machine tools are badly worn.

Future Market for Machine Tools

There is a general trend toward the introduction of American methods for efficient manufacturing, and it is believed that Holland would provide a good market for automatic and semi-automatic machinery, as many prominent men in the industrial field have spoken definitely on this subject of late and attracted considerable attention. Lessons have been learned by the war-time experience, and there is a general desire to increase production which in the past went at a rather slow pace. The demand for supplies and the unprecedented high wages caused by the high cost of living—which is perhaps on a higher level than in any other European country—have also made it necessary to increase the efficiency of labor by adopting improved machinery.

Effect of German Competition

At present, the industries of Holland are facing a depression. During the last weeks several plants have been closed owing to the inability of their product to compete with German imports. German manufacturers are now wide awake and are energetically attacking the problem of regaining their lost markets. Resolutions have been carried by the trade unions in Holland not to agree to reduced wages, and therefore manufacturers have no other choice than to close their plants or to look for more efficient methods and machinery to counterbalance the reduction in working hours effected by a new law for factories, which restricts the working hours to 45 per week, which cannot be exceeded without special license.

Efforts Made to Combat Foreign Competition

A committee has been formed by leading men in the commercial, industrial, educational, and financial fields to study the effects of the dumping of foreign-made goods in Holland. Their efforts, however, have not met with universal approval as, especially in the metal industries, the manufacturers have too much interest in obtaining cheap German supplies of raw materials, tools, and machinery; but in this field the shoe also pinches on the other foot, as structural iron work has been offered in Holland at a cheaper price per ton than Dutch manufacturers pay for raw material.

It is therefore evident that the only way to combat competition from abroad successfully is by adopting efficient machines and methods. At one time cheapness in machine tools was the only thing considered, and the German makers profited by it; now the manufacturer's mind is more open to the efficiency of American machines, tools and methods. Altogether, one might say that the conditions are favorable for American machine tools, but the question is how to overcome the difficult financial situation and to awaken the still somewhat dormant desire for better apparatus.

Obstacles to be Overcome in Creating a Demand for Modern Tools

It should not be forgotten that many of the metal industries in Holland have grown out of the handicrafts, and they were run for many years in a rather primitive manner. There is not a sufficient degree of specialization, and it is not an uncommon thing for the workman to change from one type of work to another several times a day; and as labor is not specialized, the machine tool equipment in most shops is not specialized either, but generally of a type that will serve all and any purpose. Of course there are exceptions, and the most successful enterprises are those that have been equipped for specialized manufacture; but the fact remains that the great majority of the average shops and factories lack suitable equipment and are working with inefficient methods. The greater number of these plants made good profits during the war, and they could buy improved equipment in order to increase their production and be able to compete with the aggressive foreign importer.

Central Control System in the Franklin Plant

System Employed by the H. H. Franklin Mfg. Co., for Regulating Output According to Demand, and for Controlling Manufacturing Operations by Mechanical Boards or Charts and a Pneumatically Operated Dispatch System

By FRANKLIN D. JONES

THE centralized system of controlling the rate of production and the successive order of manufacturing operations at the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., where this system has been thoroughly tested for several years, serves two important functions in factory management: First, it insures that all the numerous parts of the Franklin car will be made in quantities consistent with the demand for these cars, and that production of the different lots of parts will be started and completed on dates, based not only upon the total number of cars required in a given time, but also upon the relative order of assembling the various units entering into the construction of a complete car. The other function of this centralized system, and one that is closely allied to the first, is to control the order of the work done by the men in the various departments of the plant.

This method of controlling production is part of a system of factory management that is based on the principle of the well-known Taylor system. An effort is made to determine the most efficient method of producing each part or unit, and this method is then adhered to instead of relying upon the judgment of different workmen and foremen as to the best practice. The order of all machining and assembling operations is carefully planned, and is then followed strictly unless subsequently a better way is revealed as the result of experience. In conjunction with this standardization of manufacturing practice, the tool equipment to use and the general operating conditions are also standardized.

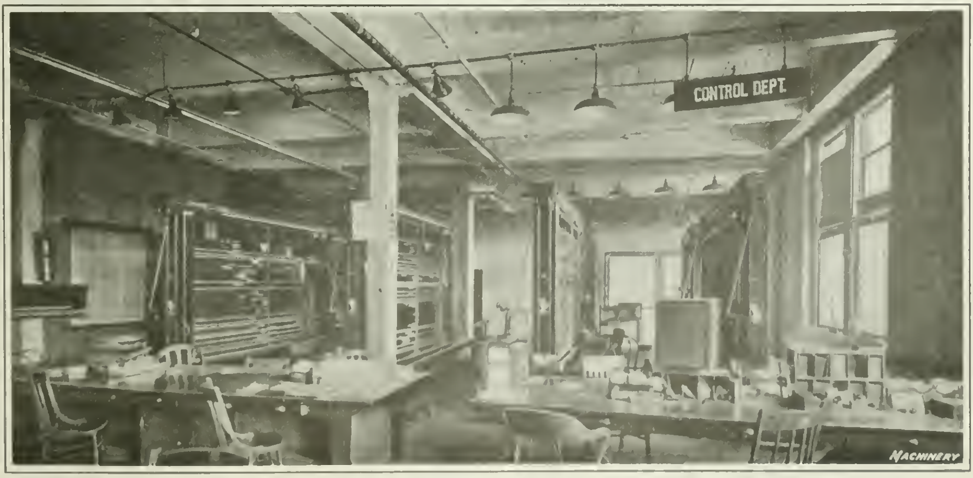


Fig. 1. General View of Control Department, showing Some of the Boards that are used to control Successive Order of Manufacturing Operations and maintain Established Production Schedules

Function of Tool and Operation Department

The tool and operation department controls the design and construction of all special tools, jigs, fixtures, etc., and the selection of machines for different operations, as well as the exact order in which the work of machining or assembling is to be done, and production rates. The entire procedure is so systematized that the order for each job is not issued by the dispatch room (as described later) until all the necessary materials and tool equipment has been delivered to the machine, so that the workmen are not unnecessarily delayed.

The amount of work assigned to different departments is regulated by referring to data representing the production capacity of different groups of machines. The machines are grouped according to types, and the maximum capacity of each group is given as the total number of minutes required by any one group for producing the particular work for which these machines are adapted. For instance, in the "burden book" containing such data, the maximum capacity of a group of fifteen engine lathes may be given as 183 minutes. When assigning to these machines any of the operations for which they are regularly used, the total time for all the operations must not exceed 183 minutes, since that figure represents the maximum capacity. As the "burden book" contains such data for all the machine tool equipment, the tool and operation department has, in convenient form, a record that shows the relation between the work assigned and the producing capacities of the different types of machines.

One of the beneficial results of this system of shop management, which has been outlined very briefly, is that shop foremen are relieved of planning how work is to be done, the successive order of issuing or assigning work to different men in the department, and the selection of machines suitable for different operations. The foremen assist the tool and operation department in determining the standard practice at the time this practice is being originated, but after that the foremen have nothing to do with deciding what machines or tools are to be used, how the work is to be routed, or even what men are to do the work. This planning is all done beforehand, and is not changed unless by general consent of everyone responsible for the existing standard practice.

While much could be written on the details of the complete system of management, this article will deal chiefly with the semi-mechanical method of regulating production in the different departments.

The Control Boards or Mechanical Charts

The general purpose of the control boards is to determine the successive order in which different jobs are given to workmen, and at the same time to show readily when work on different lots and parts should be started and finished. First, it is necessary to establish a schedule of production so that the equipment to be described can be utilized for showing just when the numerous parts are required in order to maintain this predetermined schedule. This schedule will be referred to later. Fig. 1 shows a general view of the control boards. Each board or chart is composed of narrow horizontal strips *A*, Fig. 2, mounted in slides, which are attached to vertical steel cables. These cables pass over pulleys carried by a shaft at the top of the framework, so that the entire board or chart formed by the numerous horizontal strips can be raised or lowered to any convenient position by turning handle *B*, which revolves the shaft carrying the cable pulleys.

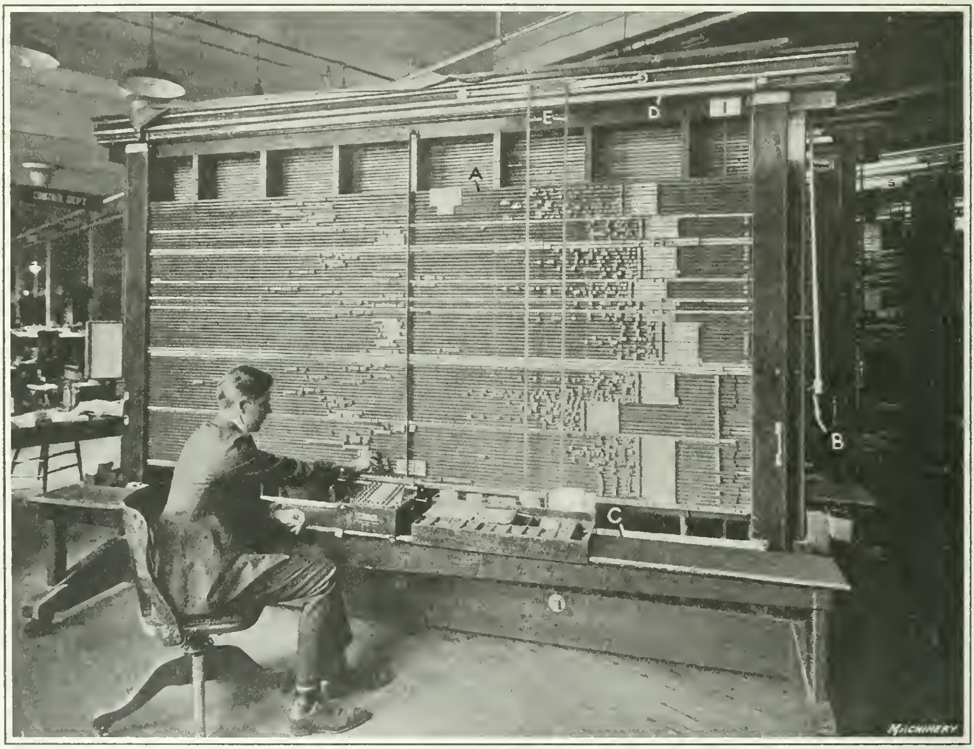


Fig. 2. One of the Control Boards. These Boards show graphically when and where Operations on Different Parts should be started, and the Relation between Actual and Desired Rates of Production

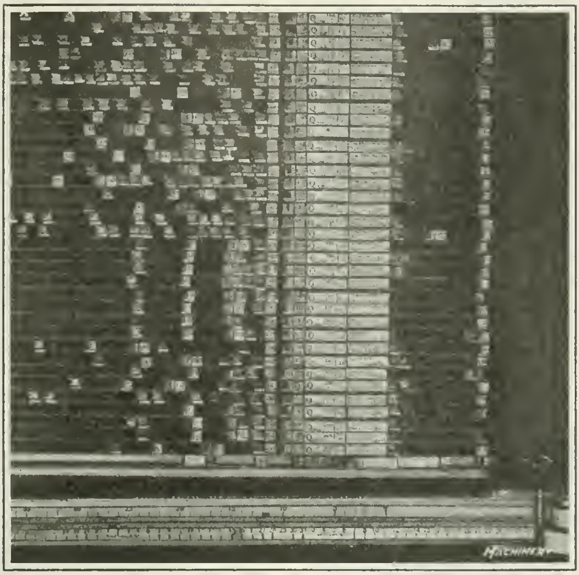


Fig. 3. Small Section of a Control Board

Each part manufactured in the plant (not purchased) is represented by one of these horizontal strips, which is simply a graphic representation of the order of operations, and is not changed until the methods of making the part are changed. White strips indicate assembling operations. On the face of each strip there are a number of small blocks, which are removable but are securely held in place by steel clips or cages into which the blocks fit snugly. These blocks indicate different steps or operations connected with the production of the part represented by the horizontal strip to which the blocks are attached. For instance, one block of the series may indicate the ordering of raw materials; another, the issuing of the materials to the shop; a third, preliminary inspection of materials; a fourth, some kind of milling operation; a fifth, surface grinding, etc. The successive order of the blocks on the horizontal strip corresponds to the successive order of performing the different operations.

One of the important functions of the control board is to determine when the manufacture of each lot of parts is to be started, so that the various units are not completed too late (thus retarding work in other departments) or too soon, but at the right time and in the correct relative order as determined by the manufacturing requirements relative to the finished product; therefore, the element of time must be considered. Each of the horizontal strips previously referred to is, in a sense, a scale, and every half inch space on it, as measured from a zero position located at the right-hand side of each control board, corresponds to a working day. Consequently, the distance between this zero position and any block on the horizontal strip, shows how many days before the completion of a given lot of parts, the work must be started on that particular part which the strip represents. For example, if the block indicating a grinding operation on the crankshafts were seven feet to the left of the zero mark, this longitudinal position on the strip would show that this particular grinding operation on the lot of crankshafts should be started 168 days before the date set for the completion of the lot of cars, because seven feet, or eighty-four inches, equals 168 half-inch spaces, and each of these represents a working day.

Experience in the manufacture of cars has demonstrated at just what stage of the work the manufacture of each lot of parts should be started, and when they should be finished, ready for assembling. By referring to Fig. 2 it will be seen that some of the horizontal rows of blocks extend much further to the left than others, which indicates that the production of these parts must be started sooner. In order

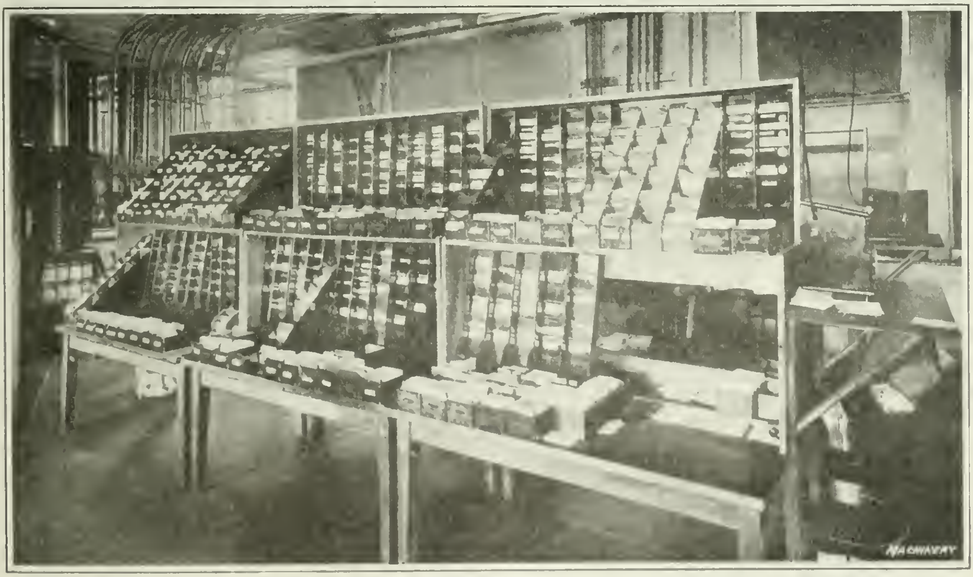


Fig. 4. Boxes in Dispatch Room, representing Groups of Machines and containing Cards that are sent to Different Departments for controlling Order of Operations

to have a complete record of the manufacturing requirements for each part produced in the plant, sixteen boards or charts similar to the one shown are necessary. These boards regulate the production of the numerous parts, so that each lot is ready at the right time, thus avoiding interference and needless delay. Certain time standards have been established in addition to the actual manufacturing time to allow for such factors as the lapse of time between issuing the requisition and delivery of the material, the time required for moving unfinished parts from one machine or department to another, the maximum time finished parts are to remain in storage, and whatever additional allowances are necessary.

The information given on each horizontal strip of a control board includes the name of the part, the drawing number, the standard number of parts in a lot (which corresponds to the number moved from one machine or operation to another), and the total number of cars for which parts have been finished at a machine, vise, or other place where work is done. If the number 100 appears in connection with the grinding operation on the cylinders, this does not mean that 100 cylinders have been ground, but enough cylinders for 100 cars, or 600 cylinders, since there are six cylinders for each motor. In order to provide means of readily changing these numbers, three rectangular shaped blocks with a figure on the face of each may be placed side by side in the cage; hence, if the number does not contain more than three figures, a single cage may be used. For larger numbers two of the cages are placed together, and blank blocks are inserted where there are no figures. Below these numbers another block is inserted horizontally, and this has marked on it the symbol of the machine, vise, or other place where work is done, together with the operation number.

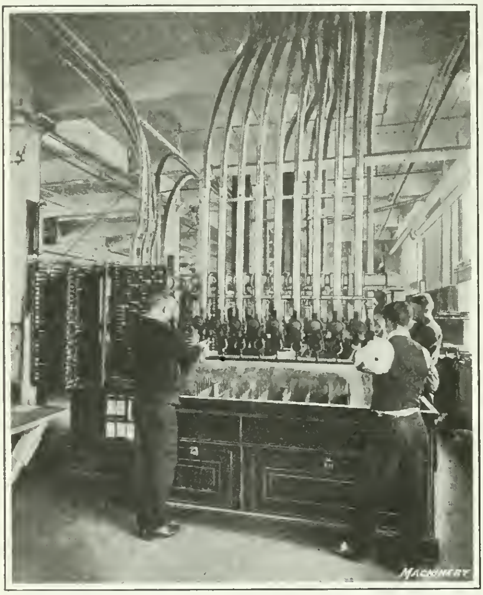


Fig. 5. Dispatching Job Cards to Different Departments through Pneumatic Tubes located in the Dispatch Room near the Boxes that are shown in Fig. 4

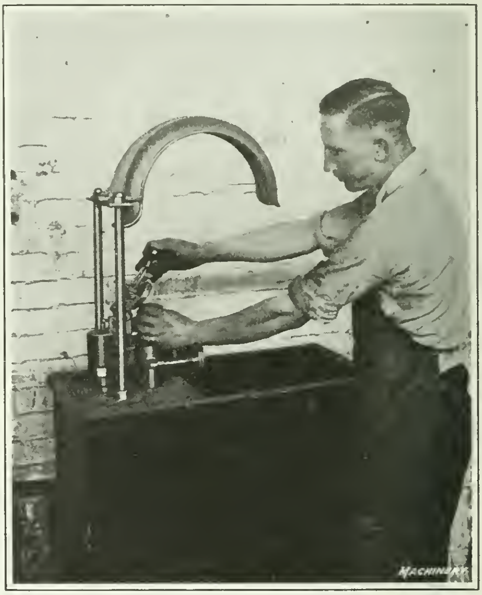


Fig. 6. Workman sending back a Card after completing the Work prescribed. The Card for the Next Job is immediately sent to him from the Dispatch Room

A balanced straightedge (the top of which is just visible at *C*), extends across the board and is suspended on cords, so that it can be raised or lowered. On this straightedge there are two tapes placed one above the other, as shown at the lower part of Fig. 3 which illustrates a small section of one of the boards. The upper tape is simply a scale having half-inch graduations. Every fifth graduation is numbered, the numbers increasing toward the left. When this tape is placed beside one of the horizontal strips, it shows how many working days ahead of the final completion date any operation must be started. For instance, if the cage and the blocks representing a turning operation on a transmission shaft is opposite No. 115 on the work-day tape, this shows that the turning of these shafts should be started 115 days ahead of the time scheduled for finishing this lot of cars, to insure turning all of the shafts required as soon as they are needed. Just below the work-day tape there is a calendar tape, which is graduated according to the working days in each month and is read from left to right. To illustrate the use of this tape, suppose the graduation for January 14, 1921, is just below the zero position of the board, which, as will be recalled is on the right-hand side; this shows that the cars in this particular lot are scheduled for completion on or before the date mentioned. By placing this calendar tape opposite any strip on the board, it shows the dates for ordering materials, when the materials should be received, and also the dates for starting all the different manufacturing operations.

How Production is Regulated According to a Predetermined Schedule

It is evident from what has preceded that this system of controlling various manufacturing operations is based primarily upon the number of finished cars required at different periods. The management, in attempting to determine approximately the number of cars to be manufactured, relies upon past experience, sales records, and the general tendency of the market. This predetermined schedule must take into account, not only the total output for the year, but also changes at different seasons of the year, the trend of sales from one year to the next, and the popularity of one model as compared with another. In other words, it is necessary to consider every factor that may affect the demand sufficiently to require consideration in connection with manufacturing.

The cars are manufactured in lots or numbers representing a certain fractional part of the output for a season. These lots and the time allowed for completing each lot are changed as demand changes. In order to have all of the numerous parts produced in accordance with the schedule decided upon for the completed cars, this schedule is laid out in the form of a graduated tape which is located at the top of the control board, as shown at *D*, Fig. 2. Opposite the graduation marks on this tape there are numbers which increase from right to left from zero up to the total number of cars in a lot. Now, if this total number is, say, 4000, and if this lot is to be completed in, say, 100 days, the numbers from zero to 4000 on the schedule tape will extend a distance of 50 inches, because according to the scale of the control board, one working day equals one-half inch. This schedule tape is advanced to the right one-half inch every working day by winding it on a reel. As the numbers above any position on the board increase due to this daily movement toward the right, these numbers show whether the parts represented by the blocks on each strip are being finished at a rate that conforms to the rate on the schedule tape.

To illustrate, if the number posted in that cage representing the finish-grinding of crankshafts is 1850 and the number on the schedule tape directly above is 1800, this shows that the finish-grinding of crankshafts is ahead of the schedule. On the contrary, if the number on the schedule tape is, say, 1900 this would indicate that this particular grinding operation is behind the schedule. In order to compare readily the production figures posted in the different cages, with the schedule tape, a vertical straightedge *E* is used. This has rollers which run on a track on the top of the board, so that it can be shifted easily.

Dispatching Orders to Different Departments through Pneumatic Tubes

When the time arrives for starting the manufacturing operations on any given lot of parts, as determined by the control board, the orders are issued to various departments through a central dispatch room which is near the control boards. In this dispatch room there are various compartments and boxes, arranged as shown in Fig. 4 which illustrates part of this equipment. These compartments and boxes represent groups or types of machines, and contain the cards that are issued to these machines for controlling the manufacturing operations. When the control board shows that a certain operation must be started, a job card and other cards to provide for movement of materials and inspection of work are filled out and placed in whatever dispatch room box represents the machine to be used. One of these cards is sent to the "move-man" through a pneumatic tube, and this man delivers to the machine indicated whatever materials, special tools, etc., are specified; then the workman's job card and another card used in connection with inspection are taken from the boxes in the dispatch room and the time is stamped on them by an electrically controlled time stamp, which may be seen at the right-hand end of the rack illustrated in Fig. 4.

The job card and whatever instructions are necessary is next sent to the man who is to do the work, and the inspection card remains in the dispatch room box. When the work specified on a particular job card is finished, this card is sent back to the dispatch room by the workman. The time is again stamped on both the job and inspection cards, and the "move-man" is notified by the receipt of another card to transfer the work to the place where the next operation is to be performed. Provision is made in connection with this system for adequate inspection of the work whenever this is considered advisable after any machining or other operation. Just as soon as the work called for on any job card has been completed, a new job card is issued to this man as soon as he returns the preceding one representing the finished work.

By sending these cards to the different workmen and to the various departments, in the proper order, the movement of any part from one machine to another or from one department to another is controlled from the dispatch room, which, in turn, is governed by the control boards. Fig. 5 is a view in the dispatch room and shows the terminals of some of the pneumatic tubes through which the cards are sent to different parts of the factory. The cards are placed in leather carriers which travel rapidly to their respective destinations, the system being operated by compressed air. Below the terminal of each tube there is a row of vertical pegs upon which the inverted carriers are placed during the short interval between the receipt of a card from the shop and the sending of a new one representing the next job for that particular machine or other place.

The shop terminal of one of these tubes is illustrated in Fig. 6, which shows a workman about to send back a carrier containing a card issued for work that has been completed. In a very short time the card for the next job is returned, the man waiting at the terminal until it arrives. By means of this system hundreds of manufacturing operations are controlled every day, and instead of depending upon the judgment of different foremen regarding the proper machines to use, the order of assigning work, and the general method of procedure, the entire manufacturing practice is based upon a plan which has been developed just as carefully as the design of the Franklin car.

* * *

UNIT TOOLING FOR FLAT TURRET LATHES

By "unit tooling" is meant the locating of an entire series of tools used for machining a part, in permanent relation to each other. This is accomplished by providing a special cast-iron arm, or multiple tool-holder which is fastened to the flat turret of a turret lathe by means of machine screws. One of these multiple tool-holders is shown attached to the turret of a Jones & Lamson flat turret lathe in Fig. 1. It will be seen that this casting is provided with several bosses in which the tools are fastened by means of set-screws. While the advantage derived by employing this special multiple tool-holder is obvious, it is also evident that the employment of such a unit tooling arrangement is a production expedient only when quantities of work of a standard nature are handled in the shop. The expense of making such a tool-holder would not be warranted for special classes of work on which no repetition orders are likely to be received.

After a job has once been set up, no further work is required of the machine setter. The operator, when completing a job, sees to it that all tools are ground and reset in their respective positions, so that after the job is finished and the tool-holder removed from the turret, the established relationship of each tool to the surfaces of the job for which it was designed is maintained. As an illustration of how this multiple tool-holder is employed on production work, a description of the entire machining procedure of a cream separator bowl top will be given. This work is performed in the shops of the De Laval Separator Co. at Poughkeepsie, N. Y. Fig. 1 illustrates the operations on the exterior surfaces of the bowl top, while Fig. 2 is a tooling lay-out of the operations on the interior.

The forging is first mounted on the faceplate of the lathe, being located by a U-washer and screw which threads into the end of an arbor. The first operation is performed with the two tools designated as 1 and 2. The operation consists of rough-facing the flange at the bottom of the forging and the shoulder near the neck. Reference should also be made to the general outline of this shell shown in dotted lines in Fig. 2, while following the machining operations on the exterior of the work. Operation 2 is performed after the U-washer and bolt have been removed as a holding means, and superseded by three faceplate clamps which provide for driving the bowl top from the flange. The second operation is performed with tool 2 which was also used in the first

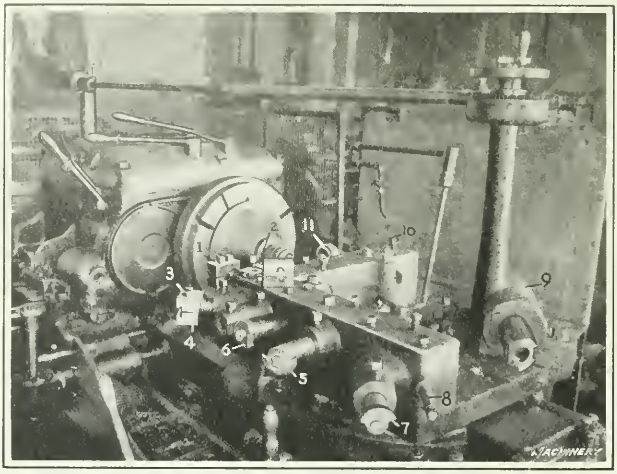


Fig. 1. Turret Lathe equipped with Multiple Tool-holder for machining Exterior Surfaces of Cream Separator Bowls

operation, and consists of rough-facing the end of the forging. Operations 3 and 4 consist of rough-turning the neck and the surface above the taper, the tools being held in the tool-holder indicated in Fig. 1 by these numbers. Operation 5 consists of finish-facing the end, the neck diameter, and the top shoulder using the circular tool-holder in the position indicated by the number 5 in the illustration.

The tool used in the next operation and its location in the multiple tool-holder are indicated by the number 6. This is a forming tool used to recess a groove on the neck of the forging. This groove may be faintly seen in the illustration. The tool designated by the number 7 forms the radius which joins the angular surface with the shoulder below the neck. Operation 8 is that of boring the end hole with the tool-holder in the boring-bar. The exterior of the forging is now finished from the beginning of the taper up, and the remaining operations are those on the taper and the flange.

The faceplate clamps are next removed and replaced with the washer and bolt used in the performance of the first operation. During the ninth operation, which consists of roughing and finishing the taper of the bowl top, the standard Jones & Lamson angular attachment is employed. This attachment is indicated by the number 9, but it will be readily understood that it is impossible to show the tool, since before performing the operation the position of the turret is changed to bring the tool into contact with the work. In this connection attention is called to the construction of the connecting-rod used on this machine. Instead of a one-piece rod, which is the usual construction, a telescopic connection is made with the driving gear, thus overcoming the trouble sometimes experienced by permitting this rod to extend considerably beyond the machine and interfere with the available space, such for example as in alleyways. Operation 10 consists of rough- and finish-turning the outside of the flange, and although the tool cannot be seen, its location is indicated by the number 10. The number 11 represents the circular forming tool used in the last operation, which is that of finishing the top of the flange and forming the radius connecting it with the taper of the forging. It requires two hours to perform these operations.

Design of Multiple Tool-holder Used in Machining the Interior of the Forging

The tooling lay-out illustrated in Fig. 2 needs but little explanation. The position of the work relative to the tools during each operation is indicated by dotted lines, and the surfaces finished at each station are indicated by heavy lines. The numerals appearing on the illustration are the same as the operation numbers, so that in referring to the work performed, the mere enumeration of the operations should be sufficient. It will be seen that the cast-iron arm *A* is of the same general design and size as that shown in Fig. 1, and that the regular Jones & Lamson angular attachment *B* is also employed in the machining of the forgings. The operations performed are as follows: (1) Drill hole in end of neck, using 1¾-inch drill; this drill must be removed during operations 2, 3, and 12. (2) Rough-turn. (3) Rough-face two surfaces. (4) Counterbore interior of neck, using square-point drill. (5) Counterbore, using tool-holder and single cutter. (6) Rough-bore interior of neck with regular boring-bar; (7) Finish-face the bottom, using a circular tool. (8) Machine the interior walls with the angle attachment. (9) and (10) Finish-turn and finish-face the surfaces indicated. (11) Finish-bore the neck and finish-face the bottom of the bowl in the neck, and the shoulder surfaces indicated. (12) Recess the flange. It will be remembered that in this operation the drill used in Operation 1 is removed so as not to interfere with the position of the work.

* * *

The official bulletin of the Interstate Commerce Commission, in a statistical summary covering a period of three months during 1920, states that the payroll of employes of railroads for that period absorbed 57.4 per cent of the gross earnings, this being the highest ratio of cost of railway labor on record. The average yearly pay of employes was $1600 a year in 1920, and at the present time it is over $1800 a year. This is about 110 per cent above the yearly average in 1915.

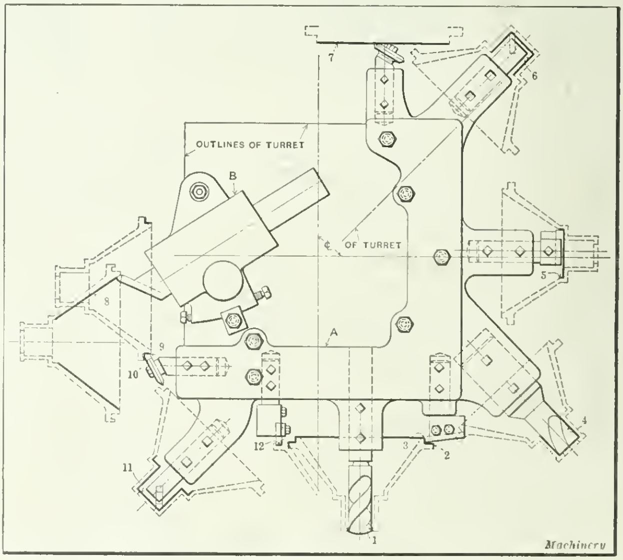


Fig. 2. Tooling Lay-out, showing Tools employed to machine the Interior Surfaces of Cream Separator Bowls

Tools and Methods for Manufacturing Precision Bench Lathes

Practice of the S. A. Potter Tool & Machine Works, New York City, in the Manufacture of Bench Lathes—Second of Two Articles

THE first installment of this article, which was published in the March number of MACHINERY, described the finishing of the beds of the Potter precision bench lathes, machining the headstock, carburizing and casehardening, and the machining operations on the lathe spindle. The present installment, which concludes the article, describes the grinding of the spindle bearings, cone, and collet chuck, the machining and graduating operations on the index-slide, and the painting and inspecting of the assembled lathes.

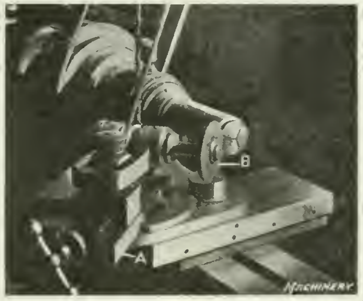


Fig. 9. Bench Lathe with Swiveling Slide for Grinding-wheel Head

Grinding Spindle Bearings and Cone

In finishing the spindle bearings *E* and *F* (see Fig. 1 in the March number) the means used in performing the grinding operation on the work are worthy of mention. After being produced on the Gridley automatics and hardened, a preliminary grinding operation is performed on the small diameter. During this operation the work is held against the head of the grinding machine by a long draw-rod extending through the spindle, and protruding beyond the end of the work. The projecting end of the rod is straddle-milled so that by means of a slotted washer which fits the milled end of the rod, the bearings may be held against the work-head. This method of location is preferable to using a mandrel, since the draw-rod does not contact with the bore of the bearing, and consequently the bearing is sprung by forcing it on a mandrel, and distorted when removed after being ground. The preliminary operation is that of taper-grinding the body of the bearing to provide a more accurate means of locating it during the remaining grinding operations. This taper is a wringing fit in a holder which is attached to the grinding machine head during the operation of grinding the bore. It is apparent that if the preliminary taper-grinding operation were not performed, the exterior straight surface could not be employed to chuck the work by wringing it into a holder, without destroying the concentricity of the exterior and interior surfaces of the bearing. After the bore has been ground, the work is mounted on a straight arbor and the temporary tapered exterior is reground straight and concentric with the interior.

In the grinding operations performed on the cone, another interesting manufacturing kink is introduced. Two grinding operations are performed, one on the bevel surface *R* of the head (see Fig. 1) and one on the tapered body, and in these operations two grinding machines are used. The work is mounted on a mandrel and is not removed until both these surfaces are finish-ground. As soon as one grinding operation is finished, the mandrel is removed and placed in the other machine for the second grinding operation. By this means, the concentricity of the two tapered surfaces is established with a much greater degree of certainty than

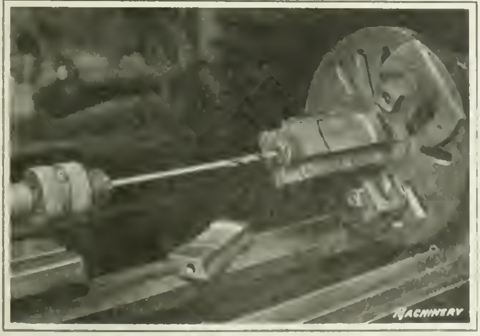


Fig. 10. Fixture used for drilling the Feed-screw Hole in the Index-slide

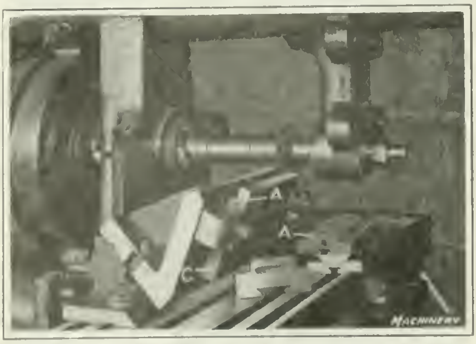


Fig. 11. Fixture for holding Bottom Slide during the Milling Operation on the Dovetail

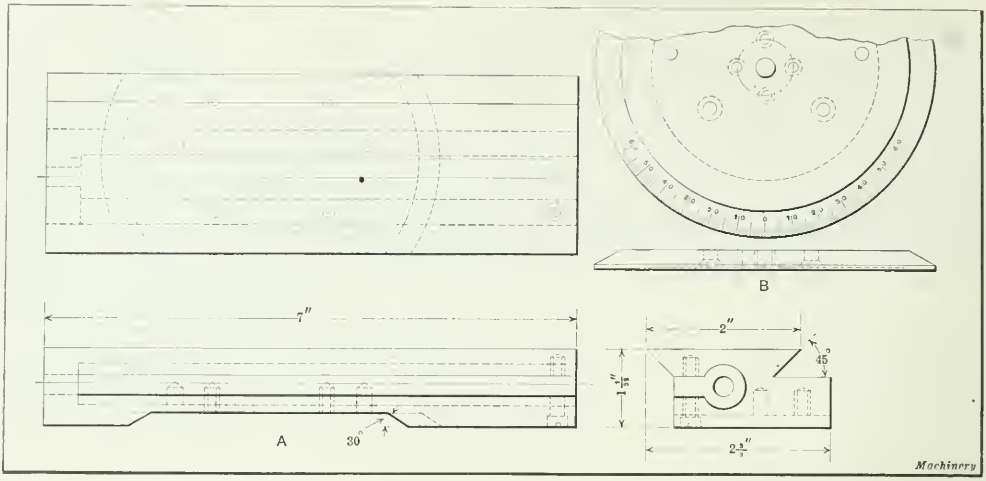


Fig. 12. Index-slide and Graduated Sector attached to its Under Surface

if the work were removed from the mandrel after each grinding operation. The time that would ordinarily be consumed in removing the work from the mandrel is also saved, and although two machines are used, the operations are of short duration so the machines are not tied up for any considerable length of time, and one operator can easily attend to both grinders. It requires ten minutes to complete this operation on one cone.

Grinding Exterior of Collet Chucks

The manufacture of the collet chucks is different in some respects from usual manufacturing procedure. The preliminary operations, from the time the collets leave the Cleveland automatic screw machine up to and including the hardening operation, are in accordance with regular manufacturing methods, but in the finishing the practice is followed of grinding the exterior, which is unusual. In a piece of work such as a spring collet, there is obviously a great possibility of distortion due to hardening, which cannot be corrected by the usual method of finishing the exterior by polishing. The practice of grinding the outside also enables the interior to be more accurately ground by chucking the collets from the outside, and, in addition, gives a greater degree of concentricity to the work.

One other factor to be considered in this connection is the human element, for polishing is a much more tiring operation than grinding, and if the best results are to be obtained conscientious effort on the part of the workmen is essential. The nature of the work does not encourage the workmen in this direction, so that on the whole, greater economy is obtained, and at the same time a more uniform product is realized by employing the grinding method. This grinding operation is performed on a Landis No. 2 universal grinder. During grinding operations on the rounded ends of the collet (see Fig. 9) a regular Potter bench lathe is used, provided with a swiveling compound rest *A* so that the wheel *B* may be swung on the same radius as that of the end curvature. A 70-grain alundum wheel is used in this operation. The illustration clearly shows the simple method provided for swiveling the compound rest as the end of the work is being ground. The production time is fifty collets per hour.

Operations on the Compound Slide Rest

The compound rest of the Potter lathe is composed of four slides, as follows: The bottom slide, which rests on the top surfaces of the bed; the lower cross-slide with graduated feed-screw for swiveling the index-slide; the index-slide *A*, Fig. 12, which is of similar construction to the lower cross-slide and to which the sector plate *B* is attached; and a top

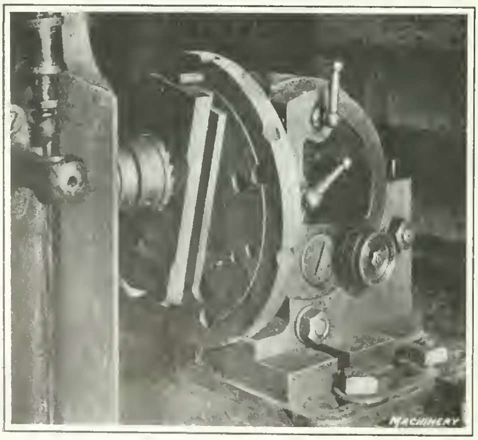


Fig. 13. Milling Graduated Disk Recess in Index-slide

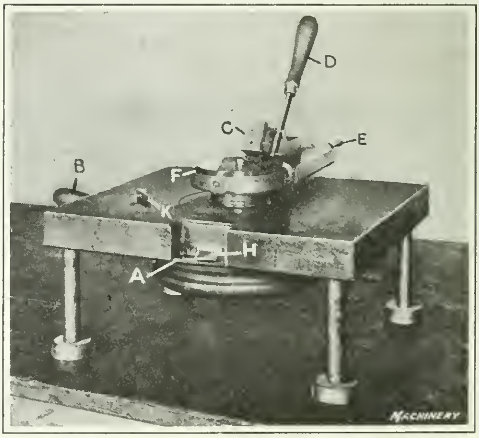


Fig. 14. Fixture used in graduating the Sector Plate

slide which fits the top of the index-slide and is operated by a nut on the index-slide feed-screw. This slide contains the T-slot in which the toolpost is mounted.

The holes through which the feed-screws for the lower cross-slide and index-slide are operated are drilled by a rather interesting tooling arrangement. A special fixture is used, which is attached to the faceplate of a Prentiss lathe as illustrated in Fig. 10, so that the work revolves while the drill is held stationary in the tailstock as it is being fed into the work. This insures a straighter hole than could be obtained if the holes were drilled in the usual manner with the tool revolving. This hole is not drilled all the way through either slide; on the lower slide it is blind, while on the index-slide as shown in Fig. 12, a hole is drilled in to meet it from the opposite end, in which the pilot of the operating screw has its bearing. The tendency of the drill to "whip" or run out at the end is overcome with this arrangement, and so a more accurate hole is obtained. The fixture shown in the illustration is set up for performing the drilling operation in the index-slide, and a piece of work is shown on the lathe bed. The floor-to-floor production time is ten minutes per casting.

On the under side of the index-slide, Fig. 12, there is a recess which fits over the graduated disk *B*. This recess is finish-milled by mounting the slide on the faceplate of a dividing head as shown in Fig. 13, and using an end-mill having angular ends to conform to the 30-degree beveled surface of the disk which is assembled in the recess. Then by revolving the dividing head, the recess is generated, the center of the end-mill being located eccentrically in relation to the center of the recess, so that one complete revolution of the index-head results in finishing the operation. The time required, including loading and unloading the work, is five minutes per piece.

By referring to the illustration Fig. 11, it will be seen that there is a dovetail *A* on the bottom slide, which fits into a corresponding groove on the lower cross-slide. The angle of these surfaces is 45 degrees, and the work is set up in the manner shown for the milling operation on the dovetail. The machine used is a No. 2 Kempsmith miller, which is equipped for finish-milling the angle on the bottom slide. The fixture employed in milling the 45-degree angle on the index-slide, Fig. 12, supports the work by two countersunk-head buttons, the angle of the head being 45 degrees, while the lateral position is established by means of a suitable locating pin. In the case of the bottom slide, however, it will be seen that a square surface is available to support the work, so that the plate *C* on the fixture is provided to accommodate this square surface. The roughing cut is performed with the work set in a vertical position in an ordinary milling machine vise, using a 45-degree single-angle cutter; but in finish-milling these dovetails, a slightly different method is employed. Instead of using a 45-degree single-angle cutter, the work is located at a 22½-degree angle from the vertical, as indicated in the illustration, and a 45-degree double-angle cutter is used.

It was found by attempting to mill these dovetailed surfaces with a single-angle cutter, that a less satisfactory surface for subsequent scraping was produced than with a double-angle cutter; it was further found that closer cuts could be taken so that the subsequent scraping operation on these surfaces could be considerably shortened. It is easy to conceive of a condition in which the flat side of a single-angle cutter would become worn sufficiently to produce a concave surface, which would be difficult to scrape flat. By using the double-angle cutter with the work tipped as required, the wear is equally distributed on both cutting edges. The wear is considerable at the point, but this does not affect the flatness of the surfaces. For each cut, the production time is seven minutes.

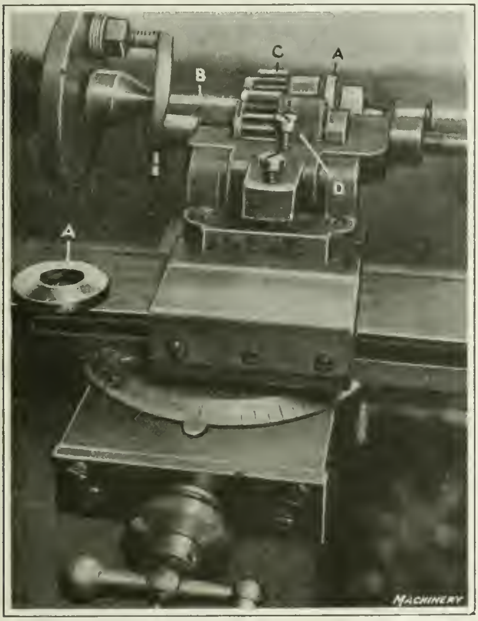


Fig. 15. Bench Lathe equipped with Gear-driven Device for rolling the Graduations into Feed-screw Index-collars

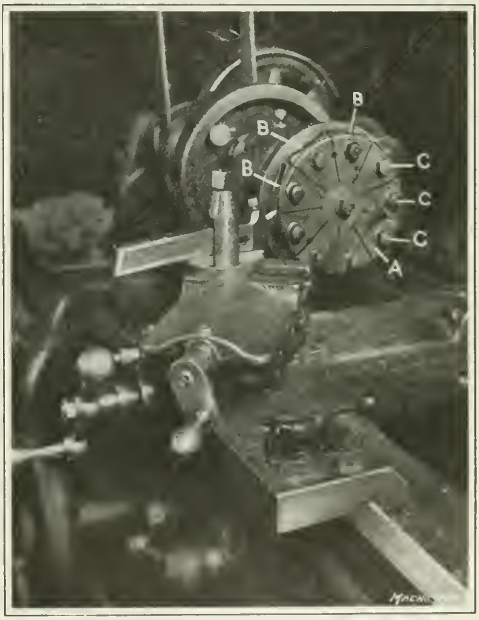


Fig. 16. Turning Toolpost Swivel Blocks from Bar Stock, using Fixture having a Capacity for Nine Pieces

Graduating the Sector Plate and Index-collar

The performance of the graduating operation on the disk *B*, Fig. 12, is accomplished by a hand fixture which is shown in Fig. 14. This device is inexpensive and accomplishes the work very quickly. On the under side of the table of the fixture there is a ratchet *A* having 360 teeth, the movement of which is controlled by two pawls, operated by handle *B*.

which may be seen on the side of the fixture. One of these pawls is of the take-up type and the other of the locking type. The marking tool is located in an angular position in head *C*, and is reciprocated by handle *D*. Its position may be adjusted radially by a cross-slide screw *E* of similar arrangement to that of the regular lathe cross-slide.

By operating the ratchet handle the graduated disk is revolved one degree with each movement and locked in this position by a pawl while the marking tool is brought forward by handle *D*, producing a graduation line of suitable length on the work *F* which is fastened to the turret of the fixture. Every fifth graduation must be longer than the others, and this is indicated when the index line on plate *H* coincides with the proper graduation on the ratchet. These different lengths of stroke for handle *D* are stopped off by inserting the stop or key *K* in the tool-head, when desired. The fixture is substantially constructed on legs so that it need not be anchored to the bench when in use. This is a rapid and satisfactory means of accomplishing this work without the use of an intricate automatic machine. After graduating, the burrs are cleaned off with a fine file, and the work is finished. The production time is ten minutes per sector plate.

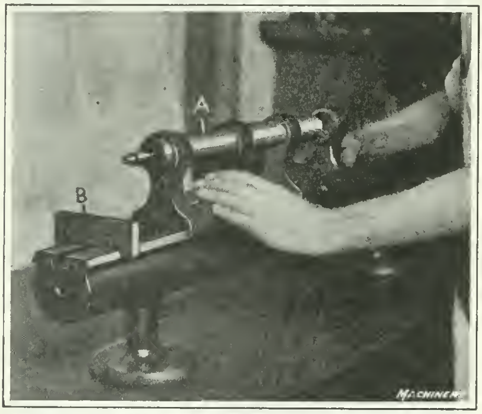


Fig. 17. Inspecting the Alignment of the Spindle Bores in the Headstock Casting

The graduating of the feed-screw index-collar *A*, Fig. 15, is performed by the rolling process, but as the illustration shows, the device used is gear-driven and so is positive as regards the spacing of the graduations. This attachment is used in connection with a bench lathe. The arbor *B* is held between the lathe centers, and carries the gear *C*, which drives the tool *D*, by means of which the graduations are rolled on the collar when the slide is advanced to sink the marking teeth to the proper depth.

What is known as a toolpost swivel block or rocker is employed in the toolpost slot for tipping the tool to angular positions. This block is made from 3/16- by ⅜-inch cold-rolled flat stock, 1⅞ inches long, and is turned to produce the rocker shape. The fixture especially designed for this operation is shown in Fig. 16, mounted on the faceplate of a lathe. This fixture consists essentially of two cast-iron disks *A*, which are normally held apart by coil springs. Each blank *B* is located near the periphery of the fixture between two small dowel-pins, and is clamped in this position by clamping nuts *C*. The outer disk contains nine radial slots so that it will yield sufficiently when the clamping nuts are tightened. This fixture has a capacity for nine pieces, and enables a high production rate to be obtained. A number of finished swivel blocks are shown lying on the carriage of the lathe. The production time is five minutes per set of nine parts.

Painting and Inspecting

The proportion of unfinished surfaces to finished ones on a bench lathe is so great that in order to add to the appearance of the machine it is necessary that care be exercised in the painting operations. In this connection, the painting of a bench lathe differs from that of the larger machine tools in that it requires considerable care in producing a proper finish. The parts are first cleaned to remove grease and other undesirable substances, and are then treated to an application of machine primer, which acts as a base or connecting medium between the bare metal and the subsequently applied coats of paint. The castings are allowed to dry for six hours after each coat of machine filler is applied with a brush. This filler is in the form of a thick paste and must be reduced to the consistency of heavy cream so that it can barely be applied with a brush.

In applying the filler, an ox-hair brush is used, and on the evenness of its application and the skill employed depends the amount of rubbing down or sandpapering which will subsequently be required. Several light coats are preferable to a lesser number of heavy coats. The castings are next sandpapered with a number of grades of garnet paper before the oil-proof machine paint is finally applied. The paints used at the Potter works are manufactured by the Sherwin Williams Co.

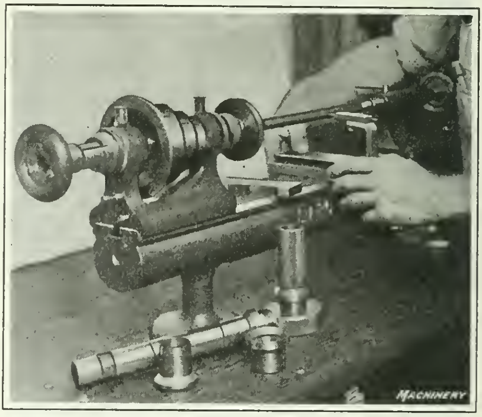


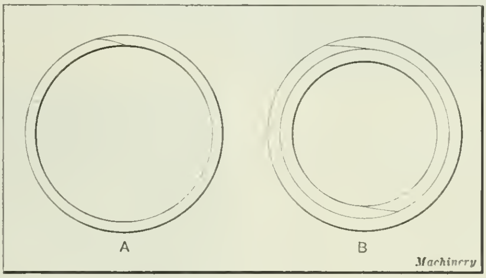
Fig. 18. Testing Assembled Lathe for Alignment, using Test Bar and Koch Indicator

The alignment of the spindle bearing holes in the headstock casting is inspected by mounting two of these castings in tandem on the finished bearing surface of a lathe bed, as illustrated in Fig. 17. An aligning bar *A* is then slid through the holes of the two castings, first with both castings in the same relative position and then reversed so that the two front bearing holes are adjacent as shown. The gage *B* shown resting on the surface of the bed is a profile gage used to inspect the top bearing surfaces on which the headstock and tailstock units fit.

In the final inspecting of the fully assembled lathe, an aligning bar is held between the lathe centers for the purpose of testing the working center lines, relative to the finished surfaces of the lathe base. The gage equipment for checking the parallelism and alignment consists of an accurately finished bottom slide casting, such as is regularly furnished with the Potter lathe, and a Koch indicator mounted on it as shown in Fig. 18. An angular faced block is adjustably attached to the under side of this bottom slide so that its finished surface may ride on the angular surface at the rear of the bed while the gaging device is slid back and forth on the lathe bed. This indicator is also used to test the concentricity of the angular surfaces of the lathe centers and their relation to the lathe bed.

Manufacture of Wrought Pipe for High Pressures

PIPE that is unusually strong in wall and weld is required for hydraulic purposes. The high pressures of hydraulic lines represent enormous bursting forces in many instances, and the potential energy of the water under such working pressures closely approaches that of the thrust of a steel rod working as a piston under similar pressures. To be dependable under such conditions, the pipe must be made with more than ordinary care; to be efficient, in view of the friction developed by the fluid under enormous pressures and high velocities, the pipe must be clean and smooth, and it must be possible to bend it without excessive distortion of the internal diameter, so as to insure uniform maintenance of velocities and the calculated working force of the fluid. These conditions require that the pipe be welded and rolled according to the best mill practice, and that the metal possess the unusual combination of high tensile strength and great ductility. This would be difficult to obtain if scrupulous care were not exercised, not only in the welding and rolling of the pipe, but also in the manufacture of the steel from which the pipe is made. Uniformity of material is essential to secure the proper strength, ductility, and rolling qualities. The practice of the National Tube Co., Pittsburg, Pa., in the production of wrought pipe will be found of interest in this connection.



A) Position of Lap Weld in Standard Pipe; (B) Position of Welds in High-pressure Pipe

In the plants of this company, pipe for hydraulic and other high-pressure purposes is made from the ore into the finished product. The steel, being in the form of solid ingots, is rolled down to plates of the required dimensions without the laminations which characterize plates rolled from built-up bars of heterogeneous material. The cross-section of the pipe wall at any given point will, because of this feature, be found to be uniform and homogeneous, and the strength factor correspondingly uniform throughout the length of the pipe. Defects, such as blisters and blow-holes, are precluded in the skelp or plates from which the pipe is made by a mechanical process of working the metal in bloom or billet form. This process, which is employed in the production of pipe sizes up to and including 4 inches, is called "Spellerizing," and is a kneading process, which consists of subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom while still hot to the action of smooth-faced rolls, and repeating the operation. By this means the surface of the metal is worked so as to produce a uniformly dense texture and facilitate the escape of any confined gases which would cause defects of the nature mentioned.

Pipe Manufactured by Butt-welding

In the manufacture of pipe for high-pressure purposes by the butt-welding process, after the plates are rolled to suitable dimensions they are charged into a long gas-fired furnace, where they are heated to the proper temperature for welding. Prior to inserting in the furnace, a strong round bar is welded on one end of each plate as a tag or "bait" to be grasped by the tongs which draw the plate through a die, where it is bent into pipe and welded (see Fig. 2).

The hot plate is welded into pipe at a point close to the end of the furnace, by drawing through a die shaped like a bell with a hole in one end. The tag end is held by tongs which engage a draw-chain operating for the full length of a steel draw-bench. The chain exerts a tremendous pulling force on the tongs and pipe, and were it not for the fact that the tag end distributes these drawing strains evenly to the end of the pipe, the hot metal would tear and the welding could not be accomplished. The pipe is reheated and drawn several times through dies of this type having gradually decreasing diameters, until the proper size is obtained. This is done to thoroughly weld the very thick abutting edges of the seam and to provide the necessary strength at this point. In the manufacture of butt-weld pipe not used for high-pressure service, a sound weld is obtained by drawing the plate through the die only once, or through two dies in immediate succession at one heating of the plate, but the tremendous pressures carried by hydraulic pipe justify additional drawing operations to make safety and dependability as nearly absolute as they can be made. When the relative wall thicknesses of standard and double extra strong pipe, such as is required for high pressures, is considered, the reason for the multiple drawing of this butt-weld pipe is obvious.

Pipe Manufactured by Lap-welding

The larger sizes of pipe for high-pressure purposes are made by a process whereby the edges of the plate are overlapped at the seam instead of being abutted. This is called the lap-weld process. The plates are suitably rolled, and the longitudinal edges are slightly beveled where they are to overlap, in order to avoid undue thickness at the welded seam. They are then heated and bent into rough tubular form, with the edges overlapping, either by means of rolls such as those used in bending boiler plate, or by means of a bending die especially designed for the purpose. Thus bent, the rough tubes, or skelp, as they are called, are charged into the rear of a furnace where they are heated to a welding temperature. After reaching this temperature they are pushed out of an opening in the front of the furnace until caught by the revolving rolls of the welding apparatus situated a few feet from the opening. These rolls are so grooved that they form a circular opening between them of approximately the same size as the outside diameter of the pipe, and in this opening is a bullet-shaped mandrel, held on the end of a strong steel rod, as shown in Fig. 3. As the pipe skelp comes from the furnace it is caught by the rolls which force it forward over the mandrel, and thus press the overlapping edges together into a sound weld. The annular space between the mandrel and the roll opening is just enough smaller than the wall thickness of the pipe to insure a gripping action of the rolls sufficient to carry the pipe forward and at the same time exert the necessary welding or forging pressure. Fig. 4 shows the pipe coming through the lap-welding rolls.

To make one length of the strong pipe used for certain purposes, two lengths of pipe are welded in this manner, and then telescoped; one length is slightly larger in diameter than the other to permit the easy insertion of one length within the other. This is so accomplished that the welds of the telescoped pipes are at diametrically opposite points, as shown at *B* in Fig. 1, and in this position they are reheated to a welding temperature and are both passed at once through the welding rolls, thus forging them into a single length of heavy-walled pipe. Maximum strength is thus obtained in the wall, while the welds are subjected to minimum pressure in service, due to their relative positions. The pipe is thus stronger than would be the case if made of one piece of thicker material joined with a single weld, as is the practice in manufacturing wrought-steel pipe in standard thicknesses. In the illustration, this is brought out by a comparison of standard and double extra strong lap-welded 6-inch nominal size pipe. The outside diameter of both pipes is the same, 6.265 inches, but the wall thickness of the pipe shown at *B* is 0.226 inch, whereas the heavy high-pressure pipe has a wall thickness of 0.864 inch.

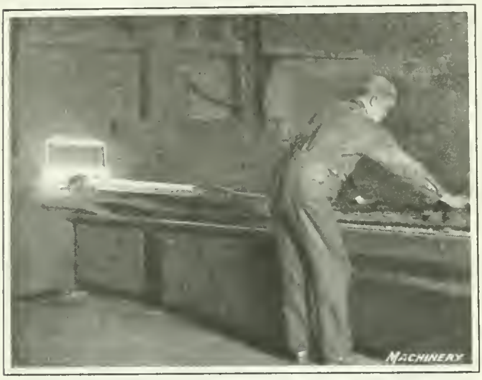


Fig. 2. Drawing and welding Skelp into Butt-welded Pipe

Sizing, Straightening, Cropping, and Testing

After the pipe has been butt- or lap-welded, as the case may be, it is passed through rolls which give it the required outside diameter, and through cross-rolls to straighten it and give it its true circular shape, as shown in Fig. 5. The pipe is slowly cooled on a continuously traveling table, after which the tags and the ends which have become damaged in manufacturing are trimmed off, and the pipe is subjected to a hydraulic test to prove the soundness of wall and weld. Butt-welded pipe for high pressures (generally called double extra strong pipe) is tested by the manufacturers with a hydrostatic pressure of from 700 to 2200 pounds per square inch; double extra strong lap-welded pipe is similarly tested, using pressures of from 2000 to 3000 pounds per square inch —the pressures varying in both instances according to the pipe size. Hydraulic pipe which is made in nominal sizes of 9, 10, 11, and 12 inches, is tested with hydrostatic pressures of from 1200 to 1800 pounds per square inch, depending upon the size and upon the wall thickness. Each of the above sizes is made in four different thicknesses or weights.

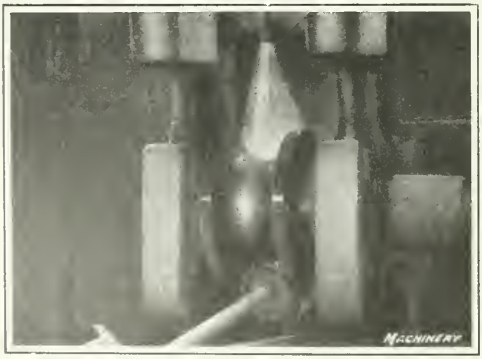


Fig. 3. Lap-welding Rolls, showing Mandrel in Position

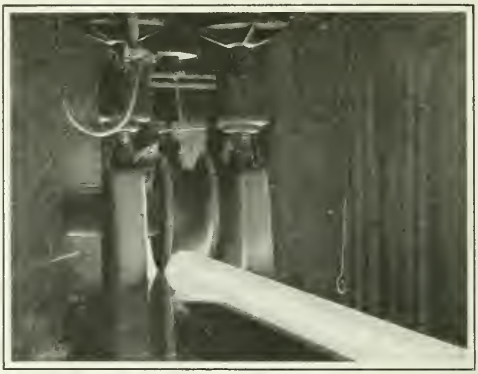


Fig. 4. Pipe coming through Lap-welding Rolls over Mandrel

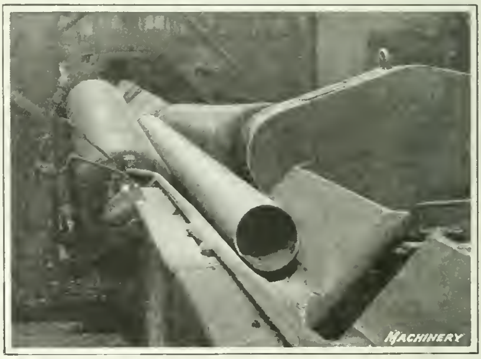


Fig. 5. Cross-rolls which straighten Lap-welded Pipe and give it a True Circular Shape

* * *

The number of factories destroyed or damaged in France during the war numbered 4241. Of these 3239 were working, fully or partially, on October 1, 1920. The number of workmen employed in 1920, as compared with those employed in 1914, was about 45 per cent. The greatest revival of industrial activity has taken place in the Lille region, the largest manufacturing center in France, where more than 75 per cent of the factories affected by the war have resumed production in whole or in part. In the metal-working field 844 factories were damaged or destroyed, of which 736 have resumed operation. Of 50 blast furnaces damaged or destroyed, 37 have resumed work. Fifty per cent of the normal force of employes formerly engaged in the metal-working industries is now at work. One-half the number of foundries and 45 per cent of the nut and bolt factories have resumed operation.

Taper-turning Tool for Spinning Machine Spindles

By W. BURR BENNETT, President, Wayne Engineering Co., Honesdale, Pa.

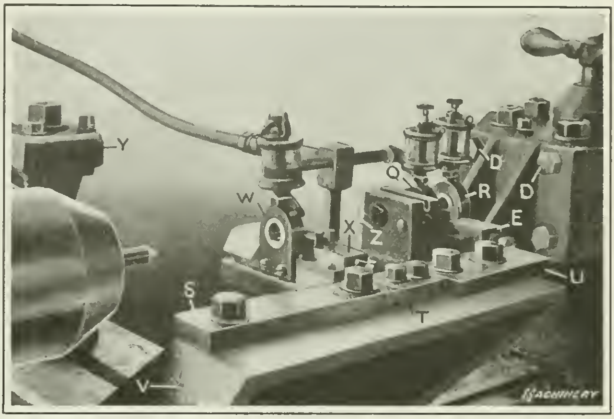


Fig. 1. Turret Lathe equipped for turning Tapered Spindles

THE urgent demand for spindle blades for silk spinning machinery during the last two years made it imperative that a new method of producing these parts be evolved, which would give a higher production rate than had previously been obtained. To accomplish this, an investigation of the various methods and available machines for producing spindles was made by the writer. The making of spinning spindles has long been considered a forging and grinding proposition, and a product of high quality has always been obtainable by this procedure. Therefore, the makers of grinding machines were first consulted with the hope that some special type of grinding machine might be obtained which would give the required production rate. It was found, however, that grinding machines of the standard type were the best that could be obtained for this purpose, and that these machines were capable of fine work, but it was felt that the highest production rates could only be realized by the use of a special-purpose machine.

Attention, therefore, was next directed to taper-turning machines and tools that might be employed in the production of spinning spindles from bar stock. Again there seemed to be no standard machine particularly adapted for the job. Some research work was then undertaken, which resulted in the development of the tool here described. This tool was designed jointly by W. M. Cummiskey, chief engineer of the Wayne Engineering Co., and the writer. Before proceeding further it should be explained that no criticism of the quality of forged and ground spindles is intended, the purpose of employing a different method being simply to increase production and at the same time to turn out spindles from bar stock which would be as good as the forged and ground product. It should also be stated that it is not the purpose of this article to describe the complete process of production, but merely to describe the tool and methods used in turning the spindles to size.

Details of Spinning Spindle Blade

The dimensions of the spinning spindle blade are shown in Fig. 3. The material is 1.20 per cent carbon tool steel containing certain other alloys which provide stiffness and wearing qualities. The stock is received from the mills in 12-foot lengths, 0.480 inch in diameter, and is fully annealed to provide free cutting qualities. This stock is held within close limits and is carefully straightened before using.

Machine and Feeds Used

The taper-turning tool equipment is shown in Figs. 1 and 2, mounted on a No. 4 Foster turret lathe. The complete machining of the spindles is accomplished on this machine. A feed of 0.004 inch per spindle revolution was first used, but it was later found that under favorable conditions the feed could be increased to 0.007 inch. A cutting speed of about 90 surface feet per minute is now generally employed, although it is necessary to change the speed occasionally to compensate for the variations in the physical properties of the stock. The maximum speed attained under favorable conditions was 100 feet per minute with a feed of 0.004 inch per spindle revolution.

The constructional details of the cam-controlled tool-slides *E* and *X*, the bushing-holders *W*, *Q*, and *R*, by means of which the work is supported, and the tool-slide blocks *I* are more clearly shown in Fig. 4. The controlling cams are mounted on casting *V*, Fig. 6, which is keyed to the cross-slide of the machine. The cams are shown by heavy dot-and-dash lines at *S*, *T*, and *U*, and their relative positions may be seen in Figs. 1 and 2. These cams are so located that the spindle is

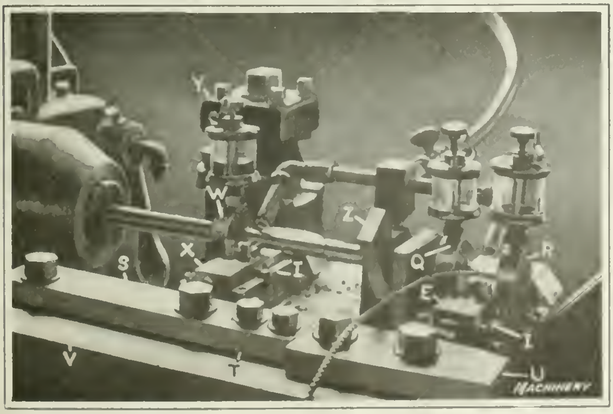


Fig. 2. Taper-turning Tools in Operation on Spinning Machine Spindle

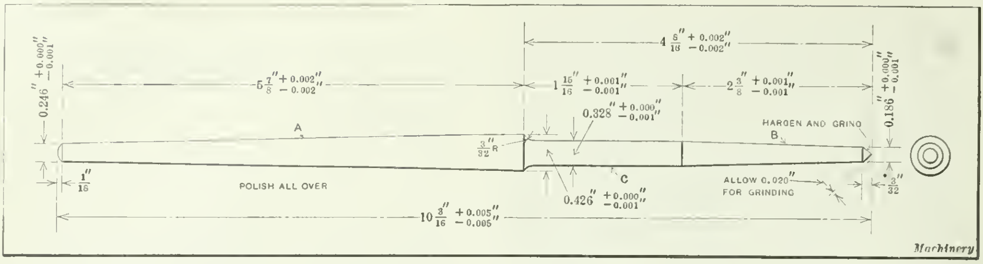

$4\frac{5}{16}'' {+0.002'' \atop -0.002''}$
$5\frac{7}{8}'' {+0.002'' \atop -0.002''}$
$1\frac{15}{16}'' {+0.001'' \atop -0.001''}$
$2\frac{3}{8}'' {+0.001'' \atop -0.001''}$
$0.246'' {+0.000'' \atop -0.001''}$
$0.186'' {+0.000'' \atop -0.001''}$
$0.328'' {+0.000'' \atop -0.001''}$
A
$\frac{3}{32}''$R
HARDEN AND GRIND
B
$\frac{1}{16}''$
POLISH ALL OVER
C
$0.426'' {+0.000'' \atop -0.001''}$
ALLOW 0.020" FOR GRINDING
$\frac{3}{32}''$
$10\frac{3}{16}'' {+0.005'' \atop -0.005''}$
Machinery

Fig. 3. Details of Spinning Spindle Blade

turned with the short taper *B*, Fig. 3, extending toward the turret. From Fig. 1, it will be seen that a conical point is formed on the end of the stock before starting the taper cuts. This is accomplished by a parting or cutting-off tool mounted at the back of the cross-slide in tool-block *Y*. This cutting-off tool is of special design, and in addition to forming the conical end, rounds the opposite end of the finished spindle. It will be seen that oil-cups are provided in holders *W*, *Q*, and *R* for lubricating the bushings that support the work. At first oil was used in these cups, but it was later found desirable to use a thin solution of machine oil and white lead. Soluble oil is used as a coolant, and the feed-pipes through which it is conducted to the tools are connected to the pumping system of the machine by means of a flexible hose.

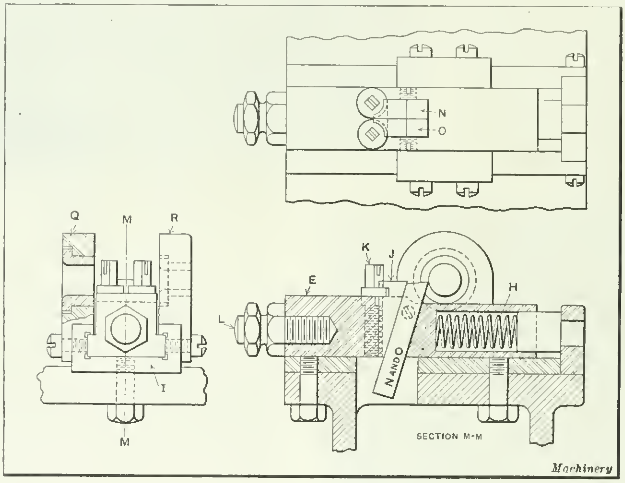


Fig. 4. Diagram showing Design of Cam-controlled Tool-slides

Construction of the Turning Tool

The main casting on which the turning tool slides are mounted is shown in Fig. 5. This casting, as will be seen by referring to Fig. 1, is mounted on the turret, being secured in place by four cap-screws *D*. It is necessary that this part be made of well-seasoned cast iron, and of sections and proportions which will give ample strength to resist the strain imposed on it. At *Z*, Fig. 5 (see also Figs. 1 and 2), there is shown a swinging stop which is used in conjunction with the turret stop on the machine. When the machine is in operation, the turret is moved up to its stop, and the stock fed out until it comes in contact with stop *Z*, whereupon this stop is swung back, and the cut started after first feeding the cross-slide of the machine in to the proper depth, as indicated by the graduated dial of the cross-feed screw. As stated previously, there are two tool-slides mounted on the main casting, and these are located in grooves *F* and *G*.

Referring to Fig. 4, it will be seen that tool-slide *E* operates in the slide-block *I*, and that this block is secured to the main casting by cap-screws. It will also be noted that the bushing-holders *Q* and *R* are secured to block *I* by machine screws. The bushings by which the work is guided are carefully hardened, ground, and lapped, the one carried in holder *R* being a good fit over the 0.328-inch finished diameter of the spindle (see Fig. 3). Tool-slide *E* is also hardened and ground, and is provided with the two tool bits *N* and *O*, which work simultaneously, one taking a roughing cut and the other a finishing cut. Two wedges *J*, operated by screws *K*, hold the tool bits in place and provide a means of adjustment. The tool-slide is held back by the compression spring *H*. Adjusting screw *L*, the head of which is held successively in sliding contact with the cams *U* and *T*, Fig. 6, adjusts the tool-slide transversely. A similar construction is employed for tool-slide *X* and cam *S*, Figs. 1 and 2.

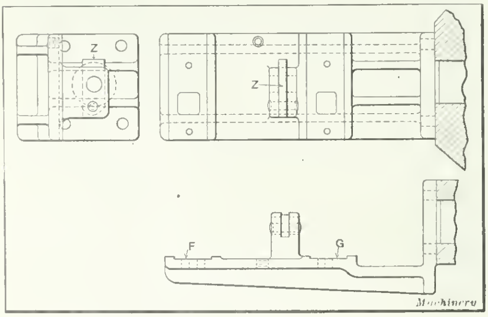


Fig. 5. Casting attached to Turret for supporting Turning Tools

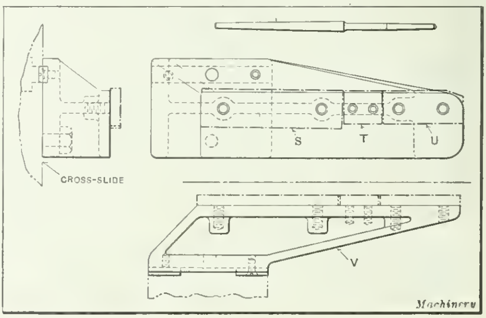


Fig. 6. Casting attached to Cross-slide for supporting Tool-slide Cams

Operation of the Tool

The following brief explanation will give a clear idea of how the tool operates. Assume that a finished piece has just been cut off, and the conical point formed on the stock by the tool held in block *Y*, Figs. 1 and 2. The operations required to finish another piece would be as follows: First bring the carriage back to the extreme right-hand position; then throw stop *Z* forward into the position which it occupies in Fig. 2; next run out the stock until it comes into contact with stop *Z;* feed the cross-slide in to the correct depth and engage the forward feed. The adjusting screw in the end of tool-slide *X* is held in contact with cam *S*, and will cause the tool to turn section *A*, Fig. 3, to the required taper. When the tool has advanced along section *A*, a distance equal to the length of section *A* plus the lengths of sections *C* and *B*, the tools held in block *E*, Figs. 1 and 2, guided by cam *U*, will begin to turn the tapered section *B*, Fig. 3. When slide *E* reaches cam *T* no transverse movement will be imparted to the tool, so that as the slide continues to the left, the straight cylindrical section *C* will be turned. The bushing in holder *R*, being carried directly back of the finishing tool, supports the work when nearing the end of the cut. The feed is automatically stopped when the cuts are completed. The operator then feeds the cutting-off tool forward, thus severing the finished piece. The machine is now ready to repeat the operation.

In summing up, attention is called to the fact that two roughing and two finishing tools are in operation at the same time—a feature which greatly shortens the production time. The results obtained by the use of this tool fully justified the cost of developing it, as it has not only proved capable of maintaining the limits of accuracy indicated in Fig. 3, but has given a higher rate of production than could be obtained by the grinding process.

* * *

INVESTIGATION ON SLUSHING OILS

The United States Bureau of Standards has made an investigation on the properties of slushing oils. The complete report of the investigation, prepared by P. H. Walker and Lawrence L. Steele, is given in Technologic Paper No. 176 of the Bureau of Standards. Briefly stated, the report arrives at the following conclusions:

Slushing oils are materials used for protecting bright metal where it is not feasible to use paint, varnish, or other fixed coatings. An ideal slushing oil is one that can be easily applied to all kinds of metal surfaces by a variety of methods. It should coat the surfaces with a sufficiently thick and impervious film to exclude moisture and air (to prevent rusting), should remain in position for an indefinite length of time, and yet be completely removable from the surface without undue labor. The material should itself have no corrosive action on any kind of metal. The report contains a discussion of properties and methods of testing, most of which were developed in the course of this investigation, and summarized results of tests of a number of samples. From a study of numerous laboratory and exposure tests, proposed specifications are given. The specifications suggested are based upon properties of the finished product rather than chemical composition. Formulas are given of some satisfactory mixtures, which are cited as examples of easily made preparations for protecting metal.

DIES FOR ELECTRIC LIGHT SHADES

An order recently came to the Phoenix Tool Co., 2 Remer St., Bridgeport, Conn., to design and make dies for use in the manufacture of electric light shades of the form shown at *B* in Fig. 1. These pieces are drawn from sheet brass, and after studying the problems connected with their production under the power press, it was decided to divide the work up into two operations. The first draw produces a shell of the form shown at *A* in Fig. 1, and then a second operation is necessary for trimming off the closed end of the shell to make a finished electric light shade of the form illustrated at *B*.

Design of the Drawing Dies

Sheet brass from which these pieces are made is purchased in the form of ribbon stock, so that it may be conveniently fed to the dies from a reel. It will be seen that guides *C* are furnished on the drawing dies shown in Fig. 2, which provide for directing the ribbon stock to the lower die. The stock advances until its progress is checked by a stop *D*, and then the upper die member descends. One edge *E* of this block is arranged to work in conjunction with the edge of a plate *F* carried by the lower die member, to provide for shearing off a blank of the proper length from the ribbon stock. Further downward movement of the upper die results in gripping the brass blank between the faces of the upper die-block and plate *G* carried by the lower die member. This plate is pushed downward by the upper die, against the tension of a rubber pressure pad located beneath eight plungers adjacent to the guides *H* that are secured to plate *G* by setscrews. The brass blank is held between the upper die-block and plate *G* by this spring tension in a way that prevents it from wrinkling while the drawing operation is in progress.

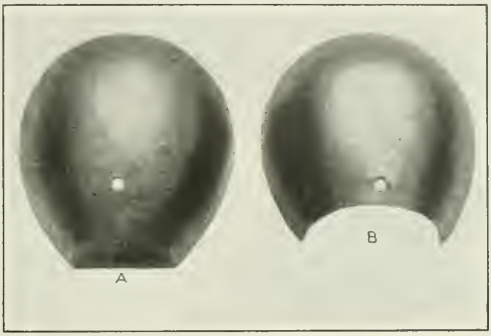


Fig. 1. Drawn Brass Shell A and Finished Electric Light Shade B

As plate *G* is pushed downward, a form *I*, of the same shape and size as the inside of the shell to be drawn, rises through the opening in plate *G* and enters the clearance space provided in the upper die member for its reception. The brass blank, which is held between the faces of the upper die-block and plate *G*, is thus drawn over form *I* and exactly duplicates its shape. The final result is a shell of the form shown at *A* in Fig. 1; the small hole in this shell is pierced by a punch *J* carried by form *I*. To any experienced mechanic it will be apparent that there will be a flash around the edge of the shell, left by the excess metal in the blank. This flash is trimmed off by the same operation which draws the shell. At the bottom of form *I*, it will be seen that there is a sharp edged block *K* which is of the same thickness as plate *G*. This block rises through the opening in plate *G* and at the bottom of the stroke of the press, it just enters the opening in upper die-block *E*, thus providing for shearing the excess metal from the drawn shell. This completes the first operation, the second operation consisting of trimming off the closed end.

Trimming Die

It has already been stated that a separate operation is employed for trimming off the closed end of the shell to bring the finished piece into the condition shown at *B* in Fig. 1. This operation is performed with a die that is manipulated by hand, this die being set up on a treadle-operated punch press. The trimming die shown in Fig. 3 forms the lower corners of the shell, and then a shear blade carried by the treadle-operated ram comes down and cuts off the end of the shell. As shown in Fig. 3, there is a form over which the shell can be dropped and located by means of a pin *L* that enters the pierced hole in the work. The trimming operation on the corners is accomplished in two stages by first throwing hand-lever *M* forward and then pulling it backward. Secured to the front of the form over which the shell is dropped, there is a tool-steel block *N* which is formed to accurately fit the contour of the inside of the shell and to have its right-hand end extend to the line on which the shell is to be trimmed; the lower right-hand edge of this block is formed to a radius corresponding to the shape to which the corners of the work must be trimmed.

Secured to the left-hand end of lever *M* there is a sliding trimming shear *O* which contacts with block *N* in a manner best shown in the lower cross-sectional view. When lever *M* is oscillated, it will be apparent that the shell dropped over block *N* occupies the space between this block and the shear *O*, so that when this shear is moved forward and backward by two successive movements of hand-lever *M*, it provides for trimming off the end of the shell to bring it to the desired condition. The design of the trimming die will be apparent from the illustration.

It will be seen that hand-lever *M* is pivoted at *P*, and that the short end of this lever extends into an opening in shear blade *O* to provide for its oscillation. An ample leverage ratio is provided between the two arms of lever *M*, so that the exertion of a moderate pressure on the lever applies an ample force on the trimming die. It will be evident that the trimming shear *O* has an extension *Q* at its right-hand side, which fits under guiding plates *R* that are secured to the die by means of dowel-pins and screws, as clearly shown in the plan view. At the center of the shear a pocket is cut in the projection *Q* that extends under the guides *R*, to form a space to receive the left-hand end of hand-lever *M*, as previously mentioned.

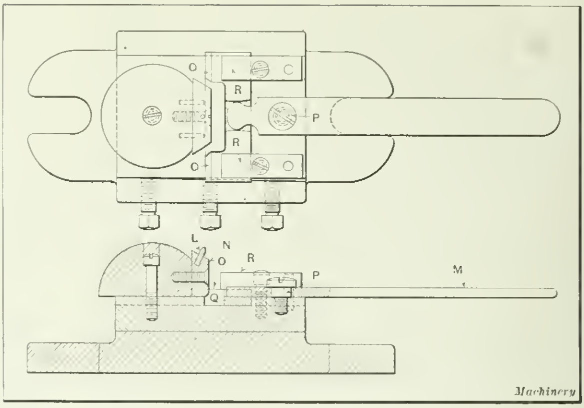


Fig. 3. Hand-operated Die for trimming Shells A to Form shown at B, Fig. 1

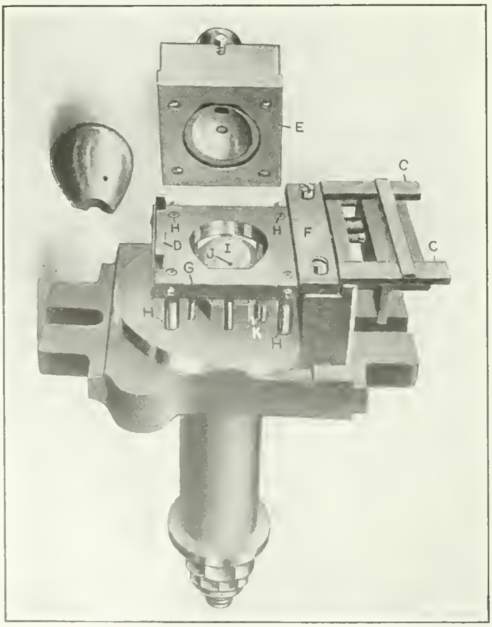


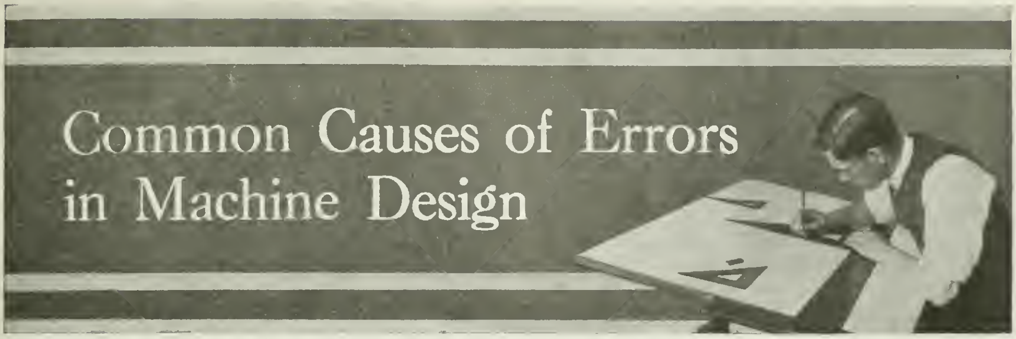
Fig. 2. Upper and Lower Dies used for drawing Shells of Form shown at B, Fig. 1

WASTE OF LABOR CAPACITY

In an address made by Herbert Hoover, president of the American Engineering Council, the governing body of the Federated American Engineering Societies, at a recent meeting of the council, the waste in production, measured by unemployment, lost time due to labor friction, loss in labor turnover, and failure to secure maximum production of the individual in the industries, was pointed out. In addition to this waste Mr. Hoover dwelt upon the waste due to poor coordination of great industries and the failure of the transportation system and the mining industry to meet the nation's requirements, thereby interrupting the steady operation of industry. Mr. Hoover pointed out how by intense production in 1918, with 20 per cent of our man power in the army, we produced 20 per cent more commodities than we are producing today. Now we are probably not producing more than from 60 to 70 per cent of our capacity, and our national industrial machine is incapable of employing more than two out of every three men ready to work.

"While we often assume that great advances in living standards are brought about by new and basic inventions," said Mr. Hoover, "even a greater field of raising the standards lies in the steady elimination of the waste referred to. The primary duty of organized society is to increase the standards of living of the people. The Federated American Engineering Societies, therefore, propose to make a primary examination of the waste in certain industries and to make constructive suggestions to remedy the faults. There is no such thing as national over-production if the industries produce the right commodities. The commodities or service produced by the whole nation is capable of absorption by the whole nation. It is true enough that any particular commodity or service can be over-produced, if it reaches a point in demand where all the members in a community have been supplied. The absorption of increased activity lies in the conversion of the luxuries of today into the necessities of tomorrow, and to spread these among the whole nation by stimulation of habit and education. To put the matter in another way, there is no limit to consumption except the total capacity to produce, provided the surplus of productive power is constantly shifted to new articles, from those that have reached the saturation point of demand."

The problem is one of infinite complexity, and Mr. Hoover did not suggest that the forces of production can be shifted by national direction, but he believes that it is practicable for engineers and business men to take hold of the matter and to eliminate some of the waste of human labor in production and to create, through the normal processes of business, new channels of employment.



Common Causes of Errors in Machine Design

Manufacturing Cost—Transportation of Machines—Compactness and Appearance

Fourth of a Series of Articles

By R. H. McMINN

THIS is the fourth of a series of articles, which began in the January number of MACHINERY, dealing with common causes of error in design and discussing fundamental points that must be considered in designing machines. The present installment takes up the influence on design of the manufacturing cost, restrictions imposed by transportation facilities, and considerations of compactness and appearance.

Manufacturing Cost

The designer must always keep in mind the cost of manufacturing the machine he is working on. If the machine is a special one and has been sold before being made, there has evidently been an estimate made of its cost in order to determine its sale price. The estimate should be examined carefully, and limitations on new patterns, kind of material, and amount of machine work must be followed closely, unless there has been a serious error in the estimate and the use of old patterns, kind of material specified, or the extent of machining conflicts with the suitable design or operation of the machine or with the purchaser's specifications. The design must not cover a machine that is more refined than necessary, or that performs operations not required by the specifications.

Whether the machine is being made before or after its sale, the consideration of cost is a very important one. Old patterns should be used if practicable. If new ones are required, they should be as simple to make and mold as possible. Finish should be allowed only where required. The allowance for fits should provide for as easy assembly as possible consistent with operating requirements. The designer should seek the least number of changes in settings for finishing each part. He should try to prevent difficulties in laying out work in the shop; for instance, he should not insist unless absolutely necessary, that a length of thirty-seven inches be divided into seventeen equal spaces. The different sizes of cored, drilled, tapped, or punched holes in any part should be as few as practicable.

Waste of Material and Labor

Waste of material should be watched. If the first design of a machine seems to demand a steel plate 60½ inches wide when the next width procurable above 60 inches is 72 inches, an examination may show that a slight modification will permit the use of a plate 60 inches wide. In quantity production, attention should be given to cutting the maximum number of odd shaped pieces from one sheet by seeking their best arrangement on the sheet and possibly modifying the design to reduce waste.

The shop's standard machines and tools should be used if possible, especially if only one or a few machines are to be built from a design. Shop standards should be adhered to as closely as possible, and stock parts utilized. Nothing unusual to machine or of uncertain result in operation should be introduced if avoidable.

When designing a machine which is to be made in large quantities, a saving in material or labor on any one part might amount to a large sum on a large number of machines built. The number of machines to be built may therefore largely affect the selection of permissible methods of manufacture. Quantity production demands that more time be given during design to the cost of each machine. However, if a man should be engaged on a design for building only one machine and should seek the very cheapest method of building everything, the time spent in doing this might be such a large factor in the expense that it would offset his efforts. Therefore the proper medium must be sought also in designing labor.

Transportation of Machines

All units of a machine must be loaded by the manufacturer, transported—usually by the railroad—unloaded by the purchaser, and moved to the exact point of erection. Restrictions in size or weight of any part or the extent to which a machine may be assembled for shipment depends on conditions surrounding all of these movements.

A manufacturer must have equipment of sufficient capacity to handle the heaviest single parts or assembled units of the kinds of machines he usually builds, and this should have some excess capacity. If these requirements be exceeded, he can probably devise or secure special means for transporting around his plant and loading extra heavy parts of any machine he wishes to build. Sometimes unusually long members must be taken diagonally through a door in a building in order to remove them. If the member is so long that one end interferes with a column, wall, or machine, a joint may have to be provided so it may be moved in two parts. To avoid such difficulties, shops that customarily handle long material, such as structural shapes, have doors in the end of the shop, if possible, where railroad tracks enter parallel to the longest dimension of the building. Large flywheels or gears are made in sections partly to meet transportation restrictions, as in the width and height of doors.

Transportation by Rail

Transportation by rail has limitations in the weight, width, height, and length that can be handled. Machinery shipments by rail are usually made in box cars or on flat cars. The average size of box car is about 8 feet 6 inches wide by 8 feet 6 inches high by 40 feet long inside, having a capacity of about 40 tons. The average flat car is about the same length and capacity, and has a platform about 9 feet wide. There are many box and flat cars in service that considerably exceed these sizes, but their use may be prevented by the limitations of a particular route. The maximum allowable gross weight of a car and lading varies with different routes due to the difference in capacity of the bridges over which a car must pass; the length of car that can be handled is determined by the degree of any curve to be encountered; and the permissible width of lading and its height above the rail depend upon the clearances of the road or roads over which the car must go.

Heights may be restricted by tunnels and viaducts. The width of the lading cannot exceed the width of the car upon which it is loaded. The allowable width of the load on open cars at different heights above the rail is variable, because the side clearance varies with the height above the rail. If the load projects over an idler car, or rests on two adjacent cars, or is borne by two cars with an idler between, the allowable width of the load is reduced to prevent it from projecting beyond the edge of the car on curves.

Some mountain roads in this country have narrow gage, sharp curves, and small side clearance, which reduces the size of their cars and hence of any loads that can be handled. If material must be transferred to one of these narrow-gage roads, this must be taken into account. If it appears that a machine or structure will have large or heavy shipping units it is well to consult the Master Car Builders' loading rules, and to obtain the weight and length limitations and the line clearances of the route over which material must be shipped, before deciding upon the design.

When Machines are Exported

If a machine must be shipped by sea, the maximum weight of any shipping unit depends upon the ports at which the machine is loaded and unloaded. The best equipped ports can handle complete medium-weight locomotives, and these have been loaded and unloaded at such ports completely assembled, except for the stack and other parts, which might be easily broken during handling and transport. However, it is customary to dismantle and box most machinery for its own protection, for ease of handling, and economy of space and cost. At some ports these boxes must be transferred in the open sea from the ship to a barge known as a lighter, and the allowable size and weight of the boxes is often quite restricted. If the material shipped is destined for the interior of an undeveloped country, this may place still further restrictions on size and weight due to the methods by which it must be transported—possibly by mule or camel. Some machines evidently could not be designed to meet such limitations, while others could be designed to consist of sufficiently small units to transport if the exact conditions were determined in advance.

Transportation over Public Roads

If the manufacturer's or purchaser's plant is not on a railroad spur, the limitations of moving a machine by truck or other means must be considered. Here the kind of road or soil that may be encountered by the carrier may limit the weight of any single unit. City regulations may restrict the load on a pavement or bridge, which must be passed over. The designer must consider clearances of overhead wires or viaducts, if any part to be handled is of great height; the ability to pass other vehicles, if the material is wide; or to turn corners, if it is long.

It is possible that some machine cannot be designed without a part so large that it will not enter the purchaser's building without removing part of a wall. The question of transporting the parts of a machine from the point of manufacture to the point of erection should be given careful consideration during design, and if any unusual methods must be employed the consent of the parties affected should be obtained before proceeding with the manufacture.

Compactness and Appearance

Compactness in design must always be sought. Space is valuable and often limited, and the size of a machine frequently determines whether it can be used in the only space available. Careful attention to this element of design will usually suggest economies in the space required.

The outward appearance of a machine cannot be ignored in its design. Some early machines for shop use were ornamented by scroll work, but this practice has been discontinued. Some machines for store and office have their exterior surfaces rather elaborately embossed, but the present tendency for such machines is toward a smooth enameled exterior. Certain "lines" add much to the appearance of such machines as automobiles which are made partly, at least, to be seen as well as used. Appearance counts for more in a machine for machine shop use than in one for a foundry or a coal mine. Utility must never be sacrificed for the sake of appearance, but appearance can often be aided by compactness, correct proportions for strength, well rounded edges, and a judicious use of curves in outlines.

The next installment of this article, which will appear in the May number of MACHINERY, will consider the influence of working environment on the design of a machine and the reaction of the machine upon its environment.

* * *

THE METRIC SYSTEM IN THE EXPORT TRADE

It has always been maintained by those who believe that the English system should not be replaced by the metric system in the United States, that the English system of weights and measures does not hamper the export trade, and that the metric system is not required for the promotion of this trade. In a statement sent out by the American Institute of Weights and Measures, 115 Broadway, New York City, a quotation is made from the Philadelphia Chamber of Commerce "News Bulletin," as follows:

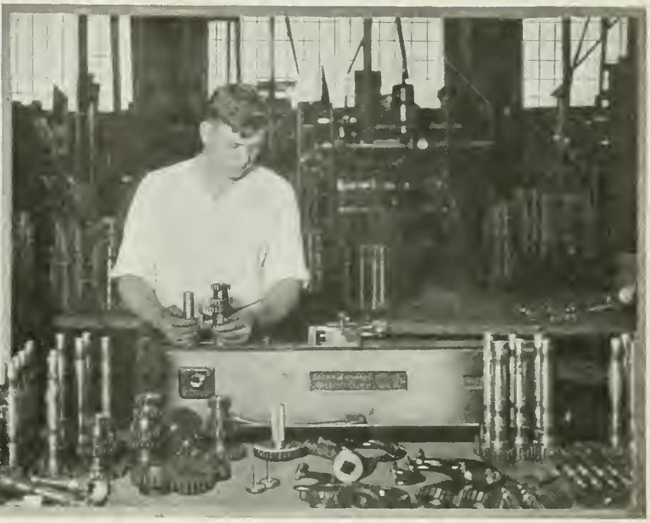
"In six years' time the exports of American machinery have trebled in value. In 1913 the total exports of machinery were valued at $127,980,000, while in 1919 they reached a total value of $378,425,000. That the total in the latter year was not greater was due to the urgent home demands for machinery of almost every description, which limited the amount available for export. Today, in addition to their branch offices in Europe, several American manufacturers maintain staffs in the Far East, Australia, and throughout South America. It is also a fact that American manufacturers, because of the efficiency of their manufacturing methods, are able to compete successfully with European manufacturers, even in countries where the tariff is in favor of the Europeans. This tremendous increase in the demand for American machinery may be traced to three causes: (1) The world-wide need of labor-saving machinery; (2) the adaptability of American machinery for almost every purpose; and (3) its low cost due to American methods of quantity production."

In view of this it is hardly reasonable to assume that the English system of weights and measures hampers the export trade of the United States. The tremendous growth of the export trade in American machinery, built to the English system, may be considered as sufficient proof that the metric system is not necessary to promote export trade.

* * *

Preliminary researches made to determine the value of alcohol as a fuel for automobile engines indicate that alcohol possesses most of the properties necessary for a good motor fuel. While its heat value is lower than that of gasoline, it may be used at higher pressures than the latter fuel. It was found advantageous to mix the alcohol with 20 per cent of gasoline, as such a mixture would start readily in cold weather and run the engine very smoothly.

Quantity Production in a Gear Shop



Practice of the Dittmer Gear & Mfg. Corporation, Lockport, N. Y., in the Manufacture of Gears for Tractors, Trucks, and Automobiles—First of Two Articles

By FRED R. DANIELS

THE making of gears in quantities presents many problems differing from those that arise when only one or a small number of gears are made at a time. Hence a description of the methods used in a shop specializing in the production of gearing in large quantities is of particular interest to men in the mechanical field. The following article deals specifically with gears used for tractors, trucks, and automobiles as made by the Dittmer Gear & Mfg. Corporation, Lockport, N. Y. There are a number of preliminary steps in the manufacture of these gears that are of great importance in meeting the exacting requirements of the automobile trade, and many precautions must be taken in order to insure a high-class product.

Testing and Preparing the Stock for the Machining Operations

In the first place, drillings are taken of all bar stock and forgings received in the plant, for the purpose of analysis, and until this analysis has shown that the steel meets the specified requirements for gear purposes, the material is not sent to the shop. All forgings are annealed in Rockwell carburizing furnaces, and pickled for about one hour in a 30 per cent solution of sulphuric acid, for the purpose of cleaning the exterior surfaces. The forgings are then washed in boiling water and are subjected to an acid neutralizing bath of boiling lime, which neutralizes any sulphuric acid yet remaining on the forgings. After thus preparing the steel for subsequent machining operations, both by improving its structure through the annealing process and by the removal of all iron oxide scale, the forgings are delivered to the machine shop.

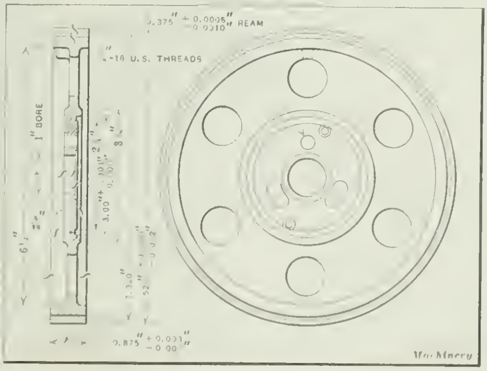


Fig. 1. Detail of Automobile Camshaft Gear

In the case of alloy steel bar stock, which is used extensively in the manufacture of gears of plain design, this preliminary treatment is unnecessary, so that the first operation is to cut the bars into disks of suitable thickness. This is done on a power cut-off saw. For cast-iron blanks, from which plain gears such as automobile camshaft gears are made, no preliminary treatment is required other than to allow the blanks to lie out in the open and accumulate a heavy coating of rust, as a means of improving the quality of the iron.

In machining plain gear blanks such as shown in place on the machine in Fig. 2, the first operation consists of facing, and of drilling and reaming the center hole, and this illustration shows the operation in process. The machine is a Baker Bros. drilling machine, and is shown performing a spot-facing operation. The work is chucked in a Barker wrenchless chuck, and is machined with a Genesee spot-facing tool. The finished face of the work is subsequently used to locate the work for the broaching operation which follows, so that assurance may be had that the hole will be perfectly perpendicular to the face of the work. The illustration shows the method in which gear blanks having a central hole are handled in transporting them through the shop. It will be seen that the gears are placed on spools, after being machined, which have a circular base so that they can be rolled from machine to machine for the different operations.

Automobile Camshaft Gears

Cast-iron gear blanks from which camshaft gears such as shown in Fig. 1 are machined, as well as all other castings of this type, require very little handling and do not demand any elaborate

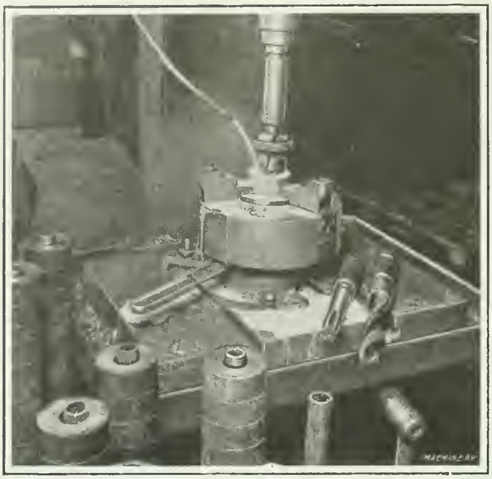


Fig. 2. Spot-facing Gear Blanks prior to broaching

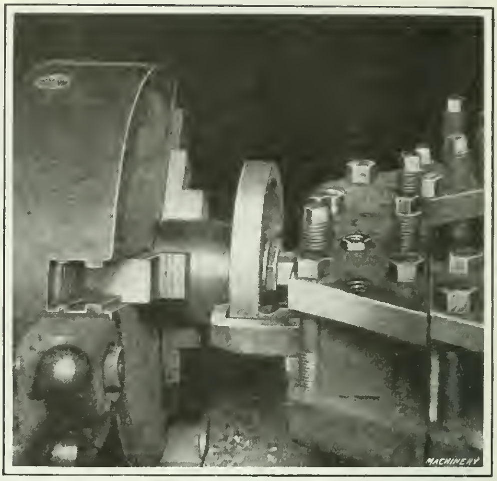


Fig. 3. Turret Lathe equipped for facing Camshaft Gear

equipment in their production. They are first machined on a Jones & Lamson turret lathe, as shown in Fig. 3, the operations consisting of drilling the central hole, facing both sides, and finish-turning the outside diameter, using the regular tooling equipment. The illustration shows the tooling for the straddle-facing operation, and the method of mounting the work on a special arbor held in a three-jaw chuck. The standard time for performing the roughing out operations is sixteen minutes, floor to floor.

This particular gear has sixty 10-pitch right-hand spiral teeth cut on its periphery, the helix angle being 34 degrees 56 minutes 14 seconds, and the lead of helix 32.918 inches. The practice in machining spur gear teeth in this plant is to first rough them out by the hobbing process and then finish them on Fellows gear shapers, except, of course, where the design of the gear will not permit sufficient space to use a hob. After the camshaft blanks have been roughed out on the Jones & Lamson machine, the various holes are drilled and tapped, and then the spiral teeth are finish-cut by the hobbing process, at the rate of 5.8 gears per hour. Fig. 4 shows a general view of a section of the plant and a number of the Cincinnati Gear Cutting Machine Co.'s gear-hobbers, on which the teeth are cut. Attention is again called to the spools on which the work is carried from operation to operation. In dealing with the more interesting types of gears to be described in later paragraphs, further reference will be made to these gear-cutting machines.

Roughing out the Stem Gears

Fig. 5 shows two designs of stem gears, variously referred to in automobile parlance as clutch or main drive gears. These gears are made from regular S. A. E. specification No. 2320 steel, which is a 3½ per cent nickel steel of the following composition: Carbon, 0.15 to 0.25 per cent; manganese, 0.50 to 0.80 per cent; phosphorus, not over 0.040 per cent; sulphur, not over 0.045 per cent; nickel, 3.25 to

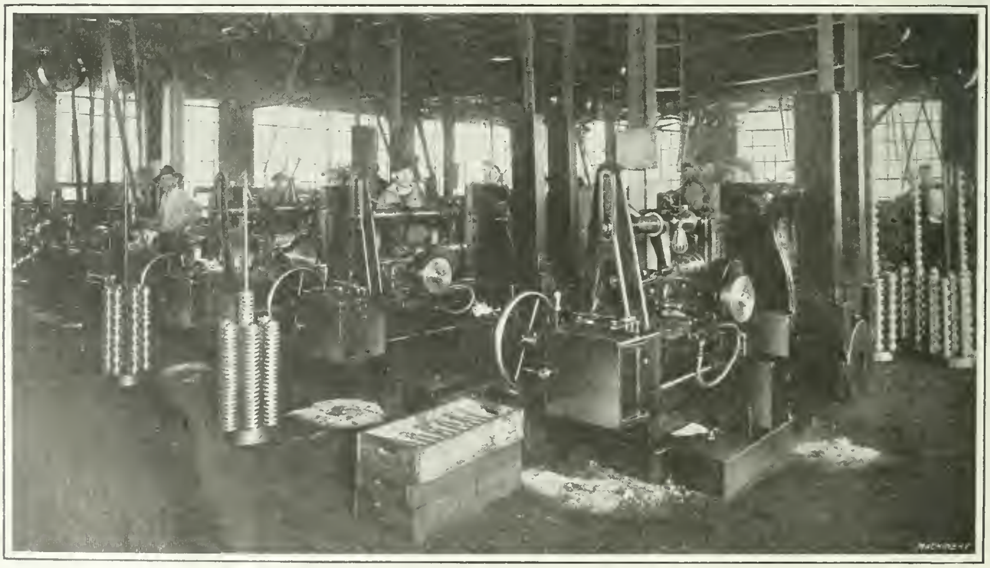


Fig. 4. General View of the Shop, showing a Battery of Gear-hobbing Machines

3.75 per cent. After the forgings have been annealed and pickled, they are then straddle-milled to length and centered on both ends, both the milling machine and the centering machine being operated by one workman. These two operations are performed at the rate of thirty gears per hour.

The roughing and finishing operations on the stem gears are performed on "Lo-swing" lathes, and the multiple tooling arrangement used is clearly illustrated in Fig. 6. This illustration shows the roughing operation on gear *A*, Fig. 5, as seen from the rear of the lathe, and is substantially the same set-up as is used for machining gear *B*. It will be evident that diameters *C*, *D*, and *E*, and the shoulders *F*, *G*, and *H*, are turned and faced with the tools with which this lathe is shown equipped, and that the finishing operations require substantially the same tooling. On the finishing operations, in addition to the diameters, the recesses are machined. The production time for both roughing and finishing operations is 13.3 finished gears per hour.

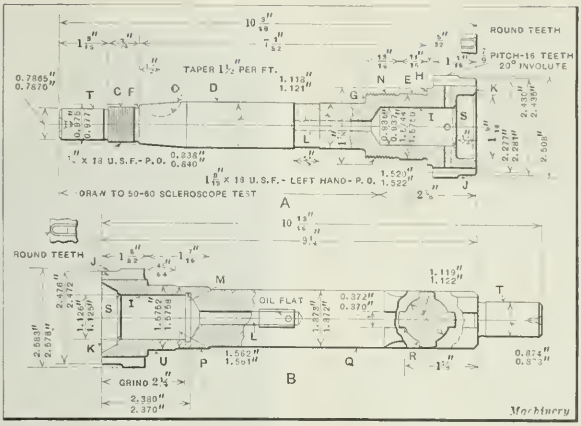


Fig. 5. Two Designs of Clutch or Main Drive Gears

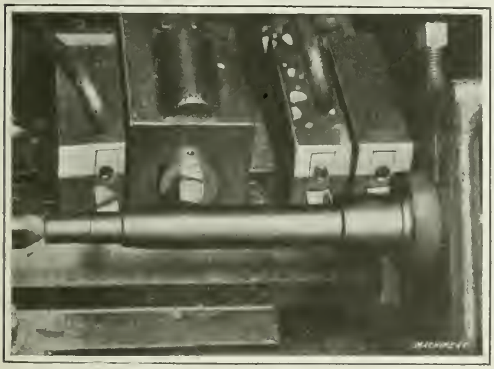


Fig. 6. Lathe showing Tooling for turning the Bearing Surfaces of a Stem Gear

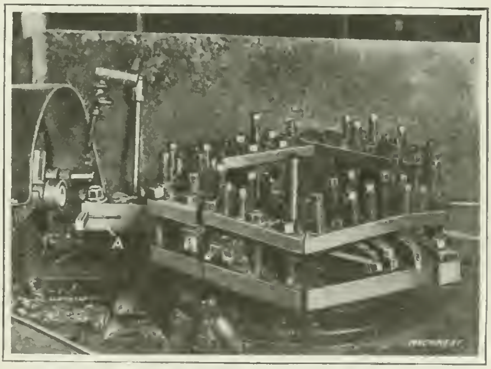


Fig. 7. Machining the Gear End of a Main Drive Shaft Gear on a Turret Lathe

After the shaft end of the gear has been finish-turned, a Jones & Lamson flat turret lathe, equipped as shown in Fig. 7, is employed to bore and finish-turn the gear end. The illustration shows this operation being performed on gear *A*, Fig. 5, and the sequence of operations and the tooling arrangement are similar to those employed in finishing corresponding surfaces of gear *B*, a fact which will be readily understood from the similarity of the two gears. The sequence of operations and the tooling are as follows: Spot and drill hole *I*, using drills in stations 1 and 2; rough-turn outside diameter with regular turning tool at station 3, carried in holder *A*, Fig. 7; rough-counterbore hole, turn surface *J* and rough-face surface *K* with tools in station 4; finish-turn outside diameter, finish-counterbore hole, and finish-face surface *K* with tools mounted in station 5 of the turret; rough- and finish-bore hole, using head adjustment and a single-point tool in station 6; drill and ream hole *L* at stations 8 and 9. The corresponding operations on gear *B* are slightly different from these in that they include cutting recess *M* and the use of a special tool for the counterboring operation. The production time for gear *A* is 4½ parts per hour, and for gear *B*, 5½ parts per hour.

In following each machining operation on these two forgings from this point to the heat-treating process, it will be seen that in a number of minor respects the operations are different. Gear *A* is threaded at *C* and *N*, the threads being chased on a Cincinnati lathe; also, a keyway *O*, in which a No. 15 Woodruff key is used, is machined on a Whitney hand milling machine. Gear *B* has two oil flats milled diametrically opposite on the long bearing surface, this operation also being performed on a Whitney hand miller. It is of paramount importance that the bearing surface of the shaft and the pitch line of the gear be concentric to within 0.003 inch, and as a means of realizing this degree of accuracy, a preliminary or "green" grinding operation is performed on surfaces *E* and *H* of gear *A* and on surfaces *P* and *Q* of gear *B*, these being the chucking surfaces by which the gears are held during the operation of finish-cutting the teeth. By following this procedure, the teeth may be used to chuck the work from the pitch line during the final grinding op-

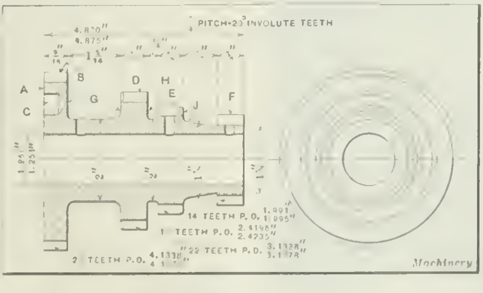

PITCH-20° INVOLUTE TEETH
4.870"
4.875"
1 3/16"
A
C
B
G
D
H
E
J
F
14 TEETH P.O. 1.991" 1.995"
TEETH P.O. 2.4198" 2.4235"
22 TEETH P.D. 3.1338" 3.1378"
TEETH P.O. 4.1338"
Machinery

Fig 8. Automobile Cluster Gear

erations performed on the bearing surface of the stem end after the gears have been hardened. Then, by chucking the work from these finished exterior surfaces, the bore *I* may be ground, thus assuring that all ground surfaces are concentric with the pitch circumference of the gear to within the established allowance. The "green" grinding operation is performed on a cylindrical grinder, with the work chucked on the long bearing surface, which in the case of gear *A* is also the surface utilized in chucking the work while chasing the threads at *N* and *C*. This brings the threads concentric with the other elementary surfaces of the gear. The preliminary grinding of the bearing surfaces is the final roughing operation before the teeth are cut.

Operations on Countershaft Cluster Gears Prior to Cutting the Teeth

The cluster gear shown in Fig. 8 is also made from S.A.E. No. 2320 steel, and the forging receives the same preliminary treatment as described in an earlier paragraph. The first machining operation is performed on a turret lathe, and consists of rough-facing surface *A*, squaring up surface *B*, drilling and boring the central hole, and removing the sharp corners at the ends of the hole. The production time on this series of operations is ten minutes per gear. The central hole is next broached on a Lapointe double-head broaching machine, the work being located from surface *A* of the gear, as illustrated in Fig. 9. The practice in automobile gear manufacture of finishing the holes by broaching, is followed not only in the case of cluster gears, but also on gears of all types having a central hole, such as those made from disks cut from alloy bar stock. It is stated that this method of machining produces a more satisfactory hole than reaming, and one that compares favorably with any other method of machining as regards finish.

Broaching is also an economical means of finishing round holes, because the broaching machines, which are of necessity used for machining keyways, and square or hexagonal holes, may not be kept constantly in service on this type of work, and consequently can be economically used for broaching round holes. In addition to reducing the idle time of the broaching machine, a high productive rate can be realized by this method of machining. The production time for this operation is fifty cluster gears per hour.

The cluster gears, as well as all gears which can be mounted on an arbor between lathe centers, are then straddle-faced to bring the ends parallel and at right angles to the center line of the hole. This operation is performed on an 18-inch Boye & Emmes engine lathe, the operation itself involving no work of special interest. The production time is thirty-five pieces per hour. The next operation is drilling the drive-pin hole *C*, Fig. 8, by means of which the work is driven during subsequent machining operations. The production time is forty gears per hour.

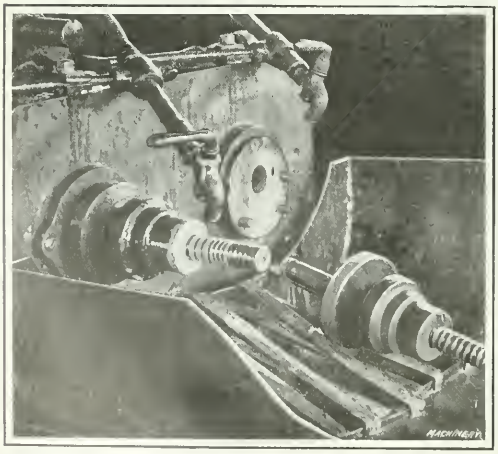


Fig. 9. Broaching Central Hole in Cluster Gear

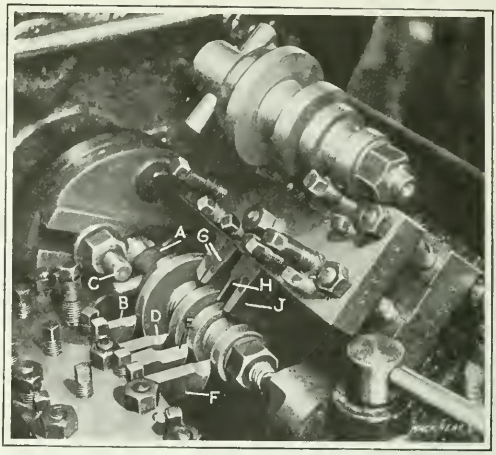


Fig. 10. Tooling Set-up of Automatic Lathe used in machining Cluster Gears

Two Fay automatic lathes are employed in the final roughing and finishing operations, in which surfaces *B*, *D*, *E*, and *F* are rough-turned, and surfaces *G*, *H*, and *J* rough-faced on one machine; and the same surfaces are finished on the other lathe. Fig. 10 shows the tooling employed in the finishing operation, and it will be apparent that the tools *B*, *D*, *E*, and *F* perform finish-turning operations on similarly designated surfaces in Fig. 8, and that tools *G*, *H*, and *J* are facing tools for finishing the surfaces designated by these letters in Fig. 8. The arrangement of the tools is typical of that employed on all lathes of this type.

The operator takes care of both machines, and there is no idle time for either machine or operator, as the operator utilizes the time consumed in machining, by preparing to quickly unload and load the work. This is done by employing a set of three mandrels, one of which is indicated at *A*, Fig. 10; a loaded mandrel is also shown lying on top of the rear tool-holder. These have a driving pin on one end for engaging driver *C* of the faceplate, and are threaded on the opposite end so that the work may be held securely in place. As soon as the finishing operation is completed, the operator removes the mandrel and its work from the machine centers, and replaces it with the loaded mandrel, which has just been taken from the roughing machine. The third mandrel, which was loaded between cuts, is substituted for the mandrel in the roughing machine, and the operation is continued with only slight interruption. Plenty of time is afforded the operator to attend to reloading the extra mandrel and to keep a close watch on the condition of the work while the machines are running. The production time on each operation is seven gears per hour. This completes the machining work on the cluster gears prior to cutting the teeth.

In the next installment of this article the cutting of the teeth, the heat-treatment, the grinding operations performed on the gears, and the inspection will be dealt with.

* * *

Consul General Alfred A. Winslow, of Auckland, New Zealand, reports that the contract for the electrification of the Otira Tunnel on one of the New Zealand railways was recently awarded to an English electrical company in preference to a New Zealand corporation that quoted on American machinery, only because the latter's bid was higher owing to the adverse exchange rate.

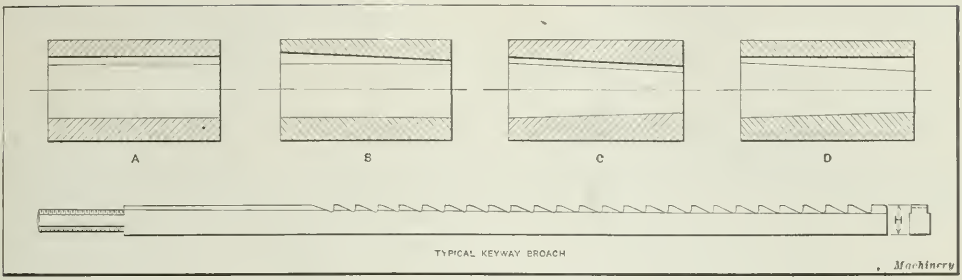


Fig. 1. Four Classes of Broached Keyways and Typical Keyway Broach

Guide Bushings for Keyway Broaching

Formulas for Designing Bushings for Broaching Accurate Keyways

By CARL H. BRIGGS

KEYWAYS may be divided into four general classes—those that accommodate straight keys in straight holes, taper keys in straight holes, straight keys in taper holes, and taper keys in taper holes. Examples of each of these are shown in section in Fig. 1, classed as *A*, *B*, *C*, and *D*, respectively. This illustration also shows a keyway broach such as is used in cutting all four classes of keyways. The guide bushings differ slightly for each class of keyway, as may be seen by referring to Fig. 3. This illustration shows the four types of guide bushings required; the work in each case is mounted on plug *P*, and the broach is guided in slot *S*.

On the dimension *T* at the bottom of these slots depends the accuracy of the depth of the finished keyway. If dimension *T* is too great, the first tooth of the broach will probably break due to overloading; but in the event of its escaping damage, the finished keyway will be too deep by an amount equal to the error. On the other hand, if dimension *T* is too small, the entering teeth of the broach will not be in the proper cutting position, and the finished keyway will be too shallow. It is the purpose of this article to present formulas by means of which dimension *T* may be readily computed.

In cases where a large amount of material is to be removed, so that it is necessary to employ two or more passages of the broach to finish the keyway, slot *S* is cut deeper, and shims are inserted under the broach after each cut, to raise it to the proper position for the next cut. The thickness of the shims should, of course, be equal to the depth of the cut taken at each pass of the broach. The amount by which the depth of slot *S* must be increased when multiple cuts are to be taken is found by the formula $(N - 1) \times C$, in which *N* equals the number of cuts required to finish the keyway to depth, and *C* the depth of each cut. In connection with the following formulas, reference should be made to the diagram Fig. 2, which represents, for straight holes, the outline of that end of the work abutting against the collar of the guide bushing (see Fig. 3). When using Fig. 2 in connection with the keyways for taper holes, it should be mentioned that the relation of elements *D*, *d*, and *a* is somewhat modified, as will be noted.

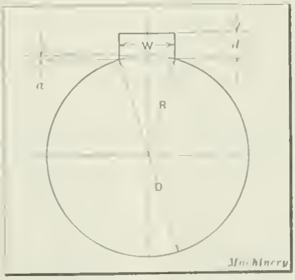


Fig. 2. Diagram showing Application of Formulas for Guide Bushings

Straight Key in Straight Hole—Class A

When only one pass of the broach is required to machine the keyway:

$$T = (D + d) - (a + H)$$

In this formula, and in all those that follow, except where noted,

$T =$ required dimension of bushing, as indicated in Fig. 3;
$D =$ diameter of hole;
$d =$ depth of keyway (normal to axis);
$a =$ height of arc (uniform); and
$H =$ height of broach measured over finishing teeth as indicated in Fig. 1.

The formula for obtaining the height of arc *a* will be given later.

Taper Key in Straight Hole Class B

When only one pass of the broach is required to finish the keyway,

$$T = (D + d) - \left[\sqrt{H^2 + \left(\frac{Y}{12} \times H\right)^2} + \left(\frac{Y}{12} \times L\right) + a\right]$$

in which

$d =$ depth of keyway at deep end;
$Y =$ taper per foot of key; and
$L =$ length, in inches, of plug P (see Fig. 3).

Straight Key in Taper Hole—Class C

When only one pass of the broach is required to machine the keyway,

$$T = \left[D + \sqrt{d^2 + \left(\frac{Y}{24} \times d\right)^2} - a\right] - \left[\left(\frac{Y}{12} \times L\right) + \sqrt{H^2 + \left(\frac{Y}{24} \times H\right)^2}\right]$$

in which

$D =$ diameter of hole at large end;
$Y =$ taper per foot of hole;
$a =$ height of arc at large end of bushing; and
$d =$ depth of keyway (uniform).

Taper Key in Taper Hole Class D

When only one pass of the broach is required to machine the keyway,

$$T = \left(D - \frac{LY}{12} + d\right) - (a + H)$$

in which

$D =$ diameter of hole at large end;
$d =$ depth of keyway at deep end; and
$a =$ height of arc at small end of hole.

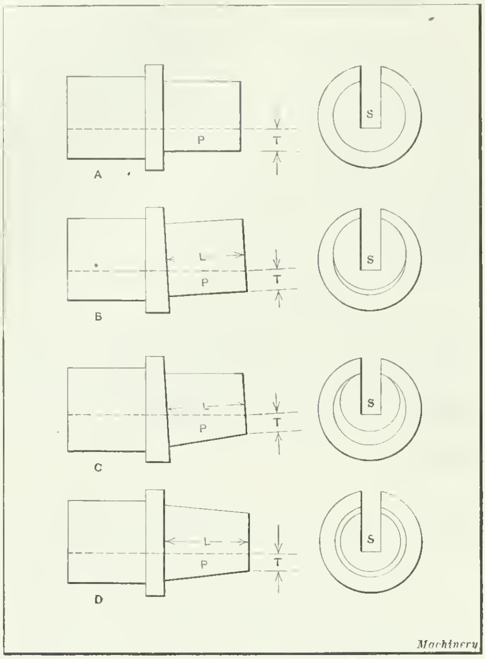


Fig. 3. Four Classes of Guide Bushings used in broaching Keyways

Height of Arc

The term "height of arc" may need a little explanation. Keyways are usually measured for depth d on the edge formed by the intersection of the side of the keyway and the hole, as indicated in Fig. 2. If the diameter of the hole is added to the depth of the keyway as measured at this point, the height of arc a will be included twice. This makes it necessary to deduct its value once, as is done in the formulas. The height of arc may be computed by the following formula given on page 500 of MACHINERY'S HANDBOOK:

$$a = R - \sqrt{R - \left(\frac{W}{2}\right)^2}$$

In this formula, the letters represent the same dimensions as in Fig. 2. When frequent use is to be made of these formulas, considerable time may be saved by arranging the various values of a in chart form. If the keyways are to be measured from the tops of the holes, the height of arc and its symbol a will not enter into the computation.

* * *

In order to show how the working rules established under federal control inflate the labor cost of railroad operation and result in great waste and inefficiency, a case was cited before the United States Railroad Labor Board in Chicago, showing that one railroad was compelled to award each man of a wrecking crew thirteen hours' pay, during which no actual service was performed. At regular and extra rates the men received thirty-seven and one-half hours pay for work all performed within twenty-four hours. Of these twenty-four hours, the men were off duty or asleep for eleven hours and were riding or eating for two hours, while receiving pay, being actually at work only eleven hours. This is not an extreme case of the unreasonable demands that labor has placed upon the railroads. Under a related rule applying to wrecking crews, claims are constantly made by men who do not actually accompany the crew but who assert that, according to the rules, they should have done so, and are therefore entitled to pay.

CALCULATING LENGTHS OF ROPE FOR DRUMS

By HYMAN LEVINE

Designers of hoists, reels, winches, etc., frequently find it necessary to compute the length of rope that can be wound on a given size drum. If the diameter of the drum flange is such as to allow but one layer of rope, the computation is simple enough, being obtained by multiplying the circumference of one coil by the number of coils in the layer. However, if the flange diameter is increased or the rope diameter decreased, so that there will be more than one layer of rope on the drum, as shown in the illustration, the problem becomes more complicated. In the following, the lengths of rope will be calculated as if each coil were an individual ring rather than all of them one continuous piece of rope. This method will cause an error due to the helical winding of the rope, but the calculations will be sufficiently accurate for all practical purposes; the larger the drum, the less this error will be.

In the various formulas to be presented,

d = diameter of rope, in inches;
D = diameter of drum, in inches;
F = diameter of drum flange, in inches;
W = width of drum, in inches;
P = pitch between coils, in inches;
C = number of coils in the first layer;
A = average number of coils per layer;
N = number of layers;
T = total number of coils;
M = mean diameter of rope coil in inches;
R = fractional remainder obtained in calculating the product of $W \div d$; and
L = total length of rope, in feet, that can be wound on drum.

By reference to the illustration, it will be evident that

$$L = \frac{\pi M T}{12}$$

The difficulties encountered in problems of this nature lie in determining the values of M and T. The number of layers N depends upon the diameter of the rope and on the difference in diameter between the drum flange and the portion of the drum on which the rope is wound. It will be apparent that the pitch diameter of the first layer, that is, the layer

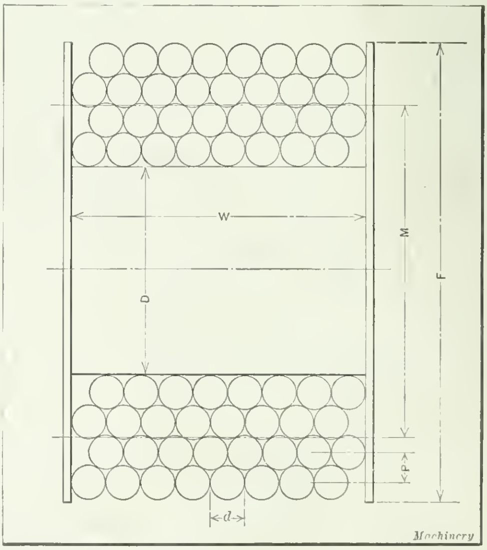


Diagram used in Evolution of Formulas for finding Rope Lengths

adjacent to the drum proper, equals $D + d$; that of the second layer, $(D + d) + 2P$; that of the third layer, $(D + d) + 4P$; and so on, the pitch diameter increasing an amount equal to the value of $2P$ with each additional layer. The number of spaces between the first and the last coils equals

$$\frac{F - (D + d)}{2P}$$

This number is, of course, one less than the total number of layers because the first layer has not been included; however, in order to insure that the last layer of coils will not be too far beyond the edge of the flange, add 0.5 to this result to find the number of layers on the drum, instead of adding 1. Thus,

$$N = \frac{F - (D + d)}{2P} + 0.5$$

The result will usually contain a decimal, but the number of layers should be taken as the nearest whole number. By making the necessary trigonometrical calculations it will be evident that

$$P = \frac{d}{2}\sqrt{3}$$

The equation for finding the number of layers can then be reduced as follows:

$$N = \frac{F - D - d}{1.732d} + 0.5 \qquad (1)$$

It is evident that the mean diameter of the rope coils M is equal to the pitch diameter of the first layer $(D + d)$ plus one-half the distance from the center of this layer to that of the last layer. Thus,

$$M = D + d + 0.866d\ (N - 1) \qquad (2)$$

The total number of coils T depends upon the width of the drum and the diameter of the rope. The number of coils in the first layer can be found by the equation

$$C = \frac{W}{d} \qquad (3)$$

In this calculation, it will be necessary to discard the fractional remainder R because it is impossible to have a fraction of a coil. The number of coils in the second layer varies with the value R: if R is equal to, or greater than, 0.5 there will be the same number of coils in each of the other layers as in the first, and $T = NC$, but if R is less than 0.5 every second layer will have one coil less than the first and $A = C - 0.5$ when the number of layers is even, and $A = C - \frac{N - 1}{2N}$ when the number of layers is odd. Also $T = N\ (C - 0.5)$ in the first case, and $T = N\left(C - \frac{N - 1}{2N}\right)$ in the last.

The different formulas evolved to satisfy the various conditions entering the calculation of the rope length for a given drum are as follows:

$$L = \frac{\pi MNC}{12}, \text{ when } R \text{ is equal to, or greater than, 0.5 inch.} \qquad (4)$$

$$L = \frac{\pi MN}{12}\ (C - 0.5), \text{ when } R \text{ is less than 0.5 inch and } N \text{ is even,} \qquad (5)$$

And

$$L = \frac{\pi MN}{12}\left(C - \frac{N - 1}{2N}\right), \text{ when } R \text{ is less than 0.5 inch and } N \text{ is odd.} \qquad (6)$$

The following examples will illustrate the procedure followed in calculating a rope length

Example—Find the length of rope that can be wound on a drum 12 inches in diameter, 6 inches wide, having an 18½-inch diameter flange, the rope being ¾ inch in diameter

Inserting the known values in Equation (1),

$$N = \frac{18.5 - 12 - 0.375}{1.732 \times 0.375} + 0.5 = 9.9 \text{ or } 10 \text{ layers}$$

Next, according to Equation (2)

$$M = 12 + 0.375 + 0.866 \times 0.375 \times 9 = 15.3 \text{ inches}$$

Solving Equation (3) to find the number of coils,

$$C = 6 \div 0.375 = 16$$

In this calculation, $R = 0$, and, as the number of layers is even, according to the conditions explained in the foregoing, Equation (5) should be used in calculating the length of rope for this drum. Therefore,

$$L = \frac{3.14 \times 15.3 \times 10}{12} \times 15.5 = 620.5 \text{ feet}$$

If the width of the drum in this problem is assumed to be 6¼ inches, C would equal 16.6; as R is greater than 0.5 inch in this case, Equation (4) should be employed in determining the rope length. Thus,

$$L = \frac{3.14 \times 15.3 \times 10 \times 16}{12} = 640.6 \text{ feet}$$

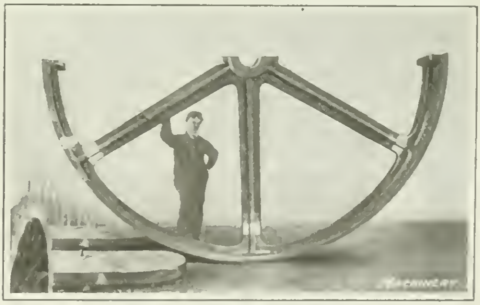
If the drum width is again considered as 6 inches, but the flange diameter is reduced to 18⅛ inches, $N = 9$, and $M = 14.97$ inches. The number of layers is odd in this case, and as R is less than 0.5 inch, Equation (6) should be used for the solution. Thus,

$$L = \frac{3.14 \times 14.97 \times 9}{12} \times 15.55 = 548.4 \text{ feet}$$

* * *

LARGE FLYWHEEL REPAIR

A large flywheel, as shown in the accompanying illustration, was recently repaired at the Newark welding shop of the Oxweld Acetylene Co. This flywheel was shipped to Newark, N. J., by a firm in Richmond, Va. The wheel is 18 feet in diameter, the spokes being 8½ by 5 inches in cross-section at the rim, which is 25 inches wide by 2 inches thick; and the hub is 18¼ inches long with a bore 9 inches in diameter. The rim was broken apart in one place, and all three spokes of the broken half wheel were snapped off short at the rim. The other half of the wheel, which was unbolted before shipping, remained intact. The illustration shows the job in its completed form, the welded parts being indicated by white chalk marks. Preparation for welding and the actual welding required fifty-seven and one-half hours. The cost was a small part of what would have had to be paid for a new casting, and the saving in time was an even greater economy.



Large Flywheel repaired by Oxy-acetylene Welding

* * *

Steel rails laid down on the railroads of the United States in 1920 cost approximately $48 a ton—an increase of 20 per cent over the cost in 1919, and 63 per cent over the cost in 1911. Crossties for railroads cost 32 per cent more in 1920 than in 1919, and 153 per cent more in 1920 than in 1911

Steels for Machine Tool Parts*

By ROBERT M. TAYLOR, Works Engineer, The American Tool Works Co., Cincinnati, Ohio

THERE has not been much information published to indicate to machine tool builders what materials are generally used by the machine tool industries. In most cases a selection of material is made by conferring with the steel mill salesmen. This method may have its advantages, but it has resulted in the same material being called by many different names. When a buyer tried to buy a material from a different source, it was a difficult task to juggle the trade names, analyses, and physical specifications to get a comparison. The automobile manufacturers met with the same difficulties, and early in their career they clearly saw the advisability of preparing uniform specifications and classifications for materials, and through the American Society of Automotive Engineers developed the S. A. E. specifications for steels.

Steels of S. A. E. specifications are now being manufactured by practically all steel mills, and if the same or similar classifications were adopted by other industries it would greatly simplify the difficulties of buyers and steel manufacturers. In the numbers used in the S. A. E. system, the first figure indicates the class to which the steel belongs: thus, 1 indicates a carbon steel; 2, nickel; 3, nickel-chromium; 5, chromium; 6, chrome-vanadium; and 9, silico-manganese. In the case of alloy steels, the second figure generally indicates the approximate percentage of the predominant alloying element. The last two or three figures indicate the average carbon content in points or hundredths of one per cent, thus 3120 indicates a nickel-chromium steel with approximately 1 per cent nickel (1.00 to 1.50 per cent) and 0.20 per cent carbon (0.15 to 0.25 per cent). Also, 1020 indicates a straight carbon steel containing approximately 0.20 per cent carbon (0.15 to 0.25 per cent). The heat-treatments have also been standardized, letters being used to designate the different kinds. These heat-treatments are given in detail on pages 1156 and 1157 of MACHINERY'S HANDBOOK.

For the benefit of buyers, draftsmen, and shop men in the machine tool industry, a list of steels suitable for many parts used extensively in the construction of machine tools is presented. While these steels are identified by S. A. E. numbers and letters, they correspond to the same grades of steel supplied under various names. The physical properties given have been secured from the best information available, but all are not results of actual tests.

COMPOSITION AND HEAT-TREATMENTS OF STEELS FOR MACHINE TOOL PARTS

Use in Machine Tools	Kind of Steel	S.A.E. Specification Numbers	Carbon, Per Cent		Manganese, Per Cent		Phosphorus, Per Cent Max.	Sulphur, Per Cent Max	Nickel, Per Cent		Chromium, Per Cent		Vanadium Per Cent		Silicon, Per Cent		Heat-treatments
			Maximum and Minimum	Desired	Maximum and Minimum	Desired			Max. and Min	Desired	Max. and Min.	Desired	Max and Min.	Desired	Max. and Min.	Desired	
Shafting; Soft and Carburized Gears; Keys	Carbon steel	1020	0.15–0.25	0.20	0.30–0.60	0.45	0.045	0.05	.....	....	....	....	...	...	.....	....	A–B–H
Spindles, Arbors; Special Shafts; Tempered Gears	Carbon steel	1045	0.40–0.50	0.45	0.50–0.80	0.65	0.045	0.05	.....	....	....	....	...	...	.....	....	D–E–H
Centers and Springs; Cams; Mandrels	Carbon steel	1095	0.90–1.05	0.95	0.25–0.50	0.35	0.04	0.05	.....	....	....	....	...	...	.....	....	F–X
Screws; Nuts; Bolts; Studs	Screw stock	1114	0.08–0.20	....	0.30–0.80	....	0.12	0.06–0.12	.....	....	....	....	...	...	.....	....	A
Lead-screws	Lead-screw stock	1135X	0.30–0.40	0.35	0.60–0.90	0.75	0.07	0.06–0.09	.....	....	....	....	...	...	.....	....	.....
Carburized Gears	Nickel-chromium steels	3120	0.15–0.25	0.20	0.50–0.80	0.65	0.04	0.045	1.00–1.50	1.25	0.45–0.75	0 60	...	...	.....	....	D–G–H
Tempered Gears; Spindles; Toolpost Screws; High-duty Shafts	Nickel-chromium steels	3135	0.30–0.40	0.35	0.50–0.80	0.65	0.04	0.045	1.00–1.50	1.25	0.45–0.75	0.60	...	...	.....	....	D–E–H
Oil-hardened Gears; Cams; Ratchets	Nickel-chromium steels	3250	0.45–0.55	0.50	0.30–0.60	0.45	0.04	0.04	1.50–2.00	1.75	0.90–1.25	1.10	...	...	.....	....	M–Q
Ball Races; Rollers; Cams; Pins	Chromium steels	5195	0.90–1.05	0.95	0.20–0.45	0.35	0.03	0.03	....	...	0.90–1.10	1.00	...	....	.....	....	M–P–R
Carburized Gears	Chromium-vanadium steels	6120	0.15–0.25	0.20	0.50–0.80	0.65	0.04	0.04	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	S–T
Spindles; Tempered Gears; Shafts	Chromium-vanadium steels	6135	0.30–0 40	0.35	0.50–0.80	0.65	0.04	0.04	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	T–U
Oil-hardened Gears; Springs	Chromium-vanadium steels	6150	0.45–0.55	0.50	0.50–0.80	0.65	0.04	0.04	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	U
Balls; Cones; Ball Races	Chromium-vanadium steels	6195	0.90–1.05	0.95	0.20–0.45	0.35	0.03	0.03	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	U
Springs; Gears	Silico-manganese steels	9250	0.45–0.55	0.50	0.60–0.80	0.70	0.045	0.045	.....	....	....	....	...	...	1.80–2.10	1.95	V
Springs; Gears	Silico-manganese steels	9260	0.55–0.65	0.60	0.50–0.70	0.60	0.045	0.045	.....	....	....	....	...	...	1.50–1.80	1.65	V

Machinery

Steel for Shafts and Spindles

Shafting—Steel 1020 is generally used either in the cold-rolled state or turned and ground. When used in the cold-rolled state it has a disadvantage in some cases where long keyways are to be cut, due to the fact that the keyway relieves the surface tension and causes the shaft to buckle or become untrue. Steel 1045 can be used for shafting requiring greater strength.

Spindles—Steel 1045 made by the crucible process is most generally used. This material can be heat-treated to increase the strength when desired, treatments D, E, or H being satisfactory. Steel 3135 made by the open-hearth process in such quantities as to insure uniformity has been popular with concerns demanding a high-grade alloy steel spindle. It has not been the practice to heat-treat this material for ordinary spindles, but the steel improves so much with heat-treatment that it is advisable to heat-treat in all cases, especially if there are any keyways or shoulders on the part. Some concerns run the hardness up to 60 scleroscope and finish machining after heat-treating, but in general practice a hardness of from 38 to 45 scleroscope is best, because when the degree of hardness is too great, the cutting becomes difficult. Treatments D, E, or H are used. Steel 6135 is suitable for spindles in extreme cases where vibration and alternate stresses are severe, but it should always be heat-treated to a hardness of from 38 to 45 scleroscope, treatment T or U being used.

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* Abstract of a paper published in the Transactions of the American Society for Steel Treating.

Steel for Gears and Cams

Gears—For gears intended to operate at low speeds and carry light loads, steel 1020 is used in the soft state. For gears of low speeds and heavy loads the following steels, heat-treatments, and degrees of hardness are suitable: 1045-H up to 65 scleroscope hardness; 3135-H up to 65 scleroscope hardness; 6135-T up to 65 scleroscope hardness. For gears of high speeds and light loads the following steels may be used: 1020-A or 1020-B up to 95 scleroscope hardness; 3120-G up to 95 scleroscope hardness; and 6120-T up to 95 scleroscope hardness. For gears of high speeds and heavy loads, use 3250-M or 3250-Q at from 72 to 80 scleroscope hardness; 6150-U at from 72 to 80 scleroscope hardness; or 9260-V at from 72 to 80 scleroscope hardness.

Cams—Where no severe strains are imposed on light sections, steel 1095-F or 1095-X can be used with a hardness up to 90 scleroscope. Where greater strength is required, use 3250-Q up to 85 scleroscope hardness. Where extreme hardness is required, use 5195-Q up to 100 scleroscope hardness, 6195-U up to 100 scleroscope hardness or 9260-V up to 100 scleroscope hardness.

Steel for Miscellaneous Machine Tool Parts

Centers—Steel 1095-X is almost universally used, heating the head in a lead pot and quenching in water to a hardness of from 90 to 100 scleroscope.

Lead-screws, etc.—Steel 1135-X is often used for lead-screws, etc., because of its free- and smooth-cutting properties. Sometimes 1020 is used, but it is not advisable except for very light duty, 1045 being better. Sulphur in this stock should not be less than 0.06 per cent.

Thrust Washers—Steels 1020 or 3120 with the carburizing treatment B are used for light service, and 1095-X, 3250-Q, and 5195-R, for heavy service.

Ball Races, Rollers, and Pins—Steel 5195-R is most used for this service, with a hardness of 80 to 100 scleroscope.

Springs—Steel 1095-F is generally used, and steels 6150-U, 9250-V, and 9260-V for severe service.

Keys—Steel 1020 in a cold-rolled condition is frequently used, but it is not recommended except where an extremely low price is desired. Steel 1045 in a tempered condition is much preferable, because of its ability to resist distortion. Steel 3250-M is used for sliding keys, etc., when a wear-proof key with great strength is required.

Bolts, Nuts, Pins, Studs and Screws—Steel 1114 is especially made to permit rapid screw machine production with a smooth finish, strength being a secondary consideration. This material can be carburized by treatments A or B. Steel 1020 will give much greater strength both in soft and carburized screws, being also carburized by treatments A or B. Steel 1045-H can be used for a tempered screw.

Toolpost Screws, etc.—For screws of extreme strength, steels 3120-B or 3135-H will give best results if the hardness is not above 65 scleroscope.

PROPERTIES OF STEELS FOR MACHINE TOOL PARTS

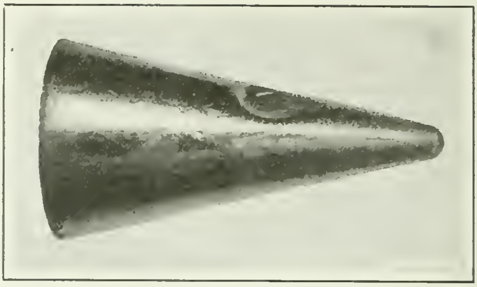
Use in Machine Tools	Kind of Steel	Properties of Annealed Steel					Properties of Cold-drawn or Cold-rolled Steel					Properties of Heat-treated Steel						
		Elastic Limit, Pounds per Square Inch	Ultimate Strength, Pounds per Square Inch	Reduction in Area, Per cent	Elongation in 2 Inches, Per cent	Brinell Hardness	Elastic Limit, Pounds per Square Inch	Ultimate Strength, Pounds per Square Inch	Reduction in Area, Per cent	Elongation in 2 Inches, Per cent	Brinell Hardness	Elastic Limit, Pounds per Square Inch	Ultimate Strength, Pounds per Square Inch	Reduction in Area, Per cent	Elongation in 2 Inches, Per cent	Brinell Hardness	Shore Hardness	Drawing Temperature
Shafting; Soft and Carburized Gears; Keys	Carbon steel	Yield 30,000	40,000	60	30	...	Yield 40,000 60,000	.....	35 30	..	...	50,000	80,000	60	20	180	34	400
Spindles; Arbors; Special Shafts; Tempered Gears	Carbon steel	50,000	70,000	45	22	...	60,000	70,000	35	18	...	80,000 90,000	115,000 125,000	42 35	16 12	250 300	41 45	800 400
Centers; Springs; Cams; Mandrels	Carbon steel	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	90,000 180,000	Transverse-Test				60 70	900 400
Screws; Nuts; Bolts; Studs	Screw stock	Yield 20,000 30,000	....	.. ..	.. ..	... ...	30,000 40,000	60,000 90,000	58 42	36 17	... ...	....	....	.. ..	.. ..	... ...	.. ..	... ...
Lead-screws	Lead-screw stock	50,000	80,000	60	30	170	Hot-rolled—Unannealed 60,000	100,000	50	20	200	......	......	..	..	...	..	...
Carburized Gears	Nickel-chromium steels	30,000 40,000	80,000	55 40	35 25	140	50,000 60,000	90,000	55	27	170	......	......	..	..	...	..	...
Tempered Gears; Spindles; High-duty Shafts; Toolpost Screws	Nickel-chromium steels	45,000 60,000	85,000	45 30	25 15	160	55,000	95,000	50	25	200	135,000 190,000	150,000 210,000	38 25	15 8	330 448	52 72	900 500
Oil-hardened Gears; Cams; Ratchets	Nickel-chromium steels	70,000	100,000	60	25	180	.....	.....	..	..	...	160,000 210,000	180,000 270.000	48 25	14 10	350 480	57 78	900 500
Carburized Gears	Chromium-vanadium steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	55,000 100,000	....	65 45	25 10	... ...	28 40	1300 600
Spindles; Tempered Gears; Shafts	Chromium-vanadium steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	100,000 125,000	....	55 25	15 5	... ...	35 72	1300 850
Oil-hardened Gears; Springs	Chromium-vanadium steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	150,000 240,000	....	35 15	10 2	... ...	.. ..	550 350
Springs; Gears	Silico-manganese steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	60,000 180,000	....	40 10	20 5	... ...	.. ..	.. ...
Springs; Gears	Silico-manganese steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	60,000 180,000	....	40 10	20 5	... ...	.. ..	... ...

Machinery

Dies for Producing a Conical Part

Operations in Manufacturing a Difficult Shell

By N. T. THURSTON
The Acklin Stamping Co., Toledo, Ohio



THE production of conical-shaped parts of the type illustrated in the heading illustration was successfully accomplished by eleven operations performed on power presses equipped with a number of interesting dies. The part is the rear cap or tail-piece of incendiary bombs manufactured in large quantities for the United States Government during the war. This piece was first made by cutting out the blank on a power press, then rolling it into a conical shape, and finally welding the ends together in a seam by the oxy-acetylene process. This method was thought to be the ideal one for the manufacture of this part, as a drawing and forming proposition was considered out of the question, mainly because of the difficulty that would be encountered in drawing the piece to a point without, at the same time, decreasing the metal thickness at the point.

The manner in which the part was ultimately drawn satisfactorily without necessitating the punching of a hole through the point is described in the following. The question of production was also believed to be against manufacturing the part by the use of dies, but an output of 500 finished pieces per hour was maintained throughout a lot of 35,000 pieces. This production was, of course, much greater than that obtained when the parts were manufactured by the method requiring the welding operation.

Material and Lubricant Used for Parts

All the operations were performed on straight-sided single-action presses. Two annealing operations between certain of the drawing operations, and the allowance of proper reductions on the part and radii on the dies were the means by which success was attained. The strip steel used was a good drawing quality, 0.065 inch thick by 5¼ inches wide, hot-rolled, pickled, and oiled. In purchasing the steel for the job, care was taken to see that the gage would run even. The use of stripped steel permitted increased production and made handling easier.

Several kinds of lubricants were tried out to obtain one that would prevent the tools from heating and wearing excessively. Special interest was taken in a soap and water solution; by mixing in the proportion of one part soap to eight parts of cold water, a satisfactory lubricant was secured, which also acted as a cleanser by removing the scale and dust particles remaining in the shell that tumbling failed to remove. The removal of this scale lessened the wearing of the tools to some extent, and the soap-and-water solution may well be recommended for similar jobs.

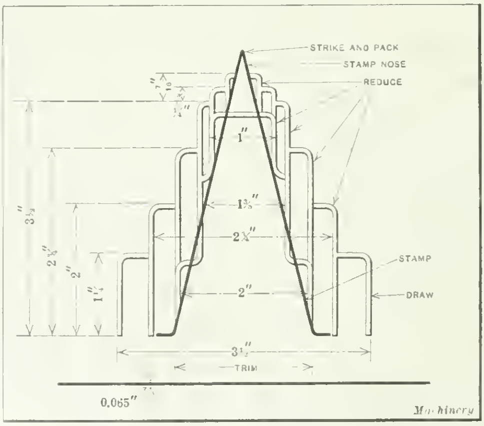


Fig. 1. Lay-out made to determine Approximate Number of Operations Necessary

Fig. 1 shows the method employed to determine the approximate number of operations and the reduction necessary to bring the piece to the required shape. During the experimental stages the first operation consisted simply of cutting the circular blank. After the correct blank size had been determined, the first operation was performed in a combination die, which cut the blank and then drew it to the shape shown above the blank at *A*, Fig. 2. This combination die is shown in Fig. 3, and was used on a No. 73½ Bliss press, being mounted on a cast-iron base *A*. The tool-steel ring *B*, which constitutes the cutting edge of the die, is forged on a machine-steel plate fastened to the cast-iron base. The tool-steel draw-ring or blank-holder *C* is carried on the top of four cold-rolled ¾-inch pins *D*, which are equally spaced under the ring and supported by rubber buffers underneath the die. The lower end of punch *E* is also made of tool steel and this part is then forged to a machine-steel shank.

When the punch descends on the downward stroke of the press, the blank is cut as the punch enters ring *B*; it is pressed against draw-ring *C*, and finally drawn over the tool-steel plug *F* to the desired form. During this step, pins *D* are forced down on the rubber buffers previously referred to, and on the return stroke of the press, the buffers force the pins up through the die, thus raising the draw-ring and forcing the part from plug *F*. The knock-out pin *G* placed in the center of the punch, is forced downward on the upward stroke of the punch, and ejects the part from the punch if it adheres. This movement of the knock-out pin is effected by an attachment secured to the press. A rod entering the tapped hole *H* in the base holds the buffers under the press. Vents are provided in both the punch and the die parts to allow confined air to escape during the drawing of the cup.

At *B* in Fig. 2 is shown a piece after the second operation, which is performed by the die illustrated in Fig. 4, in which the diameter of the piece is reduced ¾ inch, while the depth is increased 1 1/16 inches. This die is mounted on a machine-steel base *A*, secured to a No. 56 Toledo press. Plug *B*, punch *C*, and draw-ring *D* are made of tool steel, and are hardened and ground. Vents are again provided in the plug and punch to allow confined air to escape from under the descending cup, thus avoiding bulging and wrinkling of the piece. The draw-ring is supported by pins mounted on a rubber buffer, which strip the work from plug *B*. A knock-out device is also provided in the punch.

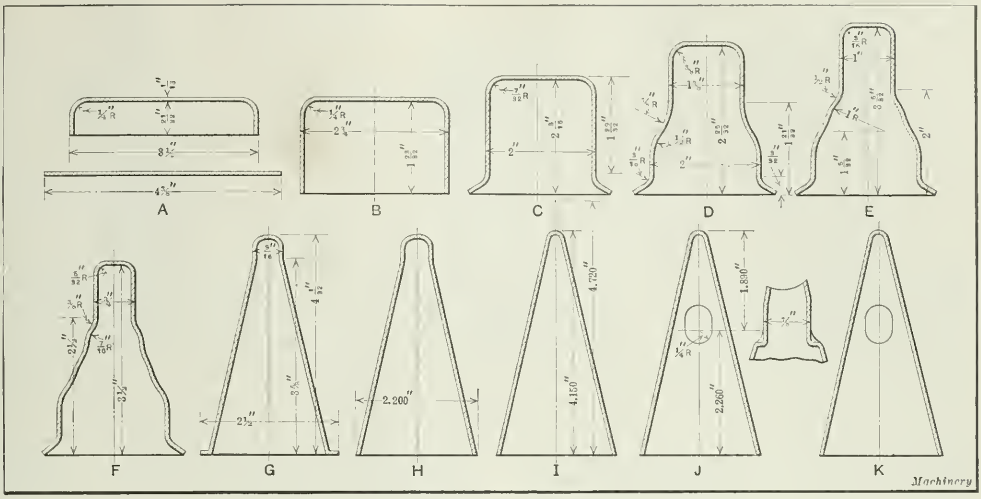


Fig. 2. Shape and Dimensions of the Shell after Each of the Operations

Successive Reducing Operations on the Shell

Prior to the third operation the parts are dipped into a solution consisting of one part of muriatic acid to five parts of water. This loosens the scale which forms on the surface of the steel during the subsequent process of annealing. The parts are then annealed by heating them to a cherry-red. It is an easy matter to remove the loose scale by tumbling, this removal being essential in prolonging the life of the wearing parts of the die. The annealing process releases all internal strains set up in the work during the first two drawing operations and prepares the piece for further drawing. The third operation is performed on a No. 56 Toledo press equipped with the die illustrated in Fig. 5 which draws the part to the shape shown at *C*, Fig. 2. A reduction of ¾ inch is made in the diameter during this operation, and the depth is increased 15/32 inch. The base of the part is now the proper size for the final drawing, and is held at this diameter during the next three operations. This die is practically like the one preceding it, in construction and operation.

Fig. 2, at *D*, shows the piece after it has been put through the fourth operation, which is performed by the die shown in Fig. 6, mounted on a No. 58 Toledo press. In this operation the diameter of the nose is reduced ⅝ inch, while the length of the part is increased 19/32 inch. The construction of this die is similar to the preceding ones. The next reducing operation produces the shape shown at *E*, Fig. 2, the die employed being illustrated in Fig. 7. The diameter of the nose is decreased ⅜ inch, while the depth of the shell is increased ⅜ inch. By keeping the increase in depth in the correct proportion to the decrease in diameter, the tendency to stretch the material is almost entirely overcome, and the desired thickness of the part is maintained. This die was mounted on a No. 74½ Bliss press.

The last of the reducing operations brings the piece to the shape shown at *F*, Fig. 2. The die used is shown in Fig. 8, it being mounted on a No. 84 Bliss press. It will be seen that it is quite similar to the dies previously described. The stampings are again annealed, before this operation. By means of the two annealing operations the part is produced satisfactorily with a minimum of breaking and tearing. The piece was given several other annealings during the experimental stage, but these were omitted during production without any undesirable effects.

Tapering the Cone, Reducing the Nose, Forming the Flange, and Trimming the Shell

The seventh operation tapers the sides of the cone, reduces the diameter of the nose, and forms a flat flange at the face, as shown at *G* in Fig. 2. This is done on a No. 58 Toledo press equipped with the die illustrated in Fig. 9. The previous annealing operations have relieved all internal strains in the metal and have somewhat softened it so that the production of a cone with uniform sides is possible. A rather interesting feature of this die is the construction

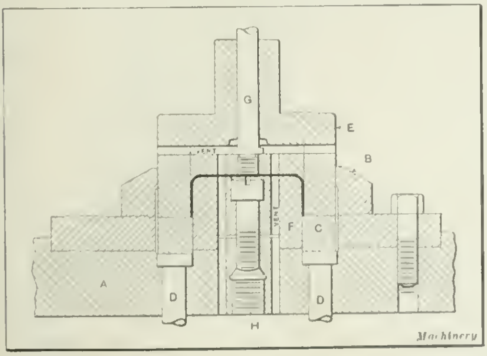


Fig. 3. Combination Die which cuts the Blank and performs the First Drawing Operation

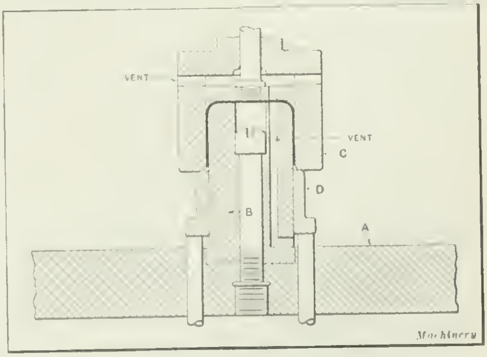


Fig. 4. Second Operation in which the Diameter of Part is decreased and Length increased

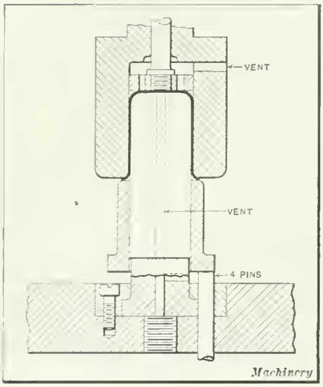


Fig. 5. Die used in Next Reduction on Part

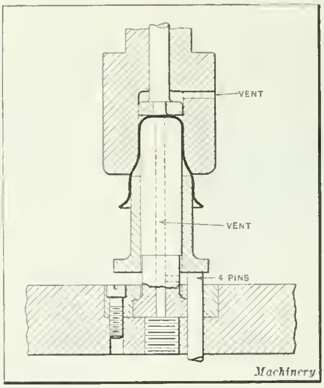


Fig. 6. Further Reduction of the Nose Diameter

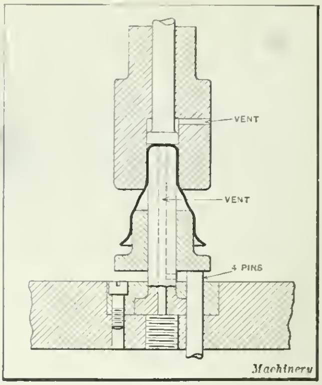


Fig. 7. Next Step in the Reduction of the Conical Shell

of the plug upon which the part is shaped; this is made of two tool-steel pieces *A* and *B*. The plug was formerly made of one piece, but considerable trouble was experienced with this construction, because of the fact that the plug would wear away rapidly about one inch from the top so that an annular depression was formed. Several different kinds of steel, tempered to various degrees of hardness were experimented with, but with little success. However, the problem was satisfactorily solved by the construction illustrated. Plug *A* is fastened to plug *B* by a screw that fits in a hole running through the center of plug *B*. When the upper plug becomes so worn that the work does not pass inspection, it is removed and another fastened into place. A supply of these tips is made up and kept on hand so that the production of the part is not greatly interfered with when substitution is necessary. Draw-ring *C* is supported on pins (not illustrated), which are used in connection with rubber buffers, as on the dies previously described.

The eighth operation is performed on a No. 77 Toledo press equipped with the die shown in Fig. 10, which trims the part as shown at *H*, Fig. 2. The flat flange produced during the previous operation permits the cone to rest evenly in an inverted position on the top surface of the trimming die *A*. Two cutters *B* are fastened on opposite sides of the punch above the trimming edge, for the purpose of cutting in two, the trimmed-off scrap rings which accumulate around the punch. Holes are drilled in the base beneath die-part *A* to facilitate the removal of the part.

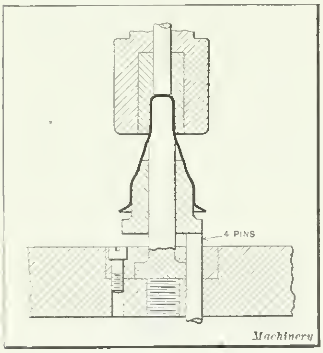


Fig. 8. Final Reducing Operation on the Part

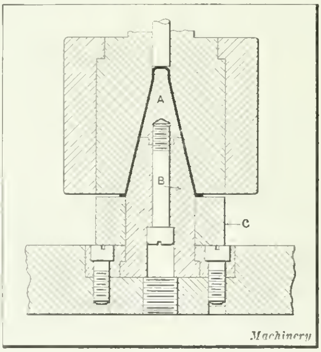


Fig. 9. Tapering the Cone and forming the Flange

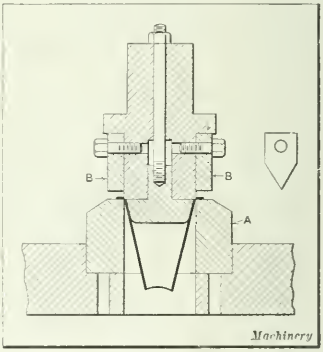


Fig. 10. Trimming the Flange from the Base

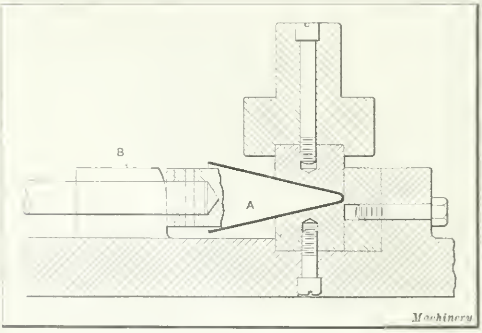


Fig. 11. Die employed to form the Point on the End of the Conical Shell in Four Strokes

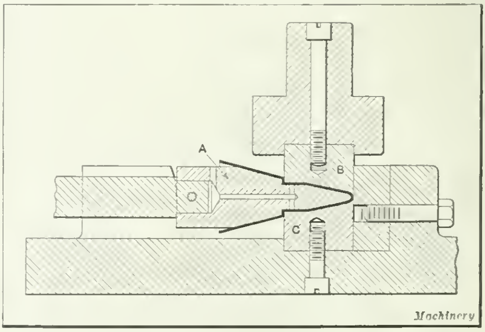


Fig. 12. Embossing Flats on the Cone diametrically Opposite Each Other

Final Punch Press Operations on the Part

The ninth operation is performed by means of the die illustrated in Fig. 11, which forms the part to the shape shown at *I*, Fig. 2. In the preceding drawing operation enough material was left straight at the nose of the part so that it could be squeezed to shape from the outside rather than from the inside. This method was adopted because of the trouble which results from the other method of drawing; the piece invariably ruptures at the point and is entirely unsatisfactory. It will be seen that this die holds the part in a horizontal position. The punch-holder and base of the die are made of cast iron, while the remaining parts with which the work comes in contact are made of tool steel.

The work is placed over the tool-steel piece *A*, which is shaped like a cone and acts as the plug in a die of standard construction. A 1-inch cold-rolled bar attached to the plug serves as a handle, by means of which the operator places the plug and work in the lower half of the die. The plug is prevented from being forced from the die as the punch comes in contact with the work, by means of two lugs *B*. In this operation, as the upper half of the die descends with the ram, it presses the work on the plug. Four strokes of the press are required to complete the operation, the plug being given a quarter-turn after each stroke. A slight jar against the side of the part is sufficient to loosen it from the plug in order to effect its removal.

The tenth operation embosses two flats on opposite sides of the cone, as shown in Fig. 2 at *J*, the die employed for this purpose being illustrated in Fig. 12. As in the preceding operation, the part is held in a horizontal position on a tool-steel plug *A*. The punch-holder and die in this case also are made of cast iron, while the parts which come in contact with the work are made of tool steel. The handle of the plug is a cold-rolled 1¾-inch square steel bar. In addition to its use in placing work in the die, the handle provides a gage for insuring that the plug will be so placed in the die that the embosses will be made directly on the axis of the work. Both embosses are made at one stroke of the press, parts *B* and *C* of the punch and die, respectively, being similar. The part is easily removed from plug *A* by jarring it slightly against the bolster plate of the press.

The final punch-press operation on the part strikes and packs the base as shown at *K*, Fig. 2, this shape being identical to that shown at *J*. The operation is performed to smooth out any wrinkles that may be left by the previous reductions, and brings the piece to the exact desired size. The die used is shown in Fig. 13. The base and punch-holder are made of cast iron, while the parts which come in contact with the work are made of tool steel, as in some of the dies previously described. This makes a construction which is, in general, equal to an all-steel die, and has the advantage that the material and labor costs are less.

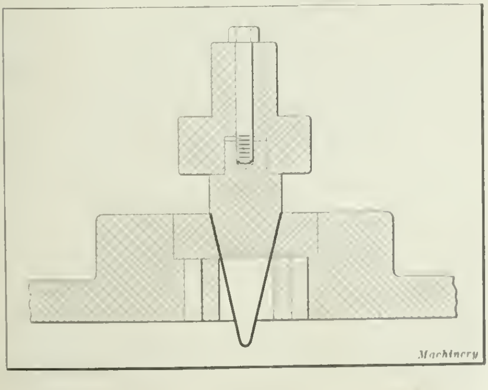


Fig. 13. Striking and packing the Base of the Part to remove Wrinkles

An idea of the accuracy required in the parts produced by the dies here described, can be readily obtained by reference to the gage illustrated in Fig. 14, upon which the parts were inspected. A line is scribed 0.011 inch from the base, and it was necessary for the end of the part, when the latter was slipped over the gage, to come between this line and the base. The parts were so consistently accurate that only a few failed to pass inspection. All the dies described in this article were designed and manufactured by the Acklin Stamping Co., Toledo, Ohio.

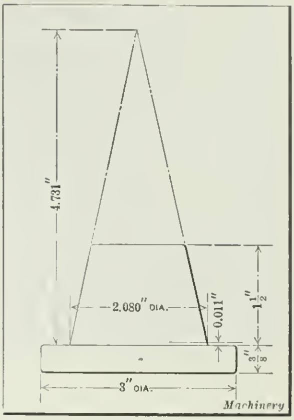


Fig. 14. Gage for inspecting Conical Shells

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FOREIGN TRADE NOTES

Reports from Belgium indicate an industrial depression particularly affecting the textile industries; but the present foreign trade of Belgium exceeds that of 1913, even when the depression of the franc is taken into consideration.

In France the question of fuel is of prime importance. It has now been agreed that Germany will supply the allied countries with 2,000,000 tons of coal a month beginning February 1. France will receive 65 per cent of this total. Oil fields have recently been discovered in Lorraine which doubtless will prove important to the French industries. It is reported that at the end of last year 50 per cent of the steel works destroyed or damaged during the war, 67 per cent of the textile factories, 50 per cent of the glassware factories, and 54 per cent of the chemical industrial plants were in operation.

In Italy, apart from labor troubles, the most serious difficulty is the question of fuel. Various plans have been proposed to relieve the shortage of coal, but whether any of these will prove successful remains yet to be seen.

The German competition in the world's markets is beginning to make itself felt. It is reported that trade between Germany and India, China, and South America is increasing. Various reports indicate that the most severe financial and industrial crisis in Germany has passed, and that the country is rapidly returning to its former producing capacity. The difficulty of Germany is largely the same as of the other European countries—a shortage of coal.

In spite of the financial depression in Japan there is great industrial activity, and plans for the extension of manufacturing in various lines are made. It is generally believed that the exportation of machinery of different classes to Japan and China will greatly increase during the next five years.

The South American requirements for industrial machinery—particularly in Brazil—are quite important, but the machine tool requirements are comparatively small. The reason for this is that the industries being developed in Brazil are mainly sugar and distilling plants, mining, electric lighting plants, etc. On the other hand, there is very little manufacturing in Brazil for which machine tools are used, and, generally speaking, the main uses for machine tools are in the railway repair shops and in the repair shops of the various industrial establishments. The same holds true largely of the other South American countries.

The Service Department and the Superannuated Machine Tool

By GEORGE M. MEYNCKE, The Oesterlein Machine Co., Cincinnati, Ohio

As everyone who will read this article is familiar with the fundamental facts about automobiles, I will give the sense of a letter recently received in terms relating to automobiles, assuming that motor cars had been in use for the past fifty years or so. Then assume that the Gogood Automobile Co. received the following letter today:

> "Gentlemen: The Gogood automobile that my father purchased from you in 1884 recently met with an accident. Please send me list of parts or illustrations of that model so that I can order the necessary repair parts."

That sounds overdrawn, doesn't it? But a similar letter addressed to a machine tool builder is not unusual, if the manufacturer happens to have been in business for that length of time. One of those letters was received early this year by The Oesterlein Machine Co. It read as follows:

> "Gentlemen: Several years ago we purchased with some other machinery a small drill press from Oesterlein & Bernhardt. We are in need of some broken parts for the press, and failing to find such a named concern listed now, we are wondering if your company is successor to Oesterlein & Bernhardt. We are anxious for this information and shall deem it a special favor to hear from you regarding this matter."

Referring as this letter does to a drill press built by Oesterlein & Bernhardt, it is doubtful if anybody now living can tell how long ago that machine was built. The great Ohio River flood in 1884 wiped out the shop of Oesterlein & Bernhardt, and when the water receded, all that was left was the partnership, which was dissolved by the withdrawal of Mr. Bernhardt.

One of the many products of Oesterlein & Bernhardt was drill presses. That flood was thirty-seven years ago, and the drill press described in the letter as purchased "several years ago" probably was built some years before the flood (the Ohio's—not Noah's.) It is forty or more years old today and is, according to the letter, only "in need of some broken parts" to put it back on the job.

Long Life of Machine Tools Presents a Service Problem to the Builder

It has often been said that the trouble with the machine tool business is that machine tools last too long, which in more specific terms means that the builders do not charge enough for their product in the first place. Suppose the owner of this drill press paid $400 for it forty years ago. The actual depreciation on that tool has been at the rate of twenty cents per week. What class of products, other than machine tools, can show such a low depreciation rate?

It undoubtedly would not pay to keep such an old style machine in service in a production shop. Nevertheless, there are shops in which such old tools meet the requirements, and they should, and will, be used; and they will be passed on until they find the strata of application to which their ability responds.

The long life of machine tools gives rise to a problem that is almost exclusively a machine tool problem. It is the repair problem. Machine tool design and construction does not stand still. Its history shows change after change in every type of tool. A problem incident to any change in machine tool design is the preserving of superseded drawings, patterns, and jigs, so that service on repairs and attachments may be given throughout the life of the tool.

The maker feels an obligation at all times to be in a position to give this service, and usually does give it at slight or no profit to himself. In fact, if the cost of upkeep and storage on old drawings, patterns, jigs, and tools was included in the repair parts cost, it is doubtful if a machine tool repair order is ever anything but a losing transaction. Contrast this with those industries whose product has short life and is produced in large quantity. In such cases, repair parts can be converted into an item of considerable income and profit to the maker.

Dividends on Service Investment

The ability to give good service on machine tools fifteen to twenty years old is not general in the industry. It has taken years to demonstrate that more care must be given to this phase of the work. Judging from the attention that this is receiving today by machine tool builders in general, it is safe to predict that in an equal period of years from today, good service, from accurate records, will be the rule.

It is not uncommon to hear such remarks as "When old man White ran the White Tool Co., he had only two clerks to help him, and now there are eight men doing the same work." Those on the inside realize that old man White neglected to do many things that for the sake of better business are necessary today. One of the items of overhead that is put into the shop system of today is the record insurance that will yield service dividends in the future.

* * *

PRESENT ACTIVITY OF THE KRUPP WORKS

In spite of the great industrial difficulties that German industries have passed through during the last two years, the Krupp Works in Essen still maintain their place as one of the largest industrial undertakings in the world. Last year the works employed on an average of 93,000 people. of which 50,000 were employed at the works in Essen and the remainder at the various iron works, and coal and ore mines controlled by the Krupp Works, as well as at the Germania Shipbuilding Yards in Kiel. In 1914 the total number of employes was about 80.000. During the war a larger number was employed, amounting in 1918 to 172,000.

Before the war the works were known almost exclusively as the producers of war material, although in point of tonnage, war material formed but a small percentage of their output. Before the war these works supplied from one-fifth to one-third of Germany's total requirements of railroad materials, including rails, wheels, and wheel rims, boiler plate, axles, and springs. During the war the Essen Works were enlarged so that the surface covered by buildings increased from 248 to 392 acres. After the armistice the works were turned into repair plants for locomotives and cars, and one part of the works has been permanently turned into a plant for the production of locomotives and rolling stock, capable of producing 300 heavy type locomotives with tenders annually, and 2500 cars. Other branches of the works are now engaged in the manufacture of motor trucks. agricultural machinery, textile and paper machinery, internal combustion engines, turbines, adding machines, cash registers, and many other products.

Reducing Lost Time by the Shop Hospital

By SANFORD DeHART, Director of Hospital, R. K. LeBlond Machine Tool Company, Cincinnati, Ohio

WHEN visitors come to our plant and pass through our hospital, they invariably inquire, "How well is your hospital patronized?" When we tell them that we are treating, on an average, seventy patients a day they are amazed. Many people are of the opinion that an industrial hospital takes care of major surgical conditions only. This is an erroneous assumption as the following will serve to prove. During the year 1920, there were treated in our hospital department 20,625 patients. This is a grand total in which the report of our dental department is included. This report includes surgical, medical, and dental cases, and retreatments.

Functions of Industrial Hospital

While it is true that the primary function of an industrial hospital is to take care of injuries arising out of a man's employment, the line of demarcation is not so clearly defined as it once was with reference to extraneous conditions. As a matter of fact, there is a greater loss of time due to illness than from surgical conditions. We have found that if we can reach the sick employe in the incipient stage, and if he is not suffering from an abnormal temperature, we can usually prevent the condition from becoming serious.

The successful hospital director of an industrial plant must be constantly on the alert for equipment, medicines and appliances, which can be used in industry for the reduction of absenteeism. He must be a modernist without being an extremist. To illustrate: We were having, as every other factory has, a high absence rate due to employes losing time on account of colds. We had proceeded along the usual lines, treating these cases as the average physician would treat such conditions outside the factory. However, it did not take us long to ascertain that the methods pursued outside were not effective in our factory, so far as reducing absenteeism was concerned. To increase our efficiency in the treatment of these conditions, we installed a spraying outfit, which works on the same principle as an atomizer, with certain improvements, such as an electric attachment, compressed air outfit, etc. This spraying outfit is known technically as a "nebulizer," and is similar to the equipment used by nose and throat specialists.

There is something about treatment with mechanical devices that makes a man feel as though something is being done for him. The patient experiences an agreeable sensation in the mouth, throat, and nasal passages and is usually willing to go on working. This outfit has reduced our absences due to colds about 37 per cent.

Likewise anyone who has ever tried to work while suffering from a stiff neck knows the pain one has to suffer. The concentration of electric heat rays, by properly constructed lamps, is an inexpensive apparatus we have used with a great deal of success in these cases. Relief is generally obtained in about twenty minutes. It is necessary, however, to repeat the treatment twice during the day. In this connection, it is well to know that stiff necks and lame backs often occur in epidemic form. These are two illustrations that show the distinct advantage over the old method of routine treatment.

A distinguished physician of Boston, Mass., once made the statement that most patients would get well, even if there were no treatment administered. A man with a stiff neck or a sprained back no doubt would get well, but industry would be deprived of his services while he was recovering. By assisting nature, recovery is often expedited.

By persistent education, largely through billboard propaganda and a factory magazine, we have reduced the accident frequency and severity rates considerably. Our 1920 records show that there were 192 less days lost than in the previous year. The injuries received for the most part were abrasions or scratches. While these conditions are minor, they become dangerous if infection sets in. Insurance companies state that they pay out more money for this type of injury than for the major injuries, since small wounds are prone to infection.

There were 1417 eye conditions treated during 1920. These cases were treated in our own eye room, which is a dark room especially equipped with electric magnets, local anaesthetics, and medicines for the eye. The particles in the eyes for the most part were floating and easily removed. Where the particle, such as emery or steel, had struck the eye ball with any force, or where it had been in the eye over night, it caused the most trouble. These pieces occasionally became adherent to the eye ball and often embedded in the eye, necessitating removal with the aid of a local anaesthetic. The subsequent treatment of these cases consisted of dilatation, a shield placed over the eye, and treatment every two hours, the patient remaining at work.

Results Obtained by the Shop Hospital

Our eye cases show a gratifying decrease. During 1917, the policy was to refer all eye cases of more than ordinary severity to an eye specialist, whose office was situated some eight miles from the plant. During 1917, 861 hours were lost, or 107 working days, from this one cause alone, at a cost of $1052. This amount included specialist's fees and state compensation, but did not include the amount lost in production.

In May, 1918, our eye room was established, and we were able to reduce our lost time due to eye injuries to 436 hours at a cost of $412. During 1919 we further reduced our lost time from eye injuries to 78 hours at a cost of $26. During the past year there were 80 hours lost, but the direct cost was only $7.50. This was accomplished without any change or addition to the hospital personnel. Impressing the employe with the importance of wearing goggles, and removing the foreign body from the eye before it becomes too firmly embedded, with the subsequent treatments, was largely responsible for the reduction. There were no eyes lost, and no impairment to vision during the year.

Reducing Accidents by the Aid of the Shop Hospital

There are a number of different causes that might contribute to the accident problem. They may be mechanical, physiological, or psychological. We have minimized the mechanical causes by installing safety devices, and where safety devices are impracticable, warning signs of danger are conspicuously placed. The psychological causes of an accident are carelessness, ignorance, over-familiarity with the hazards of employment, unfamiliarity with the employment hazards, lack of confidence, lack of discipline, and the susceptibility of the individual to accidents. Accidents do not always happen as the result of objective danger. Individual characteristics of the employe have much to do with accidents. The human factor is the chief consideration in 80 per cent of the accidents. The psychological and physiological causes of accidents are of the highest importance. The physiological causes may be due to mental worry, sleepless nights, toothache, and various diseases. One can very well understand, for example, how a toothache might be indirectly responsible for an accident.

The writer has purposely avoided mentioning fatigue, owing to its complexity. The measurement of the condition of industrial fatigue in a machine tool plant, judged by the capacity of a workman for turning out work, is a poor index as to the amount of fatigue present.

To prevent accidents due to the nervous condition caused by toothache, the R. K. Le Blond Machine Tool Co. established a dental department which has been in operation for two years. The dental department is a subsidiary department of the hospital. An idea of the popularity of this department may be gained from the fact that there were 1716 cases treated during 1920. They are classified as follows: Examinations, 244; extractions, 271; prophylactic, 240; X-ray, 10; toothache, 158; fillings (temporary), 57; treatments, 687; and pyorrhea, 49.

The saving to the company on extractions for the year 1920, based on the time a man would ordinarily lose if he were to visit his family dentist during working hours for the relief of toothache, is conservatively estimated at approximately $1200. It has often happened that an employe reporting for work after a sleepless night, due to an ulcerated tooth, was willing to continue work after being relieved by our dentist. If we had not been situated so that we could relieve these conditions, we would have lost the services of the man for the entire day.

Summary of Hospital Report

An idea of the work accomplished for the year in the Le Blond shop hospital can best be illustrated by the following figures, taken from our annual report, giving the number of cases treated: Surgical conditions, 6198; redressings, 4163; medical conditions, 5473; retreatments, 3075; and dental conditions, 1716.

We have greatly minimized the accident frequency rate among the apprentices by giving them talks on safety during school hours. These talks are accompanied by lantern slides, moving pictures, and pictorial bulletins. We have received excellent cooperation both from the instructor of the apprentice school and the foreman of the shop training school. They have been intensely interested in preventing accidents to the apprentices. The fingers are the most exposed part of the body. It used to be that an amputated finger was the badge of a machinist's trade. So well have the machines been guarded and so prompt and efficient the treatment of injuries, that we have had occasion to amputate but one joint of one finger in the last three years. It is hardly possible to overstate the importance of prompt and efficient first-aid to shorten and minimize the effect of accidents. We have had occasion to send one man to the city hospital in five years, and we have only found it necessary to use our own operating room twice in three years. This is truly a remarkable record for a plant employing about one thousand men.

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ACTIVITIES OF THE AMERICAN ENGINEERING STANDARDS COMMITTEE

The American Engineering Standards Committee is working in close cooperation with the foreign national standardization bodies, and copies of the following engineering standards issued in 1920 by these foreign standardization commissions are on file at the headquarters of the American Engineering Standards Committee. Those engineering standards that are of interest to the metal-working and machine-building field in general are listed below:

British Engineering Standards

No. 1.	Rolled Steel Sections for Structural Purposes
No. 100.	Body Spaces and Frame Ends for Chassis for Private Automobiles
No. 122.	Milling Cutters and Reamers
No. 131.	Notched Bar Test Pieces

Canadian Engineering Standards

No. 1.	Steel Railway Bridges

Belgian Engineering Standards

No. 1.	Construction of Metal Framework
No. 2.	Construction of Metal Tanks
No. 3.	Construction of Coverings and Partitions of Corrugated Galvanized Sheet Iron
No. 4.	Shafts and Transmission Pulleys
No. 5.	Construction of Metal Bridges

Dutch Engineering Standards

N-19.	Compression Couplings
N-20.	Flange Couplings
N-29.	Loose Collars for General Construction
N-30.	Loose Collars for Mill Gearing

German Engineering Standards

DIN-187.	Bearings for Transmission Shafting
DIN-475.	Widths of Spanner Jaws

Swiss Engineering Standards

VSM-10300 to VSM-10307	Technical Drawings
VSM-12050	Screw–Whitworth Threads
VSM-33900 to VSM-33914	"Sulzer" Attachment for Milling Cutters

Swedish Engineering Standards

SMS-1.	Size for Standard Sheet
SMS-2.	Metric Screw Thread System
SMS-3.	Whitworth Screw Thread System
SMS-5.	Hexagonal Nuts
SMS-7.	Finished Hexagonal Screws
SMS-8.	Series of Standard Diameters

Photostatic copies of these standards can be furnished at a nominal cost, or the copies on file may be consulted at the offices of the American Engineering Standards Committee, 29 W. 39th St., New York City.

* * *

It is reported that the Cunard Co. will build twenty-three new steamers having a total tonnage of over 300,000, which will give this company control over more than 1,000,000 tons of shipping. The present plans are for smaller and speedier steamers than have generally been built in the past. Six of the new steamers will be of 15,000 tons.

Training Men for the Machine Industry

A Description of the Highly Organized Educational and Training Departments Established by the Norton Co., Worcester, Mass., with a View to Qualifying Men for Various Classes of Occupations in the Machine Industry

By ERIK OBERG

WITH the development of the industries it has been found that the educational institutions of the country supply only part of the needs of the industries for trained men. The engineering schools and colleges train engineers, and trade schools provide educational facilities for a limited number of boys planning to take shop positions; but there is neither a sufficient number of these trade schools, nor are all of these schools so organized as to educate and train the boys passing through them in the best manner for the needs in manufacturing plants.

It has therefore become necessary for the industries—and particularly the machine building industry—to establish, through their own initiative, courses of training in individual shops and plants, whereby men may obtain the instruction necessary to fit the particular needs of a specific industry. Some of the large electrical companies have long maintained training schools of one type or another for this purpose. In the machine tool field, few manufacturers have plants large enough to warrant the establishment of an elaborate educational department, although many have of late developed well-organized apprenticeship systems with a view to training all-around machinists, toolmakers, and future foremen and superintendents.

Scope of the Norton Educational Department

Doubtless the most elaborate educational department maintained by any manufacturer in the machine tool field is that organized by the Norton Co., Worcester, Mass. The scope of this company's work covers not only the training of machinists and machine operators, but also the training of service men, demonstrators, salesmen of grinding wheels and grinding machines, grain salesmen, office assistants, customers' employes, and agents' salesmen. The various courses provided for these purposes have been described in the December, January, and March numbers of MACHINERY, in the articles by John C. Spence, superintendent of the grinding machine division of the Norton Co. In addition to these courses, however, the company provides a complete mechanical course covering two years, the object of which is to give employes who have not been able to finish high school an opportunity to take up further studies closely related to the practical work in the shop, and to become better fitted to take on added responsibility in the company's organization. Complete courses in office methods and office administration, foremen's courses, educational courses in English for foreign-born employes, and matters relating to citizenship, various evening courses, and extension courses for wheel and machine users and salesmen handling the Norton products are also provided. It is the object of this article to describe briefly the general principles involved in these courses, as it is believed that, as our industries develop, other manufacturers will gradually find it necessary to provide industrial educational facilities, and will therefore be interested in knowing what is being done at the plant of one of the large companies in the field that has developed an educational department of this type. The educational department of this company is under the guidance and supervision of Professor A. D. Butterfield, educational director. Professor Butterfield was formerly connected with the Worcester Polytechnic Institute, but he now devotes his entire attention to the Norton industrial educational activities.

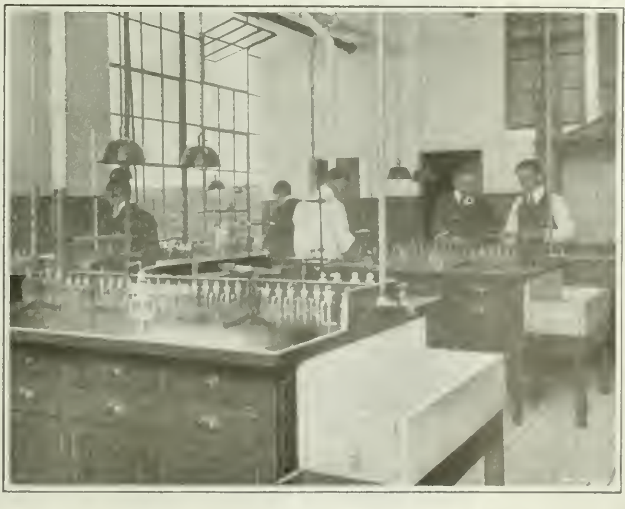


Fig. 1. A View in the Chemical Laboratory of the Norton Half-time Mechanical School

The development of training and edu-

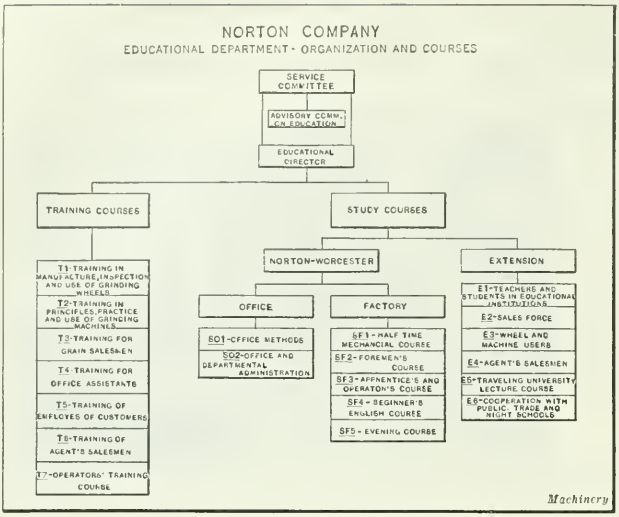

NORTON COMPANY
EDUCATIONAL DEPARTMENT - ORGANIZATION AND COURSES
SERVICE COMMITTEE
ADVISORY COMM. ON EDUCATION
EDUCATIONAL DIRECTOR
TRAINING COURSES
STUDY COURSES
NORTON-WORCESTER
EXTENSION
OFFICE
FACTORY
T1-TRAINING IN MANUFACTURE, INSPECTION AND USE OF GRINDING WHEELS
T2-TRAINING IN PRINCIPLES, PRACTICE AND USE OF GRINDING MACHINES
T3-TRAINING FOR GRAIN SALESMEN
T4-TRAINING FOR OFFICE ASSISTANTS
T5-TRAINING OF EMPLOYES OF CUSTOMERS
T6-TRAINING OF AGENT'S SALESMEN
T7-OPERATORS' TRAINING COURSE
SO1-OFFICE METHODS
SO2-OFFICE AND DEPARTMENTAL ADMINISTRATION
SF1-HALF TIME MECHANCIAL COURSE
SF2-FOREMEN'S COURSE
SF3-APPRENTICE'S AND OPERATOR'S COURSE
SF4-BEGINNER'S ENGLISH COURSE
SF5-EVENING COURSE
E1-TEACHERS AND STUDENTS IN EDUCATIONAL INSTITUTIONS
E2-SALES FORCE
E3-WHEEL AND MACHINE USERS
E4-AGENT'S SALESMEN
E5-TRAVELING UNIVERSITY LECTURE COURSE
E6-COOPERATION WITH PUBLIC, TRADE AND NIGHT SCHOOLS
Machinery

Fig. 2. Diagram showing General Organization of the Educational Department

cational courses as part of an industrial organization is of comparatively recent origin. The first school established by a private corporation in the United States, as far as is known, was that by the R. Hoe Printing Co., of New York City, in 1875. In 1913 the National Association of Corporation Schools was formed, and at that time there were probably not over twenty-five organized schools among the various industries in the United States that provided systematized educational and industrial training. The trend of recent years has been to recognize the great opportunity that industrial corporations have in affording educational opportunities to employes. The war emphasized the need of such facilities, and aided in promoting this movement.

The Norton Co. was among the earlier pioneers in the establishment of training schools. The first course given was in 1912. This consisted principally of a course in shop mathematics, given two periods a week of two hours each to boys in the shop who showed interest and aptitude for additional training. This course was part of the work of teaching the boys the machinist's trade, and was given on the company's time. In 1913 a training course for salesmen was inaugurated, in recognition of the importance of having a sales force trained in the principles of the manufacture and application of grinding wheels and grinding machines. This is the course that was described in the March number of MACHINERY.

In 1914, seven courses of instruction under the direction and supervision of a training supervisor were given for machinists, machine operators, assistants in various departments, grinding machine and grinding wheel service men, demonstrators, and salesmen. The present educational department is a gradual outgrowth of these courses organized in the past, with such additions as time and experience have suggested.

Object and Policy Underlying Industrial Training Courses

The educational department is a branch of the service department of the company, which is defined as a department including all activities, not connected with the actual manufacture of the company's products, that are considered necessary to obtain the best results from the entire organization in the way of loyalty, efficiency, and cooperation. The educational work is based purely on business principles. It is believed that what is of aid and benefit to the individual also benefits the company, because it increases the usefulness of the individual.

The object of the educational work is therefore twofold: First, it affords for such employes as desire and are qualified an opportunity for study, so planned as to fit them for additional responsibility; and second, it provides a better trained and more efficient working force for the company. It has been the policy of the company to develop men from its own organization for the more responsible positions, whenever possible; it will generally be found that there are many men within the organization who need only the opportunity of proper training to bring out their fitness for higher positions.

Organization of Educational Department

Fig. 2 shows a diagram of the general organization of the educational department of the Norton Co. The work is divided into two general groups, known as training courses, and study courses. Each of these sets of courses has a separate supervisor. The entire educational courses are placed in charge of an educational director, who is directly responsible both for the training and the study courses.

Under the head of "training," are grouped those courses that are primarily concerned with the practical side of the industry. In these, emphasis is put upon how to do the work, the training being obtained mainly from actual work in the plant in the manufacture, grading, and use of wheels and in the construction, operation, and care of grinding machines, as already outlined in previous articles in MACHINERY. Under the head of "study" courses are grouped those that follow the usual educational methods of class-room work. These courses may be considered as covering the scientific side of the industry and as having to do with the "why" of things. The study courses are subdivided

Fig. 3. A Class-room in the Half-time Mechanical School

into two sections—those given in the class-rooms, office, or factories at the Norton plant in Worcester, and those given elsewhere by correspondence or extension work.

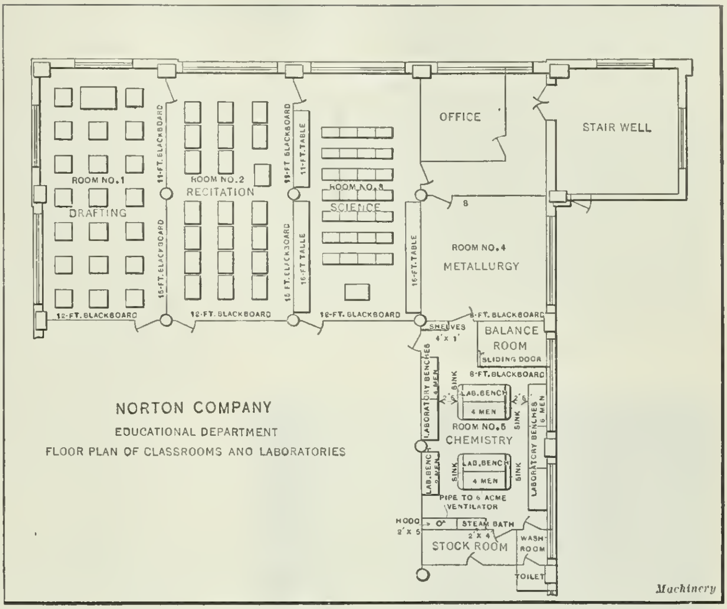


Fig. 4. Floor Plan of the Class-room and Laboratories used for the Half-time Mechanical Course

The Half-time Mechanical Course

As previous articles have dealt with the training courses, the present article will deal mainly with the half-time mechanical course given by this company. This course covers two years and is arranged on a half-time basis; that is, the men work two weeks in the class-room and two weeks in the shop, alternately, during nine months of the year, while during the three summer months they alternate between their regular machine shop work and work in the foundry and pattern shop. Fig. 4 shows a floor plan of the class-rooms and laboratories. At the present time there are about fifty students in this course, all of whom have had either a complete or partial high-school education, and some of whom have had one or more years of college. The course is really an intensified engineering course, specialized for the needs of the machine building and the grinding wheel industries. The class-room work is arranged on an eight-hour basis with four hours on Saturday, and all the class-room work is done under personal supervision. In addition to the educational director, three instructors give their entire time to the class-room work, and half a dozen specialists give part of their time to special subjects in the class-room.

At least two years of high-school work or its equivalent is required for entrance in the course, as well as a knowledge of shop work equivalent to that which can be expected from one year's work in a shop. An oral and a written examination of the candidates test their ability to express themselves clearly on the subjects in which they are being examined. Each of the students who is enrolled in the course receives individually such a wage as is mutually agreed upon by the company and the student for the time that he works in the shop. It is expected that students who enter this course will do so with the intention of completing the two years' work, and that they will remain with the company a reasonable length of time after having completed the course.

Outline of the Course

Briefly stated, the course includes shop arithmetic, algebra, plane and solid geometry, trigonometry, with practical problems from machine shop work, elementary mechanics, study of mechanisms, free-hand drawing, mechanical drawing, design of machine parts, and machine design, materials of construction, tests of materials, practical electricity, pattern shop practice, foundry shop practice, forge shop practice, time study, shop management, and fundamental principles of economics and their application to practical industrial problems.

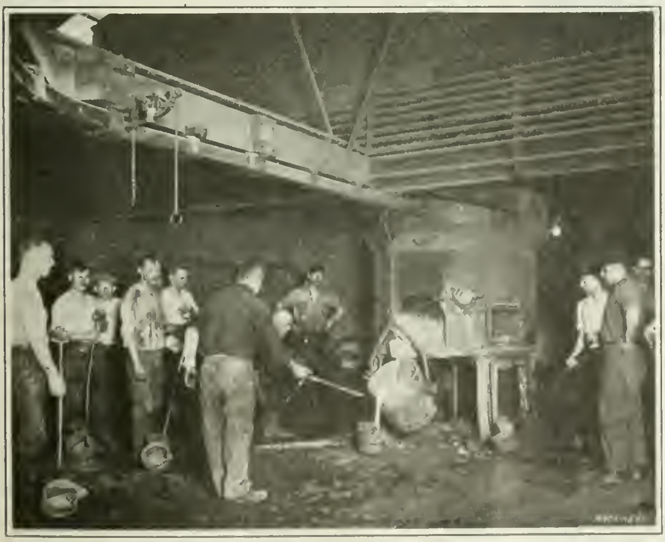


Fig. 5. During the Summer Months the Students of the Half-time Course receive Training in Foundry Work

Foremen's Course

The foremen's course is intended to acquaint foremen and sub-foremen with the relation of their department to other departments, and with the reasons for the systems used. It may be termed a "correspondence lecture" course, and consists of a weekly written article, followed by a weekly conference hour, at which time the subject matter of the lecture is discussed and questions answered or problems given. The conference hour is on the company's time. The course covers the following subjects: Discipline, wage systems, inspection, spoiled work, tool systems, planning systems, stock systems, care of machinery, service department, safety, health, and sanitation.

Other Courses Provided

In addition to the courses outlined, a course for apprentices and operators is provided, entirely apart from the regular training courses, whereby the operators may obtain through a weekly written lecture, arranged on the same plan as the foreman's course, instruction in shop arithmetic, blueprint reading, elementary mechanics, etc. Written reports and examinations are given to test the student's knowledge. One two-hour weekly lesson is given for explanations and individual instruction—one hour being taken on the company's time, and the other hour, on the student's time.

The evening courses arranged for meeting the needs of employes who cannot afford the time or expense to take any of the other courses, cover elementary and advanced mathematics, free-hand and mechanical drawing, machine design, and French and Spanish. These evening classes are given three evenings a week from 5.30 to 8.

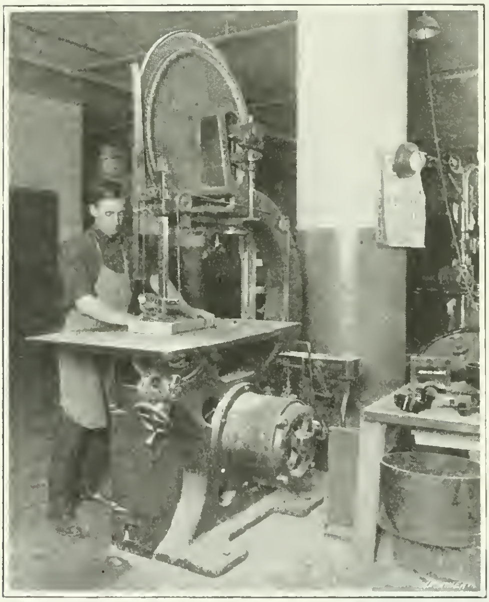


Fig. 6. Patternmaking is also taught the Students during the Summer Months

A carefully planned course is also given to foreign-born non-English speaking workmen, to afford them an opportunity to learn to speak, read, and write English, and to make them acquainted with American ideals, history, customs, and methods of government. This course is given one hour per week on the company's time.

Some of the courses outlined are of recent origin, and the actual results obtained cannot yet be recorded. Other courses, again, have been given for several years, and the results have in every instance been equal to the expectations. The Norton Co. ascribes a large percentage of the efficiency achieved during the war in its manufacturing department to its training courses, and it is evident that by the methods outlined it is possible to create and maintain a working force superior to one in which the men are expected to depend entirely upon their own resources in fitting themselves for performing the work upon which they are engaged with the greatest efficiency.

SHOP TRUCKING ON A BONUS BASIS

By ROBERT J. SPENCE

Supervisor of Training, Norton Co., Worcester, Mass.

The ways of shop truckmen are strange, and shop trucking has more possibilities toward opening up an interesting study than would appear on the surface. One day some years ago the writer met a big, husky truckman carefully pushing a truck on which balanced a piece of work about the size and shape of a baseball. "Jim," asked I, out of mere curiosity at the strange sight, "where are you going with that piece of work?"

"Up to the third floor," said he.

"Why don't you leave the truck behind and carry the work in your hand up the stairs instead of pushing the heavy truck and having to wait for the elevator? Have you a load at the end of the journey that you intend to bring back."

"No," said he, "but whenever I leave my truck behind someone borrows it and it takes me longer to find it than it takes me to do what I'm doing."

Such logic as this from Jim's point of view was unassailable; the simple expedient of a chain and padlock was far beyond his vision, and even if he had thought of it, why bother with such things when they get lost anyway?

Shop trucking, in time, becomes an institution. The job is a peculiar one from which the more ambitious graduate, and to which the less ambitious gravitate. The perfect balance between too much ambition and too little ambition is so delicate that when once a paragon is found with such perfect balance, the proper procedure is to hang on to him. The advent of the electric shop truck complicated matters a trifle. The truckman was elevated to the dignity of chief engineer of the new truck, and he was given a helper. Such a new dignity called for a watchful guardianship of the new piece of apparatus, while the helper went through the manual performance of loading and unloading the truck. The consequent result was an inability to hold the helper.

Some time ago the machine division of the Norton Co. was confronted with the fact that it must either buy additional electric trucks or induce the truckmen to do more work. There were five electric transportation trucks in service in the shop, and it looked as if two new ones would have to be purchased for the additional demands on the trucks, and possibly a spare truck for emergencies and substitution during repairs to the other trucks. A survey of the situation revealed the facts that the five trucks made 375 calls per day of 10 hours, or an average of 75 calls per truck. The calls ranged from a casting of a few ounces to castings of two tons. Each order was considered a call.

In rearranging the system of compensation, with a view to obtaining better results from the trucking division, it was decided that 80 calls per truck per day of 10 hours was an equitable figure to use as a base from which to calculate. It was decided to pay each truckman a day's pay for the first 80 calls in a 10-hour day. The decision was also made to pay a bonus of three cents per call to the driver and three cents to the helper, on all surplus calls over 80 in a 10-hour day. For a 9-hour day instead of 10, the ruling was made that the bonus was to start after 72 calls; for 11 hours, the bonus was to start after 88 calls. The regular shop day of 9 hours with time and a half for each additional hour was to be figured as a wage, and there was to be no stipulation that the truckman should make a minimum number of calls per day in order to receive his regular day's wage.

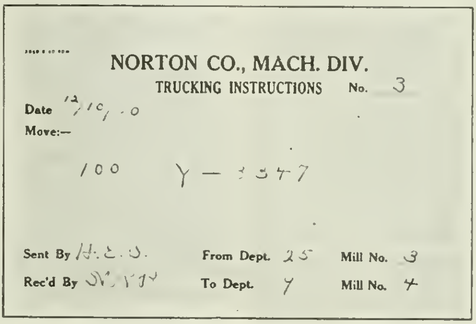
How the Piece Rate Brought Results

This arrangement could not help but appeal to the truckmen. There was nothing for them to lose and everything to gain. They were guaranteed their day's wage, regardless of the number of calls made per day, and there was a possibility of an added wage in the form of a bonus for extra endeavor. They went at the thing with a zest. Results and returns from the scheme became apparent from the start, After being in operation for six months, the returns showed that the daily calls never dropped below 130, and at times went as high as 180. Each man on a truck, both driver and helper, makes from $5 to $12 per week as a bonus over his week's wage by this plan. Friction between the driver and helper is eliminated, because the driver assists the helper to load and unload the truck. Larger loads are taken per trip because of a systematized study in the piling of work on the truck. Calls that formerly took several trips are thereby taken in one load at the price of one call.

The labor cost that formerly was between 14 and 15 cents per call has been reduced to an average of about 11 cents per call, and the average time for each call per truck has been reduced from 7½ to approximately 4 1/3 minutes. Foremen and others have gotten over the instinctive tendency to send workmen on errands to other departments, because the fast service makes the cheapness of a 4 1/3-minute trip incomparable with the usual foot-service. The same number of calls that were formerly handled by five trucks are now handled by three, and the two trucks that were released by the new arrangement are being held in reserve.

The System of Handling Calls

The system of handling the calls is very simple. When a foreman has material to move he telephones to the maintenance department. This department occupies a central station convenient to all divisions of the shop. The call is handled by a girl, who has this assignment as a portion of her work. She makes out a slip in duplicate, showing the part number, the number of pieces, the department making the call, and the destination of the work. The truckman must go to the central station to receive the slips and any necessary instructions. He is given quite a number of slips on each trip so as to save all the time possible. The truckman must pick up the material wherever it is placed, or piled, and must place the incoming delivery wherever the foreman designates. He must get the foreman's, or assistant foreman's, initials on the slip from both places. After the truckman has completed the calls he turns his slips back to the girl, and this makes the basis on which to figure his pay. All slips must be turned in the same day they are received.



NORTON CO., MACH. DIV.
TRUCKING INSTRUCTIONS No. 3
Date 12/10/20
Move:—
100 Y—3347
Sent By H. E. D. From Dept. 25 Mill No. 3
Rec'd By [illegible] To Dept. 7 Mill No. 4

Form issued to Truckmen, containing Necessary Information for the Transportation of Material

When a call is received over the telephone, or otherwise, the girl in the central station immediately makes out the instruction slip and registers on the reverse side, with a recording stamp watch, the hour and the minute of the arrival of the call. When the slip is returned by the truckman and the initials of the sending and receiving foremen show that the call has been completed, the time of the arrival of the slip is also stamped, after which it is filed away for evidence later as a possible tracer. Slips of different color are used to indicate the urgency of a call. A blue slip is the most important of all, indicating an emergency, and such calls must be attended to without delay. A red slip comes next in importance, requiring that the material must be delivered promptly. A white slip is used for the ordinary shop call. The form used is shown in the accompanying illustration. A red slip or a white slip can become an emergency call by stamping in large letters the word "Emergency" on the face of the slip, and a white slip can assume the importance of a red slip by placing on it a "Rush" stamp.

By the use of these different colored slips, the truckmen know at a glance, when they receive several call-slips, which calls to attend to first, so that valuable time is saved which might otherwise be spent in reading through each instruction call-slip if they were all of one color. If all the truckmen are out in the factory when an emergency call is received by the central station, the girl immediately turns a button which throws on a red light that is visible from several points in the shop. On seeing this light, a truckman returns at once to the station. A green light below the red light indicates that two such calls have been received or that two trucks are needed, and two truckmen respond.

The work is simplified for the truckman somewhat because there are certain well-defined traffic lanes which are kept clear at all times. These lanes are defined by thin sheet-steel strips about two inches wide, securely nailed to the floor throughout the entire plant. No material is ever allowed to be placed in a position to obstruct these traffic zones.

Handling Finished Work

Work that has been completed and is in a finished state ready for the stores department is usually handled by one man who has demonstrated that he appreciates fully the value of taking care in handling finished material. The same man also delivers these finished pieces to the assembly hands from the stores. This places the responsibility for any damage in transit directly on the shoulders of one person, and the blame is properly fixed without recourse to the files. For all such finished material, a yellow slip is used, and the urgency of the call is indicated by the use of a rubber stamp.

System Disciplinary but Equitable

No truckman is at liberty to argue with foremen or assistant foremen over any detail in connection with the trucking of material. All difficulties and complaints are straightened out by the head of the maintenance department in cooperation with the truckmen and the foremen. Friction between the people concerned is unheard of.

This system of handling shop material gives satisfaction all around. The truckmen are happy, because of the opportunity to add to their weekly wage; the foremen are pleased because of the rapid service; and the company is satisfied because of the rapid movement of material, the reduction in cost per call, and the simplicity and lack of confusion of the scheme. Back of the whole plan is the dominant idea that if there is satisfaction among all factors concerned in any distinct group (services honorably requested and honorable services rendered) there is bred a harmony that blends into a spirit of cooperation among all groups, and there need be no worry as to the morale of the organization.

* * *

RESUMPTION OF BELGIAN INDUSTRY

Statistics prepared by the Belgian Government indicate that the Belgian mining industry has fully recovered, and several of the other industries, especially those devoted to chemicals, glass, paper, and transportation, are working to almost full capacity. In June, 1913, the industrial establishments covered in the report employed 651,000 people. In June, 1920, they employed 607,000 people, or 93 per cent of the total working force in 1913. These figures indicate that Belgium is working under practically normal industrial conditions and has virtually recovered from the effects of the war as far as the industries are concerned.

Shell Forming Die

By J. BINGHAM, President, B. J. Stamping Co., Toledo, Ohio

THE die for performing the first operation in making a flange for a radiator filler cap is shown in Fig. 1. This is a combination blanking and forming die. As the steel flange-forming punch *A* descends, carrying with it punch *C*, the blank is punched out and carried down in die ring *B* about 1/8 inch, at which time the punch *C* produces the center hole. As punch *A* continues to descend, the outer flange is formed around die *F* and the center flange is produced by the punch as it passes below the level of the steel insert *G*.

The continued descent of punch *A* depresses the drawing ring *D* until it seats in the die-block as shown in the illustration. Sufficient pressure is thus produced on the rubber buffer, which supports this ring by pins, so that as the punch is raised, the drawing ring will be forced upward and eject the shell from the die. The center slug produced by punch *C* drops through the hole in the center stud. Knock-out *E* prevents the shell from adhering to the punch. The shell is made of 1/8-inch sheet brass; the diameter of the blank is 3 13/16 inches, and its appearance after the first operation may be seen by referring to the detail view shown directly above the punch.

The second-operation die for forming the flange and beveling its outer edge is illustrated in Fig. 2, and the appearance of the work after the completion of this operation is shown directly above the punch. Punch-holder *A* is made of cast iron, and is large enough in diameter to allow the knock-out rods *B* to pass down through the bolster plate, beneath which the knock-out plate *C* is carried. This plate functions as the press ram ascends, at which time the plate comes in contact with the stem of pad *D*, ejects the shell from the die, and supports the pad until the next shell is placed in position. It will be seen that the upper surfaces of this pad are angular so as to form the shell to the correct shape.

The descent of the steel punch *G* forces the previously formed outer flange of the shell around the corner of die ring *E* and up against the shoulder *F*, this being the position occupied by the shell in the illustration. It will be seen that there are a number of coil springs that hold pad *D* up against the pressure of the punch as it descends, and that they are not intended to eject the shell, as the knock-out plate *C* is the more positive provision for this purpose, as previously explained, and holds the stem in its upward position as soon as the ram of the press travels sufficiently to enable it to do so. The shoulder *F* of die ring *E* is a vital part in the construction of the die, as the metal is packed against it so that the edge will be perpendicular to the angle of the formed flange. The punch is also provided with a knock-out *H*, which is of familiar construction and operates in the ordinary manner.

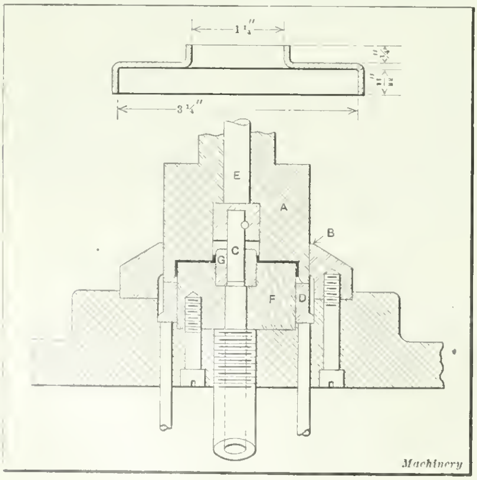


Fig. 1. Blanking and Forming Die used in the First Operation on the Shell

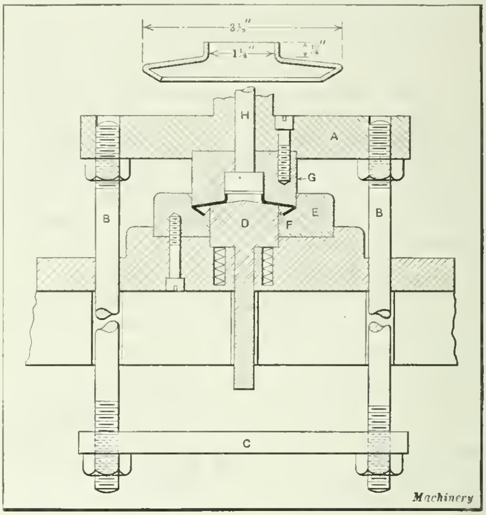


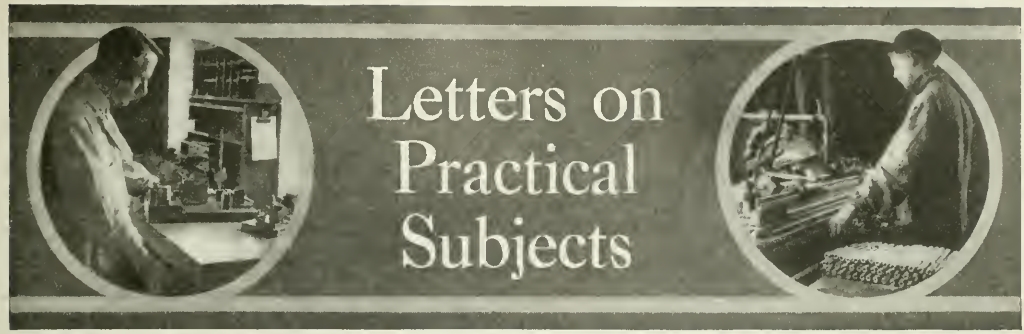
Fig. 2. Die in which Flange is formed and Outer Edge is beveled

* * *

TRADE WITH SPAIN

Previous to the war the principal foreign trade of Spain was with Great Britain, France, the United States, and Germany, in the order mentioned. The imports from the United States, however, did not consist of manufactured products to the same extent as from the other nations mentioned, a large proportion of the exports from this country being represented by raw cotton. During the war the exports from the United States to Spain increased fivefold, while those from France and Great Britain decreased considerably and, of course, the German trade was practically obliterated.

The manufacture of iron and steel is one of the most important of the Spanish industries, the greater part of the domestic production being consumed within the country. Before the war, iron and steel was exported to a value of about $1,000,000 annually, which increased to $7,000,000 in 1916. The depression after the war has been particularly severe in this industry. In spite of recent industrial developments, however, Spain remains to a great extent an agricultural country. The United States furnishes the greater part of the machinery imported by Spain—both agricultural and metal-working machinery. In 1920 Spain imported metal-working machinery from the United States to a value of $1,145,000, and in 1919 to a value of $1,282,000.



Letters on Practical Subjects

LATHE ATTACHMENT FOR CUTTING OIL-GROOVES

The cutting of oil-grooves on internal or external surfaces of such parts as bearings, washers, shafts, arbors, etc., in shops where the quantity of work of this kind does not warrant the purchase of a machine especially designed for the purpose can be readily and economically accomplished by means of the lathe attachment illustrated diagrammatically in Fig. 1. It will be seen that the members of the attachment are the driving shaft *A;* the cast-iron bearing *B;* the cast-iron bracket *C*, which supports one end of the driving shaft *A* and arbor *E* on the end of which is forged the steel crank-plate *F;* connecting-rod *G;* and the steel part *H* employed to attach one end of rod *G* to the carriage. The attachment is mounted at the rear of the headstock end of a Reed-Prentice lathe, parts *B* and *C* being bolted to the bed.

With this attachment, when the spindle of the machine is rotated, a reciprocatory movement is given to the carriage due to the fact that the latter is connected to the crank-plate *F* by rod *G*. Thus, if the tool is properly set, a helical groove will be produced on the work. The distance that the carriage moves depends upon the amount that the adjustable end of rod *G* is set from the center of the crank-plate, it being obvious that if this end of the rod is set at the center of the plate, there will be no movement of the carriage because the rod will be stationary.

Various styles of grooves can be cut by merely changing the ratio of the gears connecting shaft *A* with the regular machine spindle. If these two gears are in a 1 to 1 ratio, there will be one complete reciprocation of the carriage to each revolution of the spindle, and a groove of the form shown at *A*, Fig. 2 will be produced on the work. If the gear mounted on the driving shaft is twice the diameter of that on the spindle, there will be but one reciprocation of the carriage during two revolutions of the spindle, and the groove will be in the form of an 8, as shown on the external surface at *B* and on the internal surface at *C*. By placing a gear on the driving shaft that is four times the diameter of the gear on the spindle, the latter will make four revolutions for each complete movement of the carriage, and the groove cut on the work will be as shown at *D* and *E*. If the gear on the spindle is twice the diameter of that on the driving shaft, there will then be two reciprocations of the carriage to each revolution of the spindle, and the groove produced will be of the type shown at *F*.

This attachment has given very good results; steel bearings 3½ inches in diameter and 2½ inches in length were machined at a production rate of four minutes per piece, floor-to-floor time, the oil-groove being of the type shown at *C*. The lathe on which the oil-grooving attachment is mounted can be conveniently arranged for ordinary work without disassembling the attachment, by simply removing either the gear from the driving shaft or that of the machine spindle,

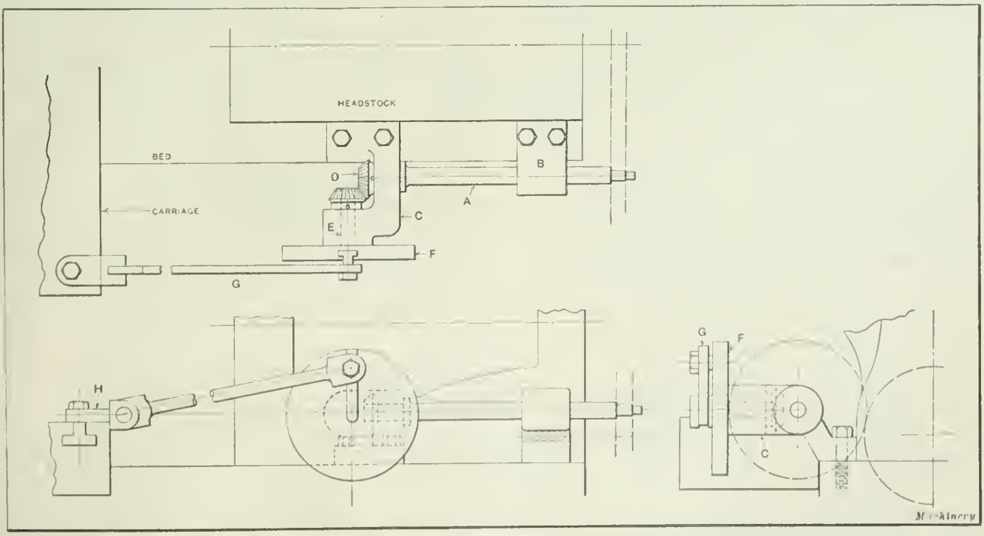


Fig. 1. Lathe Attachment for cutting Oil-grooves on Internal and External Surfaces

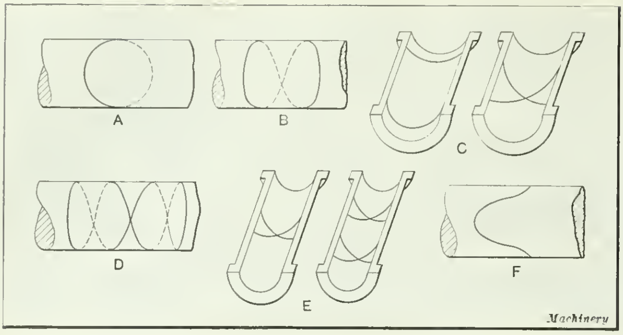


Fig. 2. Different Styles of Oil-grooves produced with Lathe Attachment shown in Fig. 1

and disconnecting rod *G* from part *H*. The maximum throw of the crank-plate on the attachment described was about 6¼ inches.

Sartrouville, Seine et Oise, France P. ROUQUET

STANDARD BLANKS FOR TOOL DRAWINGS

Where large quantities of tool drawings are used, they should be drawn on sheets of specified size, and should have standardized recording spaces for the entry of data. After having designed several such sheets for different offices and following up their use, the writer has developed the arrangement here presented which is believed to be excellent for general use. The function of such a form is to eliminate as much hand work in the drafting-room as possible, and also to draw attention to all necessary routine. While the annotations on the specimen (which is used by the draftsman in connection with making the drawing) are practically self-explanatory, some notes on the general arrangement and reasons for certain details may be added.

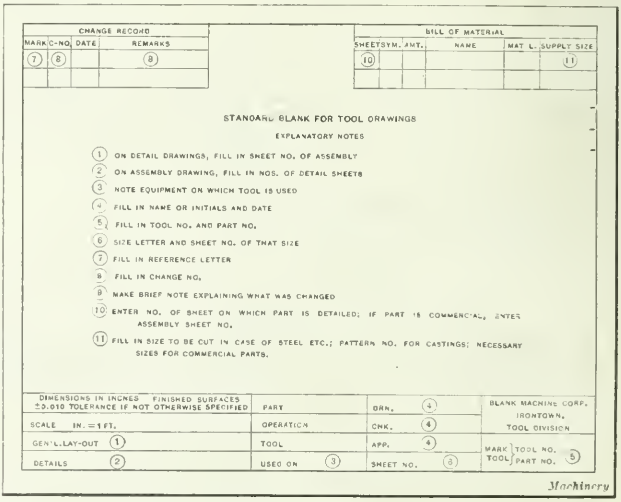
The sizes of sheets generally used and for which commercial filing cabinets are available are as follows: AA, 36 inches wide, any length (drawing folded to 24 by 36 inches); A, 24 by 36 inches; B, 18 by 24 inches; C, 12 by 18 inches; and D, 8½ by 11 inches (for small details and rough sketches accompanying letters). These dimensions are the outside dimensions of the sheet. A border line provides a ½-inch margin on all sides so that damaged and soiled edges will not mar the actual drawing. Referring to the illustration, the Change Record and the Bill of Material are put at the top of the sheet so that these lists can be filled in as required, adding more lines from time to time. To facilitate the adding of extra lines, marks are placed near the top of the right-hand border line of the sheet.

The tool number is usually sufficient identification and is filled in, in the lower right-hand corner of the sheet. A special series of numbers may be used for tools or, what is a preferable arrangement, the part number for which the tool is intended to be used may become the base number to which symbols are added. For example, part No. 529 requires, possibly, two jigs and one milling fixture. The general designation for jig is J and for milling fixture M, so that the tool numbers will be 529-J-1, 529-J-2, and 529-M-1. This method saves a great deal of cross-reference. Where the tools are used on several parts so that they cannot be identified by the number of any one part, the identification numbers must be selected from a general-use series.

In a properly regulated establishment, no changes will be made without proper authority and without the maintenance of a suitable record. Usually this record is attended to by a change order in the form of a 5- by 8-inch slip, which is numbered and which is filed for reference after being used. The simplest numbering method for the change order is to use the tool number as a base and add an abbreviation for the change such as C, and the number of the change on the tool—that is, whether it is the first, second, or third change. Thus the second change order on jig 529-J-2 would be simply 529-J-2-C2.

The sheet numbers are usually made up by using the size letter and adding the number corresponding to the quantity of drawings of that particular size required for the tool. Thus, the second A size sheet will be A-2, and the first D sheet, D-1. Each sheet can therefore be filed numerically in a cabinet of its own size, so that any sheet can be quickly located. In cases where no special form is used, but each sheet is cut and ruled independently and as required, the direct labor involved alone will amount to approximately 50 cents a sheet. The result will also be affected, because the drawing will not be neat and it will not be produced as quickly as it would be if standardized sheets were furnished. A sheet that provides spaces for the majority of routine details will naturally eliminate much of this waste. The form here presented may be advantageously employed as a guide in arranging information relating to routine so that it will be in the most convenient form and insure against omissions.

Detroit, Mich. H. P. LOSELY



CHANGE RECORD			
MARK	C-NO.	DATE	REMARKS
⑦	⑧		⑨

BILL OF MATERIAL					
SHEET	SYM.	AMT.	NAME	MAT'L.	SUPPLY SIZE
⑩					⑪

STANDARD BLANK FOR TOOL DRAWINGS

EXPLANATORY NOTES

① ON DETAIL DRAWINGS, FILL IN SHEET NO. OF ASSEMBLY
② ON ASSEMBLY DRAWING, FILL IN NOS. OF DETAIL SHEETS
③ NOTE EQUIPMENT ON WHICH TOOL IS USED
④ FILL IN NAME OR INITIALS AND DATE
⑤ FILL IN TOOL NO. AND PART NO.
⑥ SIZE LETTER AND SHEET NO. OF THAT SIZE
⑦ FILL IN REFERENCE LETTER
⑧ FILL IN CHANGE NO.
⑨ MAKE BRIEF NOTE EXPLAINING WHAT WAS CHANGED
⑩ ENTER NO. OF SHEET ON WHICH PART IS DETAILED; IF PART IS COMMERCIAL, ENTER ASSEMBLY SHEET NO.
⑪ FILL IN SIZE TO BE CUT IN CASE OF STEEL ETC.; PATTERN NO. FOR CASTINGS; NECESSARY SIZES FOR COMMERCIAL PARTS.

DIMENSIONS IN INCHES FINISHED SURFACES ±0.010 TOLERANCE IF NOT OTHERWISE SPECIFIED	PART	DRN. ④	BLANK MACHINE CORP. IRONTOWN. TOOL DIVISION
SCALE IN. = 1 FT.	OPERATION	CHK. ④	
GEN'L. LAY-OUT ①	TOOL	APP. ④	MARK TOOL } TOOL NO. PART NO. ⑤
DETAILS ②	USED ON ③	SHEET NO. ⑥	

Arrangement for standardizing the Entry of Data on Tool Drawings

UNUSUAL BORING JOB

The illustration Fig. 1 shows a temporary set-up employed for what might ordinarily be considered a difficult boring job; with the arrangement shown, the work was successfully accomplished in good time. The job consisted of boring out a large condenser and the cylinders of a rolling mill horizontal high- and low-pressure steam engine. The position of the engine in the engine house made it difficult to perform the machining operation without dismantling it. However, it was practically impossible to dismantle the condenser and cylinders to have them bored, since the condenser

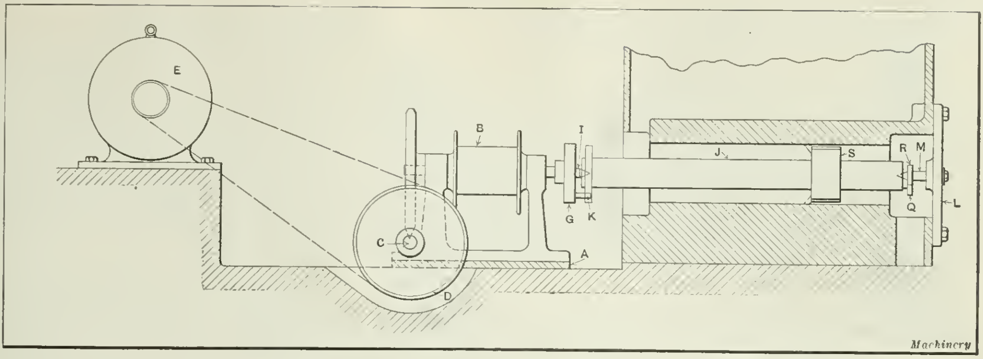


Fig. 1. Arrangement for boring Steam Engine Condenser without removing Engine from its Foundation

weighed about five tons and the cylinders were very difficult pieces to handle. It was finally decided to perform the boring operation by employing the special arrangement here described, and to do the work with the condenser and cylinders in place in the engine. This course was not decided upon, however, until it was evident that much time would be lost and that the mill in which the engine was installed would have to be shut down if the job were performed by an outside concern, which would require the cylinders and condenser to be dismantled.

The hole to be bored in the condenser was 9 inches in diameter and 4 feet 6 inches long. A baseplate *A* was first anchored to the foundation of the engine, on which was then bolted an old rope winch *B*. The winch was driven through worm-gearing, and on the end of the worm-shaft *C* a pulley *D* of suitable size was attached. The power was furnished from a five-horsepower electric motor *E* running at a speed of 960 revolutions per minute, the pulley of which was connected to the driving pulley on the worm-shaft by a 3-inch belt, the speed reduction being 3 to 1. The worm-gearing ratio of the winch furnished a further reduction of 40 to 1, so that the speed of the boring-bar was 8 revolutions per minute. The cast-iron driver plate *G*, carrying a hardened steel center *I*, was keyed to the end of the drum shaft of the winch, as shown in the illustration, so that by employing an ordinary lathe dog *K*, a suitable driving means was provided for the boring-bar *J*.

The opposite end of the boring-bar was similarly supported by center *M* carried in the end plate *L*. The end plate was attached through the same holes that were used for holding the end cover to the condenser. The boring-bar, as will be seen by referring to Fig. 2, was of the ordinary self-feeding type, with feed-screw *P* and nut *T* for traversing the toolholder *S*. The tail end of the feed-screw carried a small pinion *Q*, driven by a gear *R* attached to center *M*. The toolholder carried six tools, and provision was made for boring larger diameters by attaching another tool-holder to the outside of tool-holder *S*. The condenser was in line with the high-pressure cylinder of the engine, so that to bore out this cylinder all that was necessary was to provide a coupling bar to extend through the condenser. This same arrangement was employed for boring out the low-pressure cylinder. The whole job required one week, and the engine was again at work within two weeks.

Cleveland, Ohio C. F. George

GRINDING-WHEEL SPINDLES

The writer has read with interest the article appearing on page 374 of the December, 1920, number of Machinery. It is believed, however, that there should have been included in the description some reference to the fact that the designs illustrated are intended for internal grinding. The type of spindle shown in Fig. 1 of the previously mentioned article is used in the Plainville plant of the Standard Steel & Bearings Co., in manufacturing S.R.B. bearings, in which plant it is the writer's belief this design was developed. The spindle proper was made of tool steel (hardened and drawn to relieve strains, and ground all over for balance) and not of casehardened machine steel. Ball grooves ground in these spindles, consequently, have the same relative advantage over a casehardened bearing as a tool-steel ball bearing would have. The bearing cups were also made of tool steel, with their tapered portions lapped.

In regard to the results which a spindle of this design furnishes, it can be said that they are not altogether satisfactory. Spindles of this type require frequent adjustment, so that when they are put to continuous service (as they would be if the shop were operating on a shift schedule), it would be necessary to have a number of competent high-priced men available to make the proper adjustments necessitated by wear. In compensating for wear, it is necessary to remove the spindle and regrind the ball races. It is also necessary to maintain a copious supply of oil in the bearing housing, for upon this degree of lubrication depend the amount of heat generated, the consequent expansion of the spindle, and the resulting effect on its running qualities. This design of spindle was also tried with a large wheel for external work and was found unsatisfactory for this kind of grinding service.

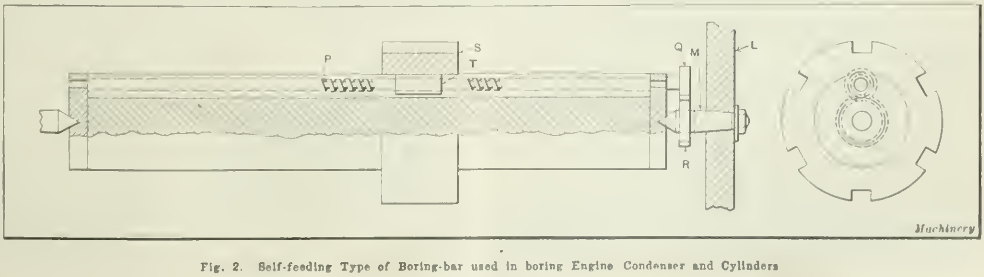
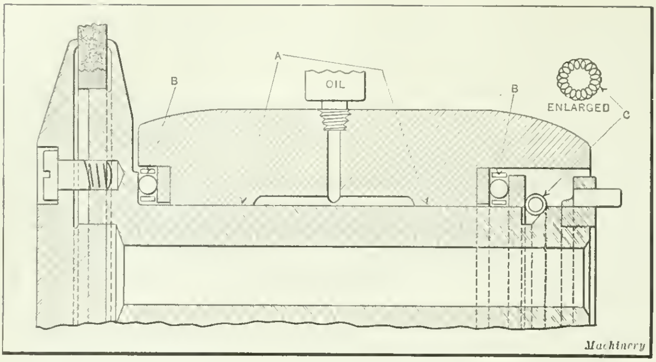


Fig. 2. Self-feeding Type of Boring-bar used in boring Engine Condenser and Cylinders



Design of Grinding-wheel Spindle Suitable for Use on External Work

For external work, a rather novel grinding-wheel spindle design was developed in the previously mentioned plant, as shown in the accompanying illustration. The spindle proper is made of tool steel, hardened and ground all over, and is mounted in a cast-iron housing *A*. This bearing is reamed and then burnished with a ball broach. Ball thrust bearings *B* are provided at each end as shown, the one at the rear of the spindle being backed up by a coiled spring formed into a loop and located in a suitable groove in the spindle proper, as indicated at *C*. The function of this spring is to compensate for expansion and wear of the spindle. This spindle is driven through a flexible coupling from an electric motor, and runs at approximately 1200 revolutions per minute, under which conditions it gives very satisfactory results for radial-grinding the cone grooves in ball bearings. This design, however, was not considered satisfactory for lapping these grooves, the lapping operation being performed on a No. 2 B. & S. universal grinder equipped with a special attachment.

New Britain, Conn. C. R. Wells

IMPORTANCE OF MARKING PATTERNS AND CORE-BOXES

Over-emphasis cannot be laid upon the importance of marking patterns, core-boxes and their loose pieces in such a manner that the parts required for molding any particular casting can be readily identified and that the molder and core-maker will have no difficulty in understanding just how the loose pieces are to be assembled. In cases where a pattern and several core-boxes having a number of loose pieces are required for a casting, the work of the core-maker and molder is far from easy unless all the pieces are adequately marked so that guesswork is eliminated. Frequently, a patternmaker neglects to do this marking if the job happens to be in a hurry or if only one or two castings are to be made, it being thought that verbal instructions to the foundrymen will suffice. However, such instructions are sometimes given to an office employe who does not thoroughly understand them, or if given to a foundryman they are likely to be forgotten by the time the cores are to be made or the casting molded. This is especially true if another similar casting is required after several months or years have elapsed.

It is not always the fault of the patternmaker that his work is not marked; sometimes he is so instructed by his foreman or superintendent for various reasons. The following incident shows that much confusion and the loss of castings are sometimes the result when the assembly of the loose pieces of a pattern and its core-boxes is not understood in the foundry. The pattern and core-boxes for a large four-way hydraulic valve were made in a hurry and sent to the foundry without markings. The casting to be produced was quite complicated from a molder's viewpoint, as the pattern had five loose pieces and there were seven core-boxes having a total of nine loose pieces. Yellow varnish spots on the pattern and core-boxes indicated where loose pieces were to be attached, but there were no markings showing which loose piece corresponded to a particular varnished spot. However, by means of verbal instructions, three castings were successfully produced, the pattern and core-boxes being then sent to the pattern loft for storage.

Ten months later another similar valve was desired for a repair job, and the pattern and core-boxes were returned to the foundry for the purpose of constructing the necessary mold. Here it was found that the previous jobs and the long storage had succeeded in almost entirely obliterating the varnished spots. As there were no other markings to indicate how the loose pieces were to be assembled, the molder and core-maker resorted to guesswork, the result being that the core-maker erred in preparing one of the cores so that the casting was produced wrong. The mistake was not discovered until after the valve had been sent to the machine shop and partially finished. A delay of three days was experienced before another casting was made, to say nothing of the loss of time and labor spent on the spoiled casting.

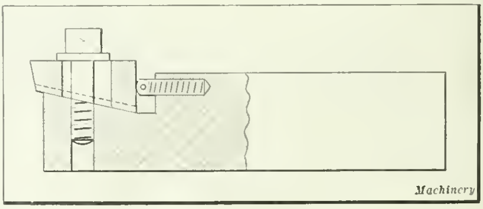
Kenosha, Wis. M. E. Duggan

HOLDER FOR FORMING CUTTER

The special cutter-holder shown in the illustration was designed for use in a screw machine when machining brass rods. When a forming cutter is used on brass rods, it is necessary that the tool be located in a definite relation to the center of the work. If the proper relation is not maintained, even if the variation is slight, the cutter will not work in the most efficient manner. With the ordinary type of forming tool held in a toolpost, it frequently becomes necessary to readjust the setting of the tool relative to the work by loosening the collar-screw, which is almost sure to result in losing the setting already obtained. This requires that the setting of the tool in the correct position be done all over again.

When using the holder illustrated, the cutter is set as nearly right as possible, after which the position in which the tool will work best is obtained by raising or lowering the tool by means of its adjustable feature. It will be seen that this fine adjustment is obtained by means of a headless set-screw, which bears against the rear side of the tool bit. This cutting member has a tongue 1/16 inch deep which fits a corresponding groove in the holder, thereby furnishing a guide in the radial adjustment of the tool bit. Since the tool bit is seated on an angular surface, it will be apparent that only a comparatively light pressure is required to be exerted by the collar-screw in order to hold the forming cutter securely.

Montreal, Canada Harry Moore



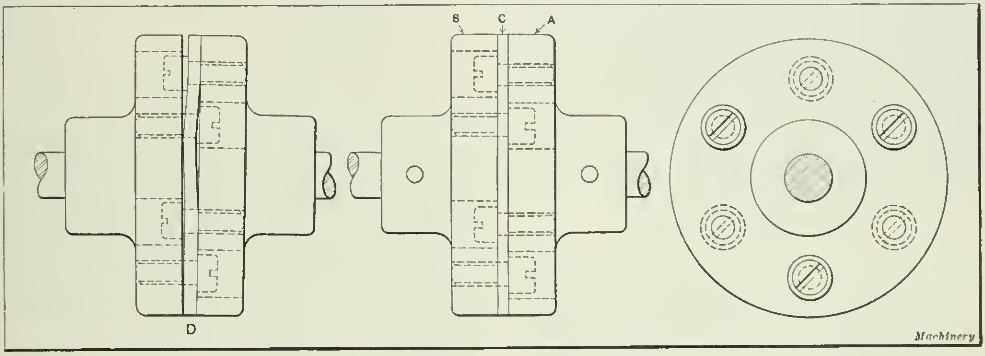
Holder with Provision for adjusting the Cutter

FLEXIBLE COUPLING

A flexible coupling which may be made without great expense and which is efficient and of simple design is shown in the accompanying illustration. This coupling will be found useful in the transmission of light loads, such as the service required in coupling small dynamos and motors. The device consists of two flanged coupling members *A* and *B*, which are secured to the ends of the shafts by any convenient means, such as pins passing through the hubs of the members. Each of these coupling members contains a number of holes for the accommodation of fillister-head cap-screws, the quantity depending upon the size of the coupling. In the illustration, three screws are used in each coupling member. The members are arranged in assembly with the cap-screw holes in one offset with relation to those in the other, as shown in the end view in the illustration. The holes that accommodate the heads of the cap-screws should be somewhat larger in diameter than the size of the head, so as to permit movement of the two parts.

Between the adjacent faces of the flanged members, there is a ring *C* which may be made either of spring steel or leather, and which is provided with holes of the proper size to permit its assembly to the two coupling members by means of the cap-screws. This ring is secured to the coupling members in such a manner that every other screw holds the ring to one of the members and the remaining screws to the other member. This provides an arrangement whereby the parts are free to move out of alignment, as indicated in the view at *D*, owing to the flexibility of the ring. This coupling contains no loose parts and operates without noise or backlash.

Poughkeepsie, N. Y. John J. Thompson



Flanged Coupling of Simple Construction permitting Flexibility

HELICAL SPRING DESIGN

Recently the writer had occasion to design a helical recoil spring for a gun of American make. This spring was to have the same outside diameter and carrying capacity as one used in a similar gun of French manufacture. The spring used in the French gun was made from ½- by ⅝-inch stock, and had a 3-inch outside diameter and a solid height of 20 inches. These English system dimensions are, of course, the nearest to the metric dimensions for the spring used in the French gun.

The spring was required to be made of round wire of such a size that the dimensions and strength of the rectangular stock spring would be duplicated, and the solid height of 20 inches be retained as near as possible. The different formulas for rectangular bar springs were tried with varying success, so that in order to arrive at more satisfactory results, it was decided to investigate with a view to deriving a new formula.

The deflection and carrying capacity of a spring are governed by the torsional strength of the material from which it is made, and this strength is determined by the polar section modulus Z_p of the section.

For a rectangular section, $Z_p = \frac{2}{9} bd^2$

For a circular section, $Z_p = \frac{\pi D^3}{16}$

In these formulas

b = long side;
d = short side; and
D = diameter of wire.

Equating the values of Z_p in the above formulas,

$$\frac{\pi D^3}{16} = \frac{2}{9} bd^2$$

from which

$$D^3 = \frac{2}{9} bd^2 \div \frac{\pi}{16}$$

$$= \frac{2 \times 16}{9 \times 3.1416} bd^2 = 1.1317bd^2$$

$$D = \sqrt[3]{1.1317bd^2}$$

From the conditions of the problem, this equation may now be written

$$D = \sqrt[3]{1.1317 \times 0.625 \times 0.5^2}$$

or

$$D = 0.56 \text{ inch}$$

A 9/16-inch diameter rod will, then, give the required results if the mean diameter of the spring (3 — ⅝, or 2⅜ inches) is retained. In this particular problem, however, the mean diameter must be changed, since the outside diameter is to remain the same. Using the well-known spring formulas for load W and deflection F,

$$W = \frac{0.4Sd^3}{D - d} \qquad F = \frac{3.14S(D - d)^2}{Gd}$$

in which W = safe load;
F = deflection per coil;
d = diameter of wire;
S = safe tensile strength of the material in pounds per square inch; and
G = torsional modulus of elasticity.

If the tensile strength is taken at 80,000 pounds per square inch and the torsional modulus of elasticity at 12,000,000

$$W = \frac{0.4 \times 80{,}000 \times 0.5625^3}{2.375} = 2399.3 \text{ pounds}$$

$$F = \frac{3.14 \times 80{,}000 \times 2.375^2}{12{,}000{,}000 \times 0.5625} = 0.2 \text{ inch}$$

The number of coils in the rectangular spring is equal to the solid height divided by the short side of the rectangular stock, or 20 ÷ 0.5 = 40, which multiplied by the deflection per coil, 0.2 inch, gives a total deflection of 8 inches.

The mean diameter of the 9/16-inch diameter wire spring is 2 7/16 inches, so if this value is inserted in the preceding equations for safe load and deflection per coil, the safe load of the spring is seen to be 2333 pounds and the deflection per coil 0.21 inch. The difference in allowable load for the two springs is 66 pounds, which indicates that the size of the wire should be increased somewhat in order to meet the requirements of the original spring. If the value of d may be expressed in terms of the safe load formula, thus

$$d = \sqrt[3]{\frac{W(D - d)}{0.4S}}$$

and the corresponding numerical values are substituted in this formula, then

$$d = \sqrt[3]{\frac{2399.3 \times 2.4375}{0.4 \times 80{,}000}} = 0.5674 \text{ inch}$$

It will be seen that this is not a standard size for wire and that it represents only an increase of about 0.005 inch over standard 9/16-inch diameter stock spring. This slight diameter difference and the fact that the difference in the safe loads of the two springs represents but a decrease of 2¾ per cent, make it evident that the round wire spring will, under normal conditions, meet the requirements. This spring corresponds closely with the values given for springs of this size wire on page 428 of MACHINERY'S HANDBOOK.

Dividing the total deflection by the deflection per coil and multiplying the result by the diameter of the wire, gives the solid height: Thus (8 ÷ 0.21) × 9/16 = 21⅜ inches. The total deflection H will be somewhat less than 8 inches if the original solid height of 20 inches is retained, as will be seen from the following equation:

$$H = \frac{20 \times 0.21}{0.5625} = 7.46 \text{ inches}$$

Baltimore, Md. H. R. BOWMAN

FOLLOW-DIE FOR EIGHT-SPOKE WHEEL

In Fig. 1 is shown the plan view of a follow-die designed to pierce and blank the eight-spoked wheel shown at A, Fig. 2. This die, however, proved unsatisfactory in use, due to the weakness of sections B, Fig. 1, which correspond to the spokes of the wheel. In order to overcome this difficulty, the follow-die shown at E, Fig. 3, was designed. The spokes are formed by this die in two piercing operations instead of one, as in the case of the die shown in Fig. 1. From view E, Fig. 3, it will be seen that the latter die is constructed so that alternate spaces are pierced by each of the multiple piercing punches.

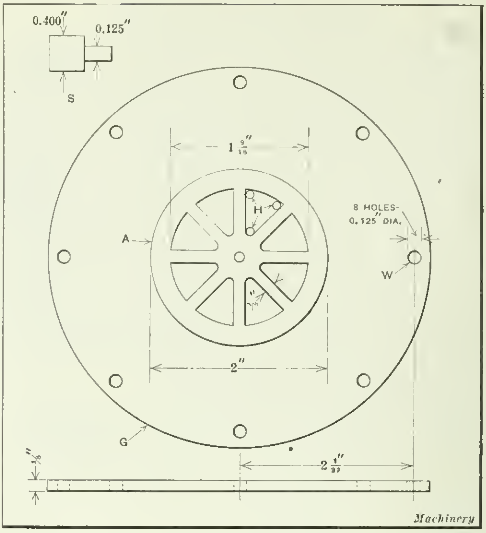


Fig. 2. Lay-out Plate used in making the Spoked Wheel Die

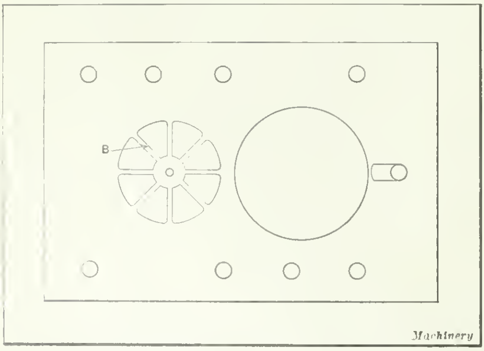


Fig. 1. Plan View of Die originally used in the Production of a Spoked Wheel

In laying out the die, a plate G, shown in Fig. 2, was first cut from ⅛-inch sheet stock. A circle with a radius equal to the diameter of the wheel plus the bridge between the blanks was next scribed on the plate. This circle was then divided into eight equal parts. A 0.125-inch hole was next drilled at each of the division points and also at the center of the circle. The spokes of the wheel were next laid out on the plate by the use of a straightedge and two 0.125-inch drills, in the following manner: As the width of the spokes corresponds to the diameters of the equally spaced holes, it was only necessary to insert the shanks of the two 0.125-inch drills in diametrically opposite holes so that the straightedge could be located against the sides of these drills when the lines were being scribed for determining the width of the spokes.

Three holes H were next laid out and drilled, being so located that they could subsequently be used when cleaning out the space between the spokes on the plate. The center distances between the two piercing dies and the blanking die were then located by means of the plate on a piece of water-hardening vanadium steel, which was to be used for the die. Holes 0.025 inch in diameter were next drilled at each of these three centers, care being taken to have them lined up accurately. The plate was then employed as a drill jig for drilling holes in the die such as indicated at K, Fig. 3. By using the shank of a drill as an arbor and the shank of another drill as an indexing pin for plate G, it was a simple matter to properly locate and drill four similar groups of holes about each piercing die center.

The three holes in each group thus drilled located the corners of the openings forming the piercing dies. For example, the holes at each corner of opening L, Fig. 3, were drilled by using plate G, Fig. 2, as a drill jig in the following manner: First the shank of a 0.125-inch drill was passed through the central hole of plate G and into hole O, Fig. 3, of the die; next the shank of another drill was inserted in hole W of plate G, Fig. 2, and pushed into hole P, Fig. 3, of the die, which was located previously by means of plate G; next the three holes corresponding to holes H, Fig. 2, were drilled through the die, using plate G as a drill jig. By properly indexing plate G and repeating the drilling operations, it was a simple matter to locate the corners of each opening accurately. After all the holes were drilled, the metal was worked out between the three holes in plate G in order that the plate could be used as a gage for filing out the die.

In the upper left-hand corner of Fig. 2 is shown a solid button S which was used in connection with the grinding

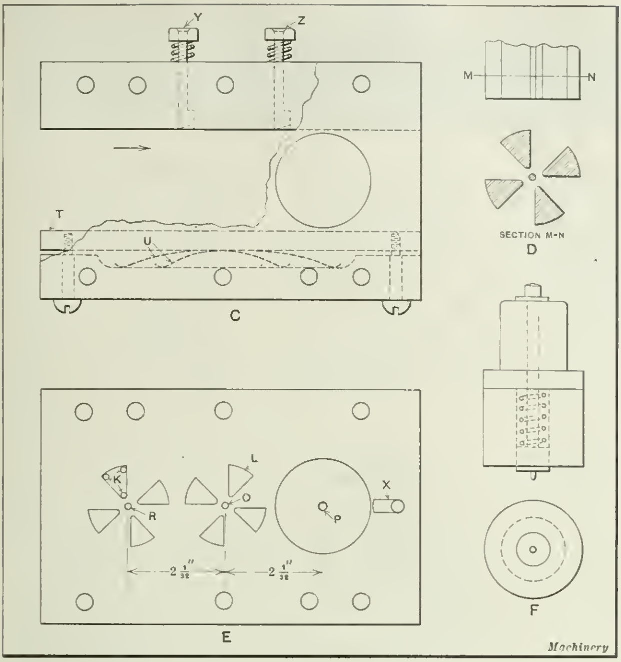


Fig. 3. Stripper, Follow-die, and Punches of Improved Design

of the blanking die. This button has the same diameter as that of a commonly used jig button and also a ⅛-inch pilot made to fit the punch holes *R* and *O* in the die, Fig. 3. Two of these buttons were made and used in the following manner: The pilot of one button was placed in hole *R* and the pilot of the other in hole *O;* a regular locating button was then attached to a piece fitted into the previously rough-bored blanking die hole; then by the use of the straightedge and a micrometer, the 0.400-inch diameter locating button was brought into accurate alignment with the two buttons in holes *R* and *O* respectively, so that the jig button could be used for indicating up the work with the machine spindle when grinding the blanking die.

At *D*, Fig. 3, is shown a sectional view of one of the piercing punches, and at *F* the blanking punch, while *C* is a view of the stripper plate used with the die. This plate is provided with a guide strip *T* actuated by flat springs *U*, which keeps the strip stock pressed against the opposite side of the stripper block, thus compensating for variations in the width of stock. The stops *Y* and *Z* are used only when starting the stock, *Y* being used to locate the work for the first piercing operation and *Z* for the second operation. After the stock is properly started, stop *X*, shown in view *E*, locates the work in the proper position for each succeeding stroke of the punch.

Brooklyn, N. Y. HOWARD W. HOUSE

URGENT NEED FOR STANDARDIZATION OF NUTS AND BOLT HEADS

Exasperating situations frequently arise because of the differences in the distance across the flats of nuts and bolt heads for the same basic size of bolt but of a different manufacture. On this account, if a mechanic endeavors to use a non-adjustable open-jaw or socket wrench for loosening a nut, the nut will probably be too large to permit the wrench to be placed on it, or else the nut corners will become rounded when the wrench is turned. No blame can be attached to the manufacturers of the wrenches because they make them to suit some one of the many different standards. The whole blame rests upon the users of bolts and nuts, inasmuch as they do not compel the trade to make all bolt heads and nuts for the various sizes of bolts, to a single standard. Of course a minus tolerance should be permitted on the nut and bolt-head dimensions for manufacturing reasons, and incidentally it might be stated that a plus tolerance should be given on the wrench openings.

In order to obtain an idea of the number of so-called "standard" dimensions across the flats of a nut or bolt head, reference need only be made to any of the mechanical engineering handbooks. It will be seen, for instance, that for a ⅝-inch diameter bolt, there may be as many as seven dimensions for the width across the flats of the hexagonal nut or head for this size of bolt. The Society of Automotive Engineers has developed bolt-head and nut standards, but these are not used exclusively in the construction of most automobiles. The S. A. E. sizes do not conform to those of the U. S. standard, and neither of them are in accordance with the standards of various manufacturers. The accompanying table shows the dimensions of hexagonal bolt heads and nuts taken from tables given in several well-known handbooks. The standards to which the dimensions in the various columns of this table apply are as follows:

Column A—U. S. standard hot-pressed and cold-punched nuts; U. S. standard rough nuts; and U. S. Government standard finished heads and nuts.

Column B—U. S. standard finished nuts; and manufacturers' standard machine bolt heads and nuts.

Column C—Cap-screws—Hartford Machine Screw Co. and U. S. Navy standard.

Column D—Manufacturers' standard hot-pressed and cold-punched nuts.

Column E—Manufacturers' standard narrow-gage hot-pressed nuts.

Column F—Whitworth nuts and heads.

Column G—Society of Automotive Engineers' standard.

The writer is of the opinion that by inspection of the data given in this table, a realization will be obtained of the absurdity of having such a variety of dimensions for a given bolt diameter. In addition, it should be stated that the U. S. Government has approved two standards, and the U. S. Navy has its own standard, which makes in all, three government standards where one is sufficient. It is believed that an appeal should be made to the manufacturers of bolts and nuts to have them request such organizations as the Society of Automotive Engineers, the American Society of Mechanical Engineers, or the United States Bureau of Standards, to recommend the use of a single uniform standard for the dimensions discussed in the foregoing. S. J.

DIMENSIONS ACROSS FLATS OF HEXAGONAL BOLT HEADS AND NUTS OF VARIOUS STANDARDS*

Bolt Size	A	B	C	D	E	F	G
¼	½	7/16	7/16	½		0.525	7/16
⅜	11/16	⅝	9/16	¾	11/16	0.710	9/16
½	⅞	13/16	¾	1	⅞	0.920	¾
⅝	1 1/16	1	⅞	1¼	1⅛	1.100	15/16
¾	1¼	1 3/16	1	1⅜	1¼	1.300	1 1/16
⅞	1 7/16	1⅜	1⅛	1⅝	1½	1.480	1¼
1	1⅝	1 9/16	1¼	1¾	1⅝	1.670	1 7/16

Machinery

*All dimensions in inches

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

PROBLEM INVOLVING ALGEBRA AND TRIGONOMETRY

R. T. R.—In the accompanying illustration, $a = 1\frac{1}{4}$ inches, $h = 4$ inches, and angle $A = 12$ degrees. Please show how to find distance x and angle B.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—According to trigonometry,

$$x = h \tan B \qquad (1)$$

and

$$\operatorname{Tan}(A + B) = \frac{a + x}{h} \qquad (2)$$

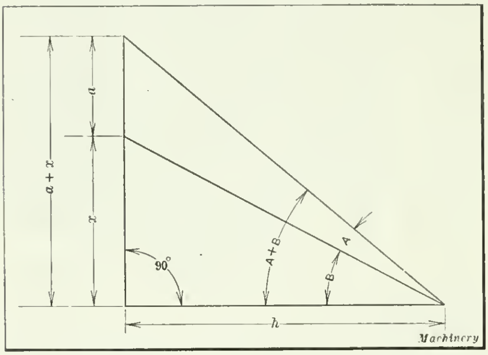


Illustration used in Algebraic and Trigonometric Problem

A number of important trigonometric formulas are given on page 154 in Machinery's Handbook among which is the following:

$$\operatorname{Tan}(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

Substituting this value for $\tan(A + B)$, Equation (2) becomes

$$\frac{\tan A + \tan B}{1 - \tan A \tan B} = \frac{a + x}{h} \qquad (3)$$

Now substituting the value of x from Equation (1), Equation (3) becomes,

$$\frac{\tan A + \tan B}{1 - \tan A \tan B} = \frac{a + h \tan B}{h}$$

Clearing of fractions,

$$h(\tan A + \tan B) = (a + h \tan B)(1 - \tan A \tan B)$$

Expanding, combining like terms, and factoring,

$$\operatorname{Tan} A\,(h \tan^2 B + a \tan B) = \tan A \left(\frac{a}{\tan A} - h\right)$$

Eliminating the factor $\tan A$, substituting $\cot A$ for $\frac{1}{\tan A}$ and arranging terms,

$$h \tan^2 B + a \tan B - (a \cot A - h) = 0$$

Solving this quadratic equation for $\tan B$,

$$\operatorname{Tan} B = \frac{-a \pm \sqrt{a^2 - 4h(h - a \cot A)}}{2h}$$

Taking this equation with the plus sign before the radical and simplifying the terms under the radical,

$$\operatorname{Tan} B = \frac{\sqrt{(a + 2h)(a - 2h) + 4ah \cot A} - a}{2h} \qquad (4)$$

Inserting numerical values in Equation (4),

$$\operatorname{Tan} B = \frac{\sqrt{94.0926 - 62.4375} - 1.25}{8}$$

$$= \frac{4.376286}{8} = 0.5470358$$

and

$$B = 28 \text{ degrees } 40 \text{ minutes } 49 \text{ seconds}$$

Now inserting the known values in Equation (1),

$$x = 4 \times 0.5470358 = 2.1881 \text{ inches}$$

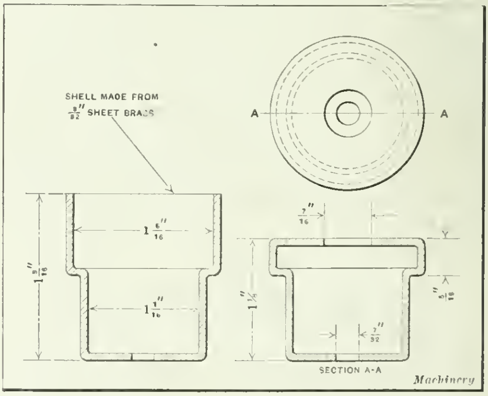
DEFINITION OF A SPLINE

K. S. A.—Disputes occasionally arise as to whether a spline is the groove into which a key extends or whether it is the key itself. Kindly explain the correct use of the term.

A.—According to the Century dictionary, a spline is "a rectangular piece or key fitting into a groove in the hub of a wheel and in a similar groove in a shaft, so that while the wheel may slide endwise on the shaft, both must revolve together." From this definition, a spline is the key and not the keyway. However, according to Webster's dictionary, a spline is a "feathered key or a keyway for a feather key." This makes it permissible to use the word spline to designate either key or keyway; but to avoid confusion, this practice should be discouraged, and the Century dictionary definition adhered to.

FORMING DIE PROBLEM

R. A. B.—Referring to the accompanying illustration, can someone explain the construction of a die or tool of some type for forming or closing in the end of the shell shown at the left, so that it will have the form indicated by the view at the right? The shell is made from 3/32-inch sheet brass and the problem is to form it by some method other than metal spinning, assuming that the latter is practicable.



Shell for which Forming Die is desired

This problem is submitted to Machinery's readers. If anyone has performed a similar operation with satisfactory results we should be glad to have them submit a description of the tool or method employed, for publication.

The Automobile Industry

The automobile industry is passing out of the spectacular stage in much the same way as the bicycle industry did some twenty odd years ago. From now on it is likely that the manufacture of automobiles will become simply one of the many great industries of the country, each of which fills an important and necessary place in the nation's life and development. As it is one of the most important of the industries using machine tools, it is of value and interest to machine tool manufacturers to review briefly its past performance, and analyze the present conditions and the probable future outlook in the automobile field.

THE year 1920 was one of unusually high production in the automobile industry, due to the general prosperity of the country during the better part of the year. Toward the end of the year, there was a marked and sudden change. The buying public became conservative in the matter of purchases of all kinds, and the automobile industry suffered along with the rest of the great industries of the country. Now the industry may be said to be passing through a crisis from which it will emerge stronger and healthier, and it will occupy a more normal position that it ever has before.

Statistics of the Automobile Industry

The automobile industry is accorded the second place in the manufacturing industries of the country, both in regard to the capital invested and the value of its product. At the end of 1919 the capital invested in the automobile industry, exclusive of parts and accessories makers, was over $1,000,000,000. The total number of motor vehicles made was 1,974,000, the value of which was $1,885,000,000—a sum which is equal to the value of the total annual production of coal in the United States. The total number of men employed was 300,000, and the annual payroll was about $375,000,000. It is estimated that in 1920, not less than 2,250,000 automobiles were built.

The total number of automobiles and motor trucks in use in the United States today is estimated at 7,000,000. A census taken by the National Automobile Chamber of Commerce indicates that of the passenger automobiles, only 10 per cent are used exclusively for pleasure, and that 90 per cent are used more or less for business purposes. Sixty per cent of the average car mileage, and 78 per cent of the car mileage of automobiles owned by farmers, is credited to business purposes. Replies received from farmers showed that in their estimation the automobile added, on an average, 65 per cent to the efficiency with which they could conduct their work.

It is estimated in the automobile trade that if the market for new automobiles were confined merely to replacements, 1,000,000 automobiles would be needed every year. This, added to the demand for automobiles by people who are not replacing old cars, would insure a steady business in the automobile industry. Altogether, 11,500,000 automobiles have been sold in the United States, but it is estimated that about 4,500,000 have been scrapped. Since 1899 about 12,000,000 automobiles have been manufactured in this country, and 9300 have been imported. About 525,000 have been exported. In 1920 only 200 foreign cars were imported, and about 120,000 American cars were exported. Of the cars exported in 1920, approximately 20,000 went to the United Kingdom, 12,000 to British India, 8000 to Canada, and 6000 to Cuba.

Present Conditions in the Automobile Industry

During December and January many of the automobile shops were entirely closed down, while others worked a few days a week with but a fraction of their normal working force. In most cases, the work at that time consisted either in supplying repair parts or in assembling cars from parts already manufactured. In the month of February there was a distinct improvement in conditions not only in Detroit—the great automobile center—but also in most of the other cities and towns where automobiles are manufactured.

The conditions in Detroit may be considered as a fair indication of the conditions in the entire industry. In the last week of February, 27 per cent of the total number of workers employed in the automobile and allied industries in that city previous to the depression, were at work. In some plants the production was as high as 50 per cent, while in others it was not more than 10 per cent. During March, a considerable number of men were put to work and it is believed that in the early part of April, the productive capacity of the automobile plants in Detroit will be increased to an average of 35 per cent, and that this increase will continue until at least 50 or 60 per cent of the capacity will be taken care of in the early months of the summer.

During the period when the plants were shut down, the automobile manufacturers accumulated a number of orders, and it is believed that at the rate at which the plants are operated they will barely be able to cope with the orders so far received and those yet to be placed for spring buying. It is estimated that during the coming year, the total number of automobiles built by all automobile manufacturers of the country will be about 40 or 50 per cent of the number built in 1920, or approximately 1,000,000 cars.

The high estimate placed by automobile builders upon replacements is doubtless somewhat optimistic, because the present tendency is to make a car last longer than in the past. Mechanically, automobiles are so perfected that their life is much greater than formerly, and whereas it has not been unusual in the past for automobile owners to acquire a new car at least every other year, many users are now expecting modern cars to last twice that length of time or more. Even then, the car is not worn out, but is worth a fair price in the second-hand market and can be used for several years more.

Prospects in the Automobile Industry

The question that naturally arises is this: If the automobile factories are to turn out only half of their 1920 capacity in 1921, how are they going to keep their large plants occupied? To answer this question definitely is of course impossible, but the most likely development is that automobile manufacturers in the future will make more of the parts for their automobiles in their own plants than they have in the past, and will thereby be able to take care of practically all of their plant capacity.

The part makers will doubtless suffer the most, because the demand upon them will be greatly lessened. Some plants devoted to the making of automobile parts in the past will have to be diverted to other industrial uses. It is reasonable to believe that the automobile industry, instead of occupying the center of the stage, will take its appropriate place in the industrial world. Some of the other industries that have been rather in the background during the last few years will develop and increase so that they will require, to some extent at least, some of the manufacturing facilities already available. It must also be remembered that the tractor has only begun to be recognized as a factor in our agricultural life. Its future is doubtless one of the greatest importance.

Improved Methods and Reduced Costs

As the automobile industry works out its problems during the coming years, it is likely that there will be a reduction in manufacturing and selling costs which will gradually be reflected in a reduction in prices of automobiles. This will make the better grade of cars available to an ever-increasing number of users, thereby placing the automobile industry on a firmer footing than ever. In spite of the highly developed methods in the automobile industry, there is still in many cases an opportunity for a decrease in the manufacturing costs, particularly in the case of the higher priced cars. And all will agree that there is an opportunity for a decrease in the selling costs, as the methods of selling automobiles are exceedingly costly, practically no attempt having as yet been made to economize in this direction.

In meeting the new conditions, wage reductions are necessary. Wages in the automobile industry have been abnormally high, causing a great deal of difficulty to manufacturers in other lines. In Detroit, as well as in other automobile centers, wages in the automobile plants are being reduced on an average 20 and 25 per cent, and if these reductions do not bring the level of wages to a point where workers in this industry receive the same compensation for the same class of work as in the other industries, further wage reductions may be expected.

In the buying of materials and supplies, the automobile manufacturers at the present time are exceedingly conservative. They look forward to further reductions in the prices of both steel and other materials, and there is every evidence that in the future the automobile industry will be conducted with that same strict economy that has been necessary in the past in other competitive industries.

The foregoing paragraphs are an attempt to give a perspective view of the present situation in the automobile field. The outlook is distinctly hopeful, and the crisis that the automobile industry is passing through is probably one of great benefit to the industry itself and to the commercial and industrial interests of the nation at large. From now on that industry will occupy a definite stabilized position with the rest of the metal-working industries. It will be less subject to sudden fluctuations, its status will be more definitely determined, and it can look forward to a prosperous future.

* * *

INDUSTRIAL CONDITIONS IN FRANCE

From MACHINERY'S Special Correspondent

Paris, March 12, 1921

The general industrial situation in France is not marked by any appreciable improvement. Almost complete industrial inactivity continues. The manufacturers of raw material find but a small market for their products, and business in the metal-working field remains very quiet, except in the plants working on railroad equipment. One of the main causes is to be found in the coal situation. English and American coal is too expensive, and France has to depend almost entirely upon the coal imported from Germany. The blast furnaces and steel mills have greatly reduced their production, and many blast furnaces are not operating. In the machine building field, in general, manufacturers complain of lack of orders.

The French Machine Tool Trade

About a year ago a combination of French machine tool builders was formed. This includes practically all the firms that have been engaged in building machine tools either entirely or as a side line. At one of the meetings of the association the question of increasing the tariff on machine tools to the highest possible point was taken up, and vigorous protests were raised against orders being sent by the French railroads to foreign countries.

The nominal price of machine tools remains the same, although there is hardly any buying; but the few transactions that have taken place involve machines offered at reduced prices or on special terms. In the small tool field there has been a considerable reduction in price, due primarily to the reduction in the cost of high-speed steel. Present prices for small tools are about 30 to 40 per cent below the prices in 1920.

There is considerable activity among foreign firms establishing themselves in France. A Swedish ball bearing company—the N.K.A. Ball Bearing Co.—has just built a plant of considerable size in the vicinity of St. Quentin for the manufacture of ball bearings. Another Swedish machine tool manufacturer has established an agency in Paris, and a large German machine tool firm has established a German branch in Paris for selling large machine tools and pneumatic tools. Another German company has just been organized to start in France, under its own name, the building of a large factory for the manufacture of compressed air equipment. This firm will enter into direct competition with the Ingersoll-Rand Co. in France.

The Automobile Industry

The French automobile industry has suffered the same as this industry has everywhere else. The firm of Citroën still continues to manufacture automobiles, but has made a considerable reduction in price in order to dispose of its product. It has also organized a taxi company in Paris using its own cars. The Panhard firm is planning to manufacture a limited number of automobiles, while the Majola firm has gone out of business. Dietrich & Co. are making a new type of six-cylinder fifteen-horsepower automobile. They have also received an important order for railroad material so that their plant operates nearly at capacity. The Gnome & Rhone Motor Co. is at present increasing its capital, and in addition to building automobiles and motorcycles, will manufacture textile machinery and semi-Diesel engines.

Higher Tariffs Demanded

Leaders in the French Chamber of Deputies and Senate have stated that they will protect French manufacturers from the competition of countries where the exchange rates are depreciated as compared with French currency. M. Haudos, president of the Customs Commission, has declared that "we are more and more swamped by products manufactured in foreign countries and especially those of Germany. We must protect ourselves immediately from this danger." On the other hand, the government is reluctant to increase tariff duties without careful consideration except in some instances. The general political situation in France prevents the increase of tariff against friendly countries, as for example, Belgium, so that the main question is to find a method of protecting French industries mainly against the competition of Germany.

Labor Conditions

There is a general tendency toward reduction in wages; one automobile firm has announced a 10 per cent reduction, which will probably be increased to 20 per cent by the time this is published. The men at first refused to work at the new rate and left the factory, but took up work again after two days when told that the firm was unable to take them back at the old rates. The men returned against the advice of the president of the French Federation of Labor. The principal officers of the federation have advised the men not to work at a lower scale of wages, but it seems certain that the men are not going to follow this advice, being more interested in having a job at a reduced wage scale than in having no job at all.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

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Multiple-spindle Vertical Boring Machine. Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y.. 800
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Oliver 16-inch Rapid-production Lathe. Oliver Machinery Co., Grand Rapids, Mich. 801
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Gleason 8-inch Spiral Bevel Gear Generator. Gleason Works, Rochester, N. Y. 802
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Springfield Shear Blade and Face Grinder. Springfield Mfg. Co., Bridgeport, Conn. 806
Eastern Self-opening Die-head. Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. 806
Simmons Tool-holder. Simmons Economy Tool Corporation, 981 Broadway, Albany, N. Y. 807
Sebastian Lathe. Sebastian Lathe Co., Cincinnati, Ohio... 807
Canedy-Otto Universal "Burning In" Machine. Canedy-Otto Mfg. Co., Chicago Heights, Ill. 807
Putnam Heavy-duty Axle Lathe. Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass... 808
Pulaski Vertical Boring and Turning Mill. Pulaski Foundry & Mfg. Corporation, 2422 Euclid Ave., Cleveland, Ohio.. 808
Southwark Universal Flue Welder. Southwark Foundry & Machine Co., Philadelphia, Pa. 809
Putnam Traversing-head Shaper. Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass.... 809
Brown Recording Thermometer. Brown Instrument Co., 4510 Wayne Ave., Philadelphia, Pa. 810
Bridgeport Herringbone Milling Cutters. Bridgeport Cutter Works, Inc., 50 Remer St., Bridgeport, Conn. 810
Biggs Tangent-cut Box-tools. P. H. Biggs Machine Co., 1235-1237 W. 9th St., Cleveland, Ohio 810
Velco Keyway Broaching Set. Velco Mfg. Co., Inc., Greenfield, Mass. 810
Hollingworth Heavy-duty Shaper. Hollingworth Machine Tool Co., Covington, Ky. 811
Knebel Self-tightening Drill Chuck. Knebel Mfg. Co., Inc. 352 N. Burritt St., New Britain, Conn. 811
Titan Quick-change Collet Chucks and Sockets. Titan Tool Co., 26th and Holland Sts., Erie, Pa. 811
Anderson Vertical Tapping Machine. Anderson Die Machine Co., Bridgeport, Conn. 812
G. B. Spur-geared Chain Block. Andre Weill & Co., Inc., 149 Broadway, New York City 812
Cincinnati Planer Power Traverse. Cincinnati Planer Co., Cincinnati, Ohio 812
Reed-Prentice Cone-head Lathe. Reed-Prentice Co., 677 Cambridge St., Worcester, Mass. 813
McKneat Oil-burning Equipment. McKneat Mfg. Co., Easton, Pa. 813

Bath Micrometer Plug Gage

This internal micrometer gage is essentially an instrument to be used in quantity production. It enables a workman, in producing a hole, to know its exact size during the machining process, as well as the exact amount of stock removed per cut, and so permits him to finish the hole with the assurance that he is obtaining the desired size. Thus it is unnecessary for him to depend upon "Go" and "Not Go" gages, which indicate the size of a hole after it has been finished rather than during the operation.

THE accurate measurement of cylindrical holes in parts is made possible by the use of the micrometer plug gage here illustrated, which has four measuring jaws that are expanded radially by operating a screw, after the instrument has been inserted in a hole, until each jaw is brought into line contact with the wall of the hole, the exact diameter of the hole being read in ten-thousandths of an inch from graduations on the handle of the gage, which record the positions of the jaws. This instrument is a product of John Bath & Co., Inc., 8 Grafton St., Worcester, Mass., and is furnished with a master ring gage for determining the accuracy of the micrometer gage at all times. Provision is made for adjusting the micrometer gage to compensate for wear. The basic size of the gage illustrated is 2 inches, but measurements ranging from 1.950 to 2.020 inches may be made.

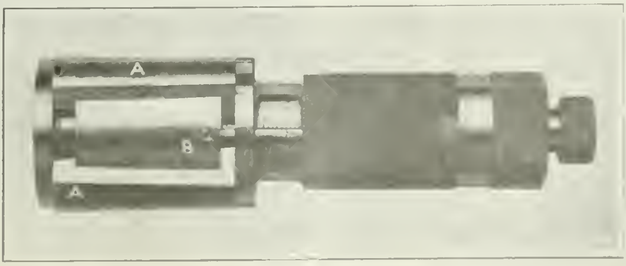


Fig. 1. Micrometer Plug Gage developed by John Bath & Co. Inc.

The four measuring jaws *A*, Fig. 1, are provided with true cylindrical contact surfaces, and are held in perfect alignment on the sliding member *B* by means of close-fitting dovetailed slots. These measuring jaws are expanded or contracted when this slide is moved back and forth through the operation of a screw, this being accomplished by turning the graduated end of the gage handle. A longitudinal movement of slide *B* of 0.005 inch increases or decreases the diameter across the measuring jaws 0.001 inch. It is claimed that, as the movable jaws fit tightly in the dovetailed grooves of the slide and are controlled by an accurate screw without backlash, an instrument is obtained which is as rigid as a solid plug. Thus when the gage is inserted in a hole and adjusted by turning the micrometer head, the jaws stop abruptly when they come in contact with the walls of the hole, owing to the fact that there is no resilience in the instrument. This rigidity is a fundamental requirement in well made measuring tools. It eliminates springiness of the parts, which is sometimes referred to as "feel" and which often gives rise to variations of from one to several ten-thousandths of an inch when external measurements are made by two different people.

An important feature in the construction of the micrometer gage is the arrangement for reading the size of a hole. The micrometer head has ten main graduations, spaced about ½ inch apart, each space representing a movement of the measuring jaws of 0.001 inch. These main graduations are subdivided ten times, each of the spaces representing a movement of 0.0001 inch. An additional scale consisting of seven graduations is provided on the shank of the gage handle, the

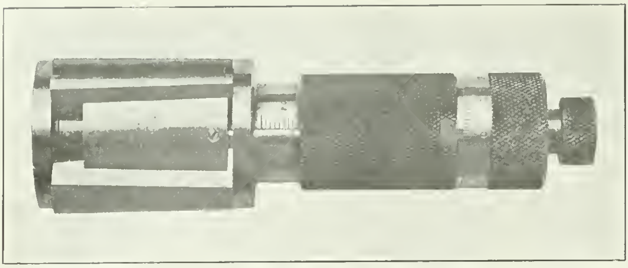


Fig. 2. Setting of the Micrometer Graduations when the Diameter across the Measuring Jaws is 2.020 Inches

distance between each of these graduations corresponding to the amount that the slide is advanced during a complete turn of the micrometer head, and during which an expansion or contraction of the micrometer jaws of 0.010 inch is made. This scale presents a means of indicating the amount that a reading is over or under the basic size of the gage. Thus in Fig. 2, the diameter across the jaws, as indicated by the reading on the handle, is 2.020 inches, and in Fig. 5 the diameter is 1.950 inches. A knurled thumb-screw on the handle end of the gage serves to clamp the micrometer head firmly, and thus permits a retaining of a setting or reading.

Provision is made to compensate for wear of the jaws. As shown at *A* in Fig. 3, this consists of a series of serrations on the outer end of the sleeve carrying the micrometer graduations and a similar series of serrations on the knurled member by means of which the gage screw is operated. By withdrawing the locking screw of this knurled member and moving sleeve *B* a distance of one serration, a jaw adjustment of 0.0001 inch is made. This adjustment is, of course, maintained when the knurled member is again advanced longitudinally and locked in place. By this means, any amount of adjustment up to 0.070 inch may be secured.

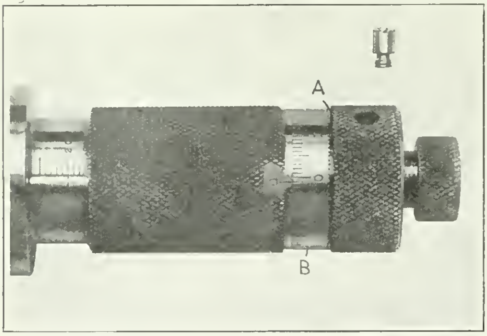


Fig. 3. Method of compensating for Wear of the Measuring Jaws

During the manufacture and inspection of the micrometer gage, it is compared by means of light wave measurement, with reference gages certified by the Bureau of Standards to be correct within a few millionths of an inch. The micrometer gage can therefore be adjusted so that when set at zero, the jaw diameter will be true within plus or minus twenty-five millionths inch. This limit represents variation from absolute size, and does not prevent the use of the gage in the inspection of ring gages or other internal cylindrical work to a greater degree of accuracy, as it is possible to detect errors as small as one hundred-thousandth inch.

After having been standardized by means of light waves, the internal micrometer gage is, in turn, used to verify a master reference gage, the latter being then preserved to serve as a standard by means of which the micrometer gage may at any time be adjusted and reset to the correct size, through the use of the adjusting arrangement previously explained. By reference to Fig. 4, it will be seen that the construction of this reference ring gage differs somewhat from the usual form. The deep wall section of the gage provides a great amount of rigidity, and the series of concentric holes, while having little effect on the strength of the ring, serves to reduce the weight materially; these holes also permit air circulation which causes the ring to return quickly to a normal temperature after being subjected to abnormal heat or cold.

Another fundamental feature of this reference gage is its narrowness. It is evident that a broad ring gage will pass over surface depressions and make contact with only the high points of a plug being measured. However, a narrow ring serves to detect and locate any errors existing in the plug, and is thus better suited for use as a reference master gage. That there is little opportunity for wear to occur on the master ring gage when it is used solely as a standard for the micrometer gage may be realized from the fact that when inspecting the micrometer gage no sliding action takes place, because the jaws are expanded to come in contact with the internal surface of the ring.

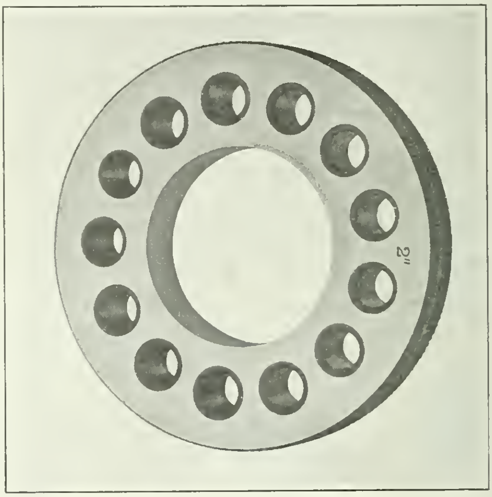


Fig. 4. Master Ring Gage for ascertaining the Accuracy of the Micrometer Gage

The process of inspection by means of the micrometer gage is sufficiently simple to permit its use by an unskilled workman. In measuring a hole, if there is any indication that the hole is elliptical in shape, that is, if it is out of

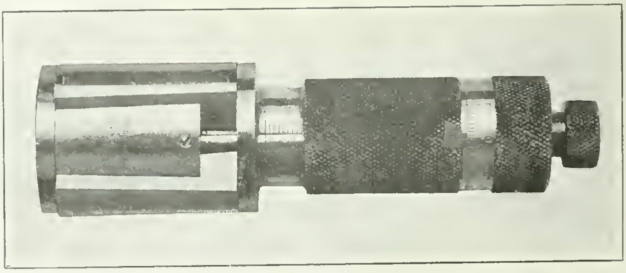


Fig. 5. Setting of the Micrometer Graduations when the Diameter across the Jaws is 1.950 Inches

round, the exact amount of error can easily be determined by rotating the gage a certain amount. By means of this gage it is possible to take measurements at different points in a hole, that is, at the front, at the center, or at the rear. This advantage permits any taper or bell-mouth to be readily discovered. The best way of measuring the diameter of a lapped internal cylindrical surface is to have the surfaces of both the part and the micrometer perfectly clean. They should first be washed with soap and warm water and then dried. The presence of lubricant simply serves to cover up or hide defects.

It is stated that great care has been given to the proportioning of all wearing parts of this micrometer gage to insure long life and accuracy. All movable parts are protected from grit and dust. An entire set of thirty-two gages will give continuous measurements by ten-thousandths from ⅞ inch to 3 inches.

UNIVERSAL PORTABLE CRANE

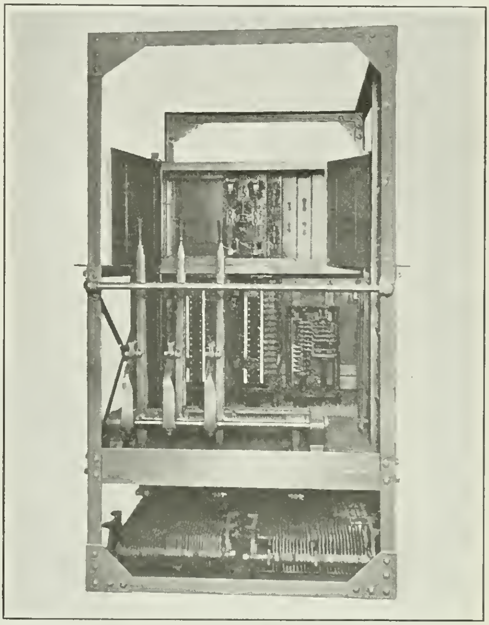
The portable crane shown in the accompanying illustration is mounted on a truck having steel wheels that permit the truck to be run on standard-gage railway tracks or on the ground. This truck is equipped with a driving mechanism for propelling it at a slow speed under its own power, and is controlled and steered from the operator's platform. The crane and truck complete are built by the Universal Crane Co., Swetland Bldg., Cleveland, Ohio. The current for the lifting magnet is supplied from an outside source, but the crane is so arranged that a generator driven by the crane motor could furnish the current. The crane capacity is from 3 to 4 tons, depending upon the counterweight, length of boom, mounting, and radius at which the crane works.

Self-propelling Crane made by the Universal Crane Co.

It is not necessary for the crane to be mounted on the truck shown, as it will operate equally well on a flat railroad car, an automobile truck, a trailer, or on a ground foundation. The crane may be driven by a 40-horsepower gasoline engine or by an electric motor of equal capacity. It has a full circle swing, and the length of the boom may be varied. The following equipment can be furnished with the crane: Grab bucket; electric magnet; hoist block; single, double or separately driven drum; and steam shovel.

PAWLING & HARNISCHFEGER CRANE CAB

The operator in the cab of a traveling crane usually has a limited amount of space in which to move about, and for this reason exposed knife switches, magnetic control parts, and resisters introduce a serious hazard. The cab illustrated has recently been placed on the market by the Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis., having been designed to insure maximum safety of the operator. As on previous crane cabs built by this concern, a false bottom is provided for the resisters, but there is also a front lever control, and the entire controller equipment and current-carrying parts are fully enclosed in a cabinet at the rear of the cab. The illustration shows the various cabinet doors open, but when they are closed all chance of the crane operator coming in contact with any live parts is entirely eliminated. The main knife switch is operated by a handle placed on the outside of one of the cabinet doors. Arrangement of the units in this manner makes unnecessary the usual controller covers. The wiring at the rear of the units is made accessible by removing a panel at the back of the cabinet. The control levers operate radially, and are placed at the front of the cab so as to allow the crane operator an unobstructed view of the shop.



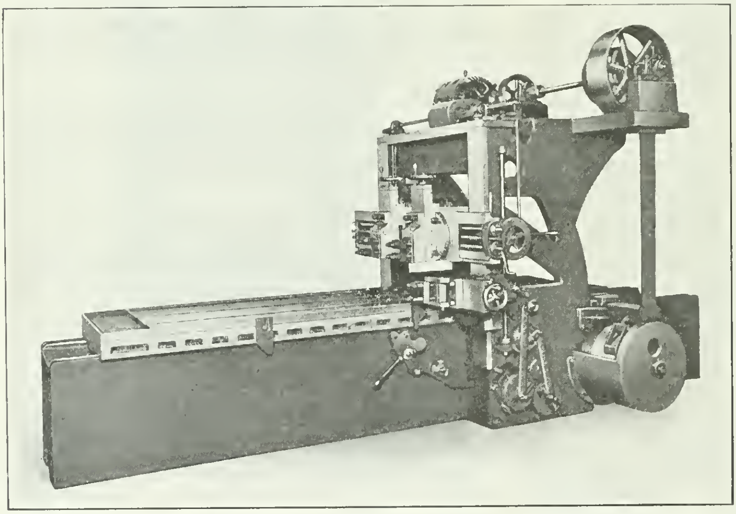
Crane Cab made by the Pawling & Harnischfeger Co. in which the Entire Controller Equipment is enclosed in a Cabinet

WHITCOMB-BLAISDELL PLANER

The 32-inch planer shown in the accompanying illustration is a recent addition to the line of machine tools built by the Whitcomb-Blaisdell Machine Tool Co., 677 Cambridge St., Worcester, Mass. As on preceding machines of this type, the planer is provided with the company's patented second-belt drive, which permits the number of gears beneath the table to be relatively small, and reduces the jars and shocks produced by the reversal of the table. However, this planer differs from the smaller sizes in that it has a double gear reduction from the second-belt drive shaft to the table rack.

The compact construction of the machine will be apparent by reference to the illustration. The cross-rail is heavy and deep and has extra ribbing at the back to give sufficient stiffness. The table is braced with ribs at frequent intervals to guard against any possibility of springing. The table T-slots are planed from the solid metal, and the center T-slot extends the full length of the table beyond the chip pockets. Projecting ledges on the under side of the table prevent the dropping of chips into the ways. The housings are of the box type, bolted to the bed and rigidly connected at the top by a heavy rail. The bed is cast with a solid top, the only opening being at the center where the double gear reduction is placed. However, this opening is covered by a sheet-metal plate in such a way that only the upper segment of the bull gear projects through it.

The machine is equipped with a patented cross-rail binder that enables the operator to lock the cross-rail securely to the housings by operating a lever, without moving from his position on the working side of the machine. Patented self-locking shipper dogs are also a part of the regular equipment. It is only necessary for the operator to set these dogs for the required length of stroke. The principal dimensions of the machine are as follows: Actual width between housings, 36 inches; planing height under cross-rail, 32¾ inches; length of table, 10 feet; width of table, 28 inches; length of bed, 16 feet; length of down feed, 13 inches; and minimum distance between centers of tool-boxes, 7¼ inches. The approximate weight of the planer is 17,500 pounds.



Thirty-two-inch Planer built by the Whitcomb-Blaisdell Machine Tool Co.

FAFNIR BALL-BEARING LINE-SHAFT BOX

The fact that the application of ball bearings in lineshaft boxes saves a great amount of power otherwise lost in transmission is no longer questionable. In installations of this kind the following points should be observed: The ball bearings must be located on a shaft that contains no shoulders; the inner rings of the ball bearings should be firmly seated on the shaft to avoid any possibility of tipping or slipping; provision must be made so that any deflection or misalignment of the shaft does not cramp the balls; the boxes should be designed in such a way that they can be installed as units without requiring delicate adjustments; and, finally, the ball-bearing boxes should be interchangeable with plain bearing boxes in standard hanger frames. With these points in mind, the Fafnir Bearing Co., New Britain, Conn., developed the bearing box illustrated in Fig. 1, which is provided with a transmission ball bearing at each end.

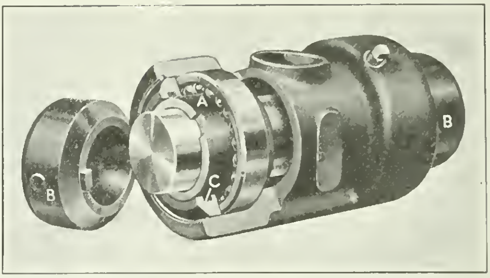


Fig. 1. Ball-bearing Lineshaft Box made by the Fafnir Bearing Co.

The principal feature of this box is the manner in which the ball bearings are mounted on the shaft. Each ball bearing is placed on a wide inner ring *A*, which is mounted directly on the shaft. Collar *B* is placed on the shaft in front of the ring in such a way that two lugs on the collar enter two slots on the front end of the ring, so that the latter is rotated with the collar. The collar is secured to the shaft by means of two hollow set-screws. A felt packing ring *C* is placed on the inner ring in front of the balls, and held in place through the medium of a retaining ring in an annular groove on the box casting. By this construction, the shaft, collar, and inner ring of the ball bearing revolve as one unit. The inner ring projects a sufficient distance beyond the packing ring to prevent the driving collar from coming in contact with the latter, and so all thrusts are delivered to the bearing.

It is permissible for the inner ring to be a slip fit on the shaft, and, in addition to this easy installation, other advantages of the wide inner ring are the amount of bearing afforded to the shaft, and the firm seating that the ring offers for the ball bearing. The purchaser receives the ball-

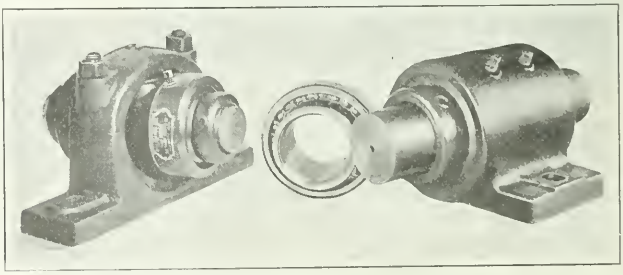
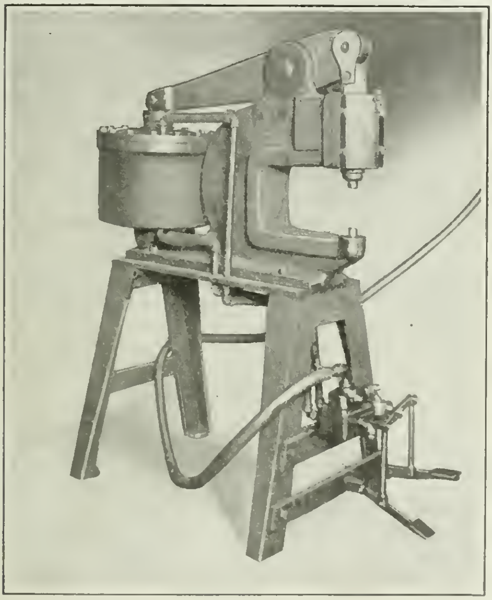


Fig. 2. Self-aligning and Rigid Pillow-blocks furnished Complete with Bearing Box

bearing box as a unit, ready for installation, and need only slip the box in place in a hanger frame or pillow-block, tighten the hanger screws in the ordinary manner, and tighten the screws of each driving collar on the shaft. Fig. 2, at the left, shows a box installed in a self-aligning pillow-block, and at the right, in a rigid pillow-block. Pillow-blocks of these types can be purchased complete with the ball-bearing box. Because of the interchangeability of this ball-bearing box with plain boxes in standard hangers, it is just as easy to install it in old shops as it is on shafting just being erected. It is only necessary to replenish the box with lubricant about once every six months.

BAIRD COMBINATION PUNCH AND RIVETER

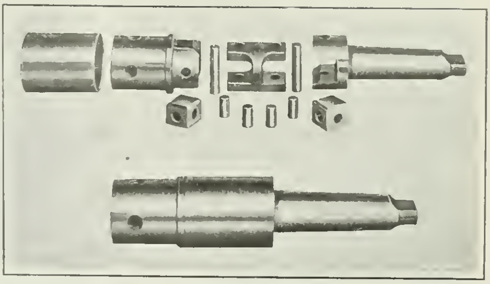
The accompanying illustration shows a new punching and riveting machine developed by the Baird Pneumatic Tool Co., Kansas City, Mo. The frame of the machine is a one-piece casting having a split head. The air cylinder is of a single type, and is connected by means of a heavy lever to the ram of the machine. By this arrangement a pressure of 70,000 pounds may be exerted on the riveting dies or punch. The machine is controlled by a foot-pedal valve, thus allowing the operator the use of both hands to direct work being punched or riveted. Two of the advantages claimed by the manufacturer for this machine are its high speed of operation, and the fact that two classes of machines are incorporated in one. The machine is capable of punching plates up to ⅝ inch in thickness, and of cold-riveting up to ¾ inch in diameter. The machine and stand complete weighs approximately 650 pounds.



Combined Punching and Riveting Machine built by the Baird Pneumatic Tool Co.

CINCINNATI UNIVERSAL-JOINT TOOL CHUCK

The Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio, has recently developed the universal-joint tool chuck which is shown in the accompanying illustration before and after being assembled. The joint is full-floating and has been incorporated in the construction to permit the use of the chuck in connection with all types of boring and reaming fixtures requiring a table support for the tools. The use of the chuck eliminates errors on the work due to faulty alignment of the base or table of the machine on which an operation is to be performed, or of a fixture with the machine spindle. The universal joint is made comparatively short, in order to reduce the movable range of a machine spindle as little as possible.

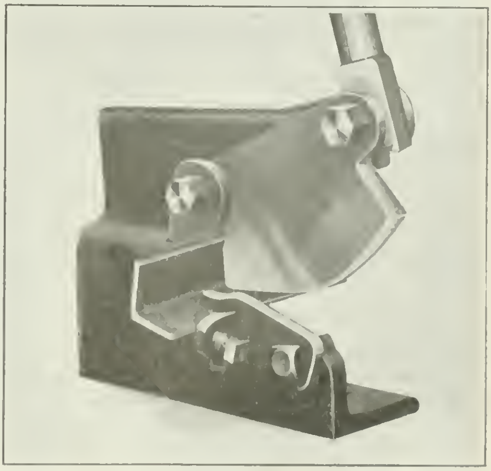


Disassembled and Assembled View of Universal-joint Chuck made by the Cincinnati Engineering Tool Co.

This chuck is regularly made in three sizes, the shanks and holes in the socket ends being machined to Morse tapers; however, the chuck can also be furnished with any special style of shank or socket. The shank of the small regular size is No. 2 taper, while the socket may be either No. 1 or No. 2 taper, according to the wishes of the purchaser; the intermediate size may have either a No. 3 or No. 4 taper shank and either a No. 3 or No. 4 taper socket; and the large size of chuck has a No. 5 taper shank and a No. 5 taper socket. The various parts are made of alloy steel, hardened and ground.

DREIS & KRUMP STEEL ANGLE SHEAR

The steel angle shear illustrated is a product of the Dreis & Krump Mfg. Co., 2909-2923 S. Halsted St., Chicago, Ill., and has a capacity for shearing angle-irons up to 1½ by 1½ by 3/16 inch. The operating principle of the device is quite similar to that of the steel slitting shear described in the February number of MACHINERY. The frame and base are integral, being a pressed-steel piece. The shear blade is actuated by a geared lever, and is reversible having two cutting edges. It can be raised sufficiently to permit insertion of work from the front of the device. A clamping

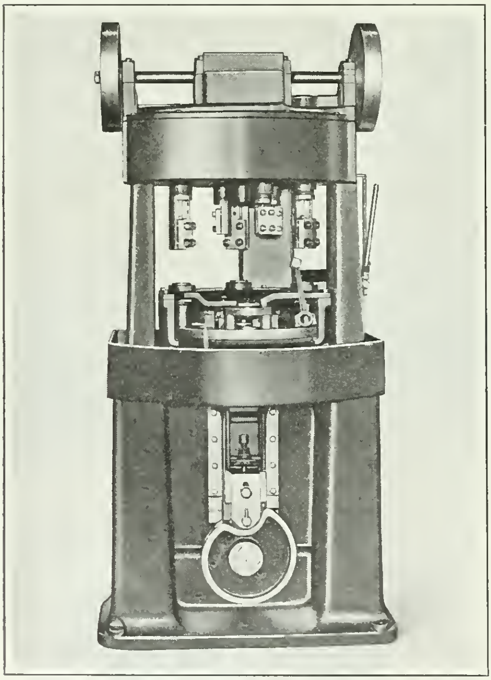


Chicago Steel Angle Shear made by the Dreis & Krump Mfg. Co.

arrangement prevents the work from shifting while being cut. The weight of the machine is 22 pounds; the length of the base, 9 inches; and the height of the frame, 8 inches.

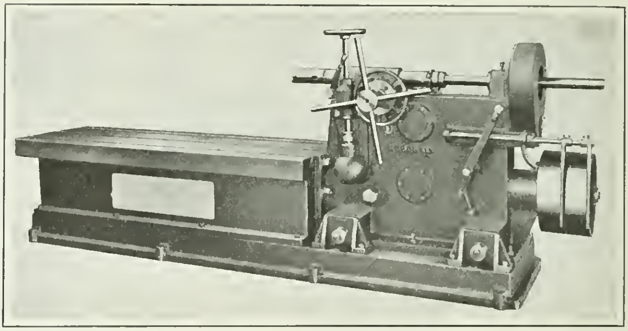
MULTIPLE-SPINDLE VERTICAL BORING MACHINE

A multiple-spindle vertical boring machine on which the spindles rotate but are held stationary vertically while an intermittent revolving work-holding table arranged for station boring is raised and lowered alternately to bring the work up to the cutting tools, has been recently placed on the market by the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. The movement of the table is effected by a cam mechanism on the machine base, the cam permitting a variable feed and a quick return. The arrangement is such that as each successive station of the table reaches a certain position, no tool engages the work held in this station when the table is raised; this permits the piece to be removed and another substituted without stopping the machine.



Multiple-spindle Vertical Boring Machine made by the Manufacturers' Consulting Engineers

The machine is intended for a single purpose only; when it is desired to adapt it for machining different parts, it is necessary to change the head, the rotary table, and the cam. An idea of the capacity of the machine will be gained from the fact that in operating on connecting-rods, the large hole in which is 1⅞ inches in diameter by 1¾ inches long, both the large and small holes are rough- and semi-finish-bored and reamed in 65 seconds. A similar machine rough- and semi-finish-bores and reams a 3¼-inch diameter cylinder, 9 inches deep, in 1½ minutes. When the bottom of this bored hole is finished, one cylinder is completed in 1 minute 42 seconds. With larger machines of this type more than one piece of work can be finished per revolution of the table.



Horizontal Drilling and Boring Machine manufactured by Baker Bros.

BAKER HORIZONTAL DRILLING AND BORING MACHINE

The No. 217-H horizontal drilling and boring machine built by Baker Bros., Toledo, Ohio, which is shown in the accompanying illustration, was developed to meet quantity production needs, being particularly suitable for machining automobile crankcases, large transmission cases, rear-axle housings, etc. Fundamentally, the design of the machine is the same as that of the No. 217 vertical drilling machine manufactured by the same concern, including the annular ball-bearing drive. Practically any desired feed and speed of the spindle can be obtained through the use of change-gears. A vertical adjustment is provided to permit machining castings or forgings of different sizes.

The machine is capable of driving a 2-inch diameter high-speed drill in steel. The principal dimensions are as follows: Maximum height from table to spindle, 16⅛ inches; minimum height, 15⅜ inches; length of table, 75 inches; and length of feed, 16 inches. The weight of this machine is approximately 4750 pounds.

SHEPARD LATHES

The "Sterling" lathe manufactured by the Shepard Lathe Co., Rising Sun, Ind., is now being built with a completely enclosed geared head, and may be equipped for being driven by means of a single pulley countershaft, by a foot-treadle, or by a small electric motor mounted on the headstock and arranged for connection to an ordinary lamp socket without the provision of additional power, wiring, or control. A machine driven by the last-named method is illustrated in Fig. 1. The lathe may be furnished with either a plain or

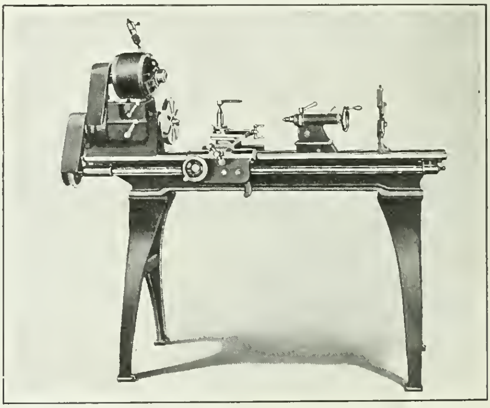


Fig. 1. Lathe built by the Shepard Lathe Co. for Garages, Training Schools, Light Manufacturing Work, etc.

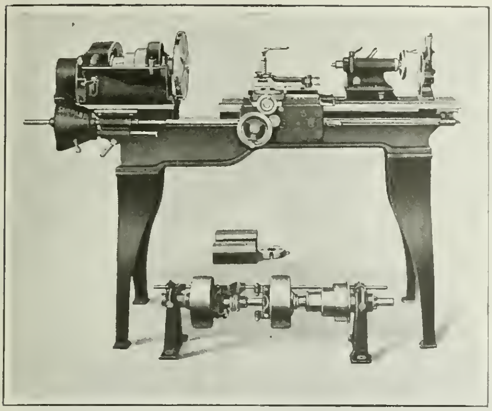


Fig. 2. Twelve-inch "New Shepard" Lathe now built in a Gap-bed Design

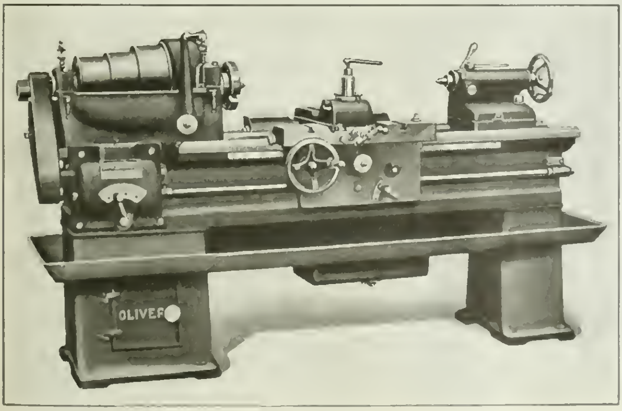
gap bed, and with standard or bench legs. The various types are especially suitable for use in garages, training schools, colleges, and repair shops, and for light manufacturing work.

The 12-inch "New Shepard" lathe made by the same concern is now also being made with a gap bed, as shown in Fig. 2. The swing of this machine is now 19 inches for a distance of 5 inches perpendicular to the front of the faceplate. The bed is designed to make it especially strong beneath the gap. The carriage is so constructed that there is no misalignment when it projects over the gap.

OLIVER 16-INCH RAPID-PRODUCTION LATHE

After having tried out the 16-inch rapid-production lathe here illustrated, in several automobile manufacturing plants, the Oliver Machinery Co., Grand Rapids, Mich., is placing it on the general market. This machine might be considered as a 16-inch heavy-duty engine lathe, except that all parts not of use in the quantity production of work likely to be handled on the machine, have been eliminated. In the illustration the lathe is shown equipped with a three-step cone pulley having large diameters and wide steps, this combination permitting a powerful drive at comparatively high speeds.

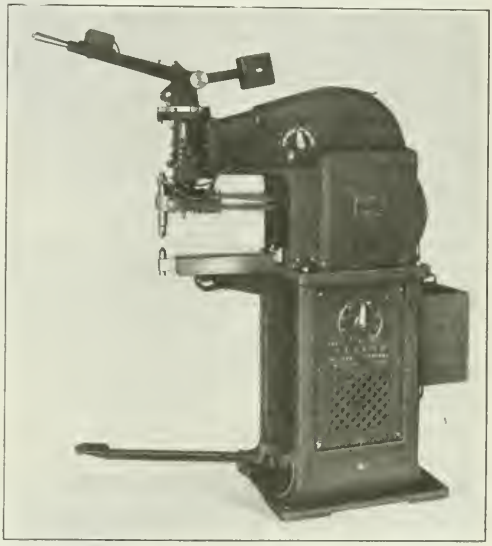
One of the features of the machine which permits a high rate of production is the operation of the starting and stopping clutch through the medium of the lever at the front of the headstock. The lathe may also be furnished with a headstock having double or single back-gears. Four speeds are obtained through the quick-change gear-box. It will be noticed that the toolpost construction on this machine is unusually massive to provide for taking heavy cuts. Provision is also made for supplying a continuous flow of cutting compound to the work.



Rapid-production Lathe built by the Oliver Machinery Co.

TAYLOR SPOT-WELDING MACHINE

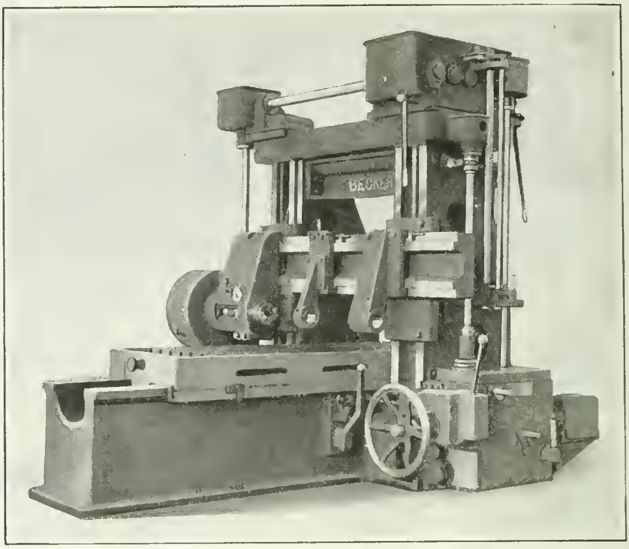
The Taylor Welder Co., Warren, Ohio, has recently introduced the improved type of spot-welding machine here illustrated. One of the new features of this machine is that the head has square slides and steel caps instead of the round spindle construction employed on preceding types. This new design permits any looseness of the parts due to wear to be readily compensated for. The machine may be operated either by the hand-lever at the top, or by means of the foot-treadle. The hand-lever can be swiveled 90 degrees on each side of the center, and locked in any position between these points by means of a screw. It is unnecessary to make any disconnections when changing from hand-lever to foot-treadle operation, the hand-lever remaining in the upper position when the machine is being operated through the use of the foot-treadle. The height of the hand-lever can be changed to suit the operator, and the travel of the lever and that of the foot-treadle can be regulated by means of the lever shown on the right side of the overhanging arm. The foot-treadle may be swiveled to the right or left, and may be removed when not in use. Pressure on the work may be altered by means of an adjusting screw in the center of the upper electrode-holder.



Spot-welding Machine built by the Taylor Welder Co.

Either an automatic or non-automatic switch may be used. When using the automatic switch, the electrodes are brought under spring pressure in contact with the work; then a further movement of the hand-lever or foot-treadle turns on the current and the work is immediately heated to a welding temperature. A further movement of the hand-lever or foot-treadle cuts off the current, causes a positive pressure to be applied to the metal, and completes the welding operation. The non-automatic switch is operated by a button in the end of the hand-lever, the electrodes being brought into contact with the work under positive pressure, permitting the operator to apply heavy pressure before and after the current is turned on and off. Additional pressure may also be applied by means of the foot-treadle. This machine is capable of welding two pieces of sheet steel from 1/64 to 1/4 inch thick or of corresponding gages.

BECKER PLANER-TYPE MILLING MACHINE



Planer-type Milling Machine built by the Becker Milling Machine Co.

A line of planer-type milling machines of the design illustrated is being built by the Becker Milling Machine Co., 677 Cambridge St., Worcester, Mass., in widths ranging from 24 to 48 inches, and in lengths up to 20 feet. These machines are of heavy construction and are driven through a single-pulley gear-box mounted on top of one of the housings. A clutch furnished on the driving pulley for starting and stopping the machine is operated by means of a lever conveniently placed on the operating side. On motor-driven machines, a similar arrangement eliminates the necessity of stopping and starting the motor in order to stop the machine.

Hardened steel gears of the automobile transmission type are furnished, and these run in oil. Speed changes are obtained by operating levers located on the side of the right-hand housing. The drive to the spindle is through a bronze worm-wheel and a steel worm running in oil. The bed and table are of the box type and heavily constructed to insure rigidity. The table is driven by a spiral worm directly connected to the table rack, this worm also running in oil. The milling head has a hand and power traverse on the rail. The rail is counterweighted and is elevated by power, a fine hand adjustment being provided. This type of machine may also be furnished with two vertical milling heads

GLEASON 8-INCH SPIRAL BEVEL GEAR GENERATOR

A new size of spiral bevel gear generating machine manufactured by the Gleason Works, Rochester, N. Y., is shown in the accompanying illustrations. The principle on which this machine operates represents no departure from that of the larger spiral bevel gear generator made by this concern, which was described in the April, 1914, number of Machinery. The older machine has been used principally in the production of automobile rear-axle driving gears. Several improvements in design and some new features have been incorporated in the new generator in order to meet the requirements of fast production on smaller size gears. The machine is particularly adapted for cutting automobile overhead camshaft driving gears, for which there is a constantly increasing demand. It has a capacity for cutting spiral bevel gears up to 10 1/8 inches in pitch diameter for an 8 to 1 ratio, and gears up to 7 1/4 inches in pitch diameter for a 1 to 1 ratio. The largest pitch for which the machine is adapted is limited only by the depth of cut, and corresponds to that of a 4 diametral pitch gear.

Two different sizes of cutter-heads can be used on the machine: A 9-inch diameter cutter with sixteen blades, and a 6-inch diameter cutter having twelve blades. There are six speeds for each size of cutter, ranging from 52 to 200 feet per minute for the 9-inch cutter, and from 35 to 133 feet per minute for the 6-inch cutter. The cutter-spindle *A*, Fig. 2, is driven by the internal gear *B*, which is mounted between the cutter and the front spindle bearing. This construction relieves the spindle of all torsional strains. The spindle bearings are mounted eccentrically in a drum which can also be turned eccentrically in the generating plate *C*, with respect to the

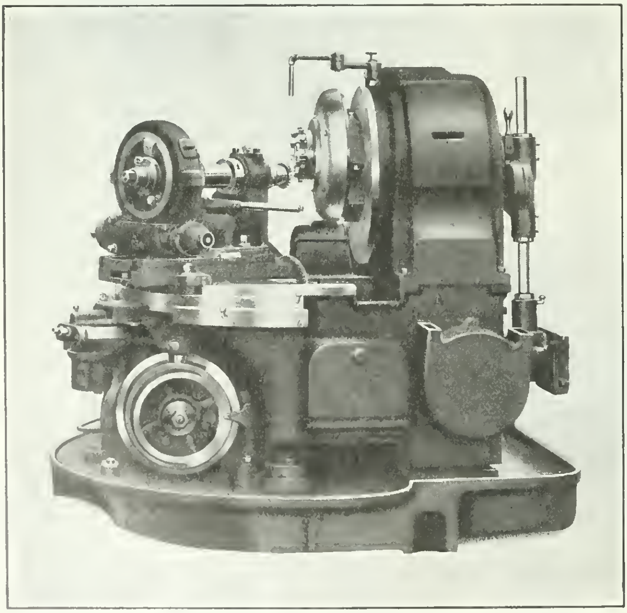


Fig. 1. Eight-inch Spiral Bevel Gear Generator manufactured by the Gleason Works

center of the machine. The different radial settings of the cutter are obtained by turning this drum in the generating plate. A positive stop has been provided for use when changing the cutter setting from the top to the bottom setting of the tooth. This provision eliminates the necessity of reading graduations every time a cutter setting is changed.

The cam which swings the gear blank in and out of contact with the cutter is designed in such a way that the blank is withdrawn slightly from the cutter at the beginning and end of the cutting roll, so that the difference of the backlash in the gear trains connecting the cutter- and the work-rolls with the reversing mechanism does not cause the cutter to cut into the blank at the time that the rolling motions are reversed. By this withdrawal of the gear blank at the beginning and end of the cutting roll, the actual generating roll required is considerably shortened. The speed of the cam varies during one complete cycle. The feed change-gears control the actual cutting time only, while the time consumed in withdrawing the blank from the cutter, in indexing, and in returning the work to the cutting position, is constant and less than five seconds. If the time in which a tooth is actually cut is doubled, then the time it takes for one complete cycle of the feed-cam will be increased only by the increase in the actual cutting time. There are fourteen feed changes on the machine, ranging from 5 to 43 seconds actual cutting time per tooth, or from 10 to 48 seconds total cutting time.

The oil-pan has two sumps, one of a 6-gallon capacity for holding lubricating oil, and another of 8-gallon capacity for cutting oil. The lubricating oil is pumped to a reservoir on top of the cutter-spindle housing, from which it is distributed by gravity to the various bearings to be oiled. This machine is a complete unit, on which gears can be both roughed and finished. However, when a battery of machines is in use, it is the general practice to use this type of machine for finishing only, the gears being first roughed out on a less expensive spiral bevel gear roughing machine. The weight of the machine is 5500 pounds, and the floor space occupied, 48 by 65 inches.

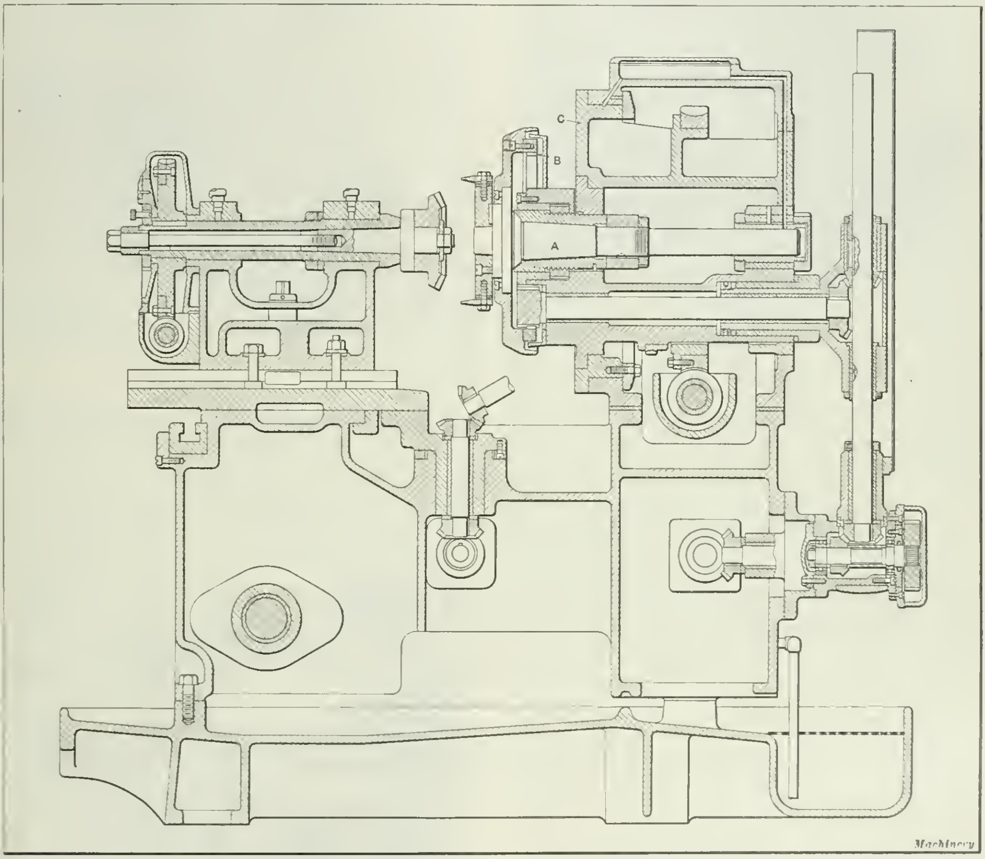
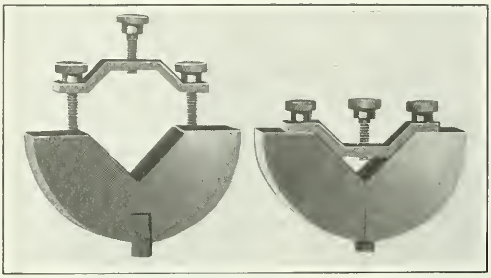


Fig. 2. Cross-sectional View of Gleason Spiral Bevel Gear Generator, showing Manner of Driving

PRECISION GAGE-BLOCK FOR THREAD LEAD VARIATOR

A lathe attachment designed by the Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., for increasing or decreasing the normal lead of the lead-screw and for correcting any error in this lead, was described in the March number of MACHINERY. The accompanying illustration shows a gage-block designed to facilitate the setting of this lead variator. This gage-block is clamped directly on the work, and can be used on work up to 3 inches in diameter. At the left in the illustration the device is shown with the clamping member in position for large-diameter work, while at the right it is shown arranged for work of small diameter.

The projection at the bottom of the gage-block is exactly 1 inch wide. The method of using the gage-block is as follows: A dial indicator is mounted on the toolpost of the lathe, and a reading is taken on the right side of the projection on the under side of the gage-block, the latter being mounted on the work as previously explained. The cross-slide is then operated until the indicator has been withdrawn to clear the gage-block, after which the lathe spindle is revolved as many times as there are threads to the inch on the work. The scribed line seen on the gage-block at the right indicates complete revolutions of the spindle. After the spindle has been revolved as described, a reading is taken by the indicator against the left side of the projection on the gage-block, the dial indicator having traveled exactly 1 inch, provided the lead of the lead-screw is correct, which can be determined by means of the dial indicator. In cases where it is desired to obtain a precise lead, the rack of the variator is tilted up or down as necessary until the dial indicator gives the same reading on both sides of the gage-block projection.



Gage-block used in setting Lead Variator made by the Precision & Thread Grinder Mfg. Co.

BROWN SPRING COUPLING

A flexible spring coupling known as the "Kanti-lever" has been developed by the Brown Engineering Co., 133 N. 3rd St., Reading, Pa., for use as a connection on such equipment as dynamos, motors, steam turbines, lineshafting, and air compressors. This coupling is of all-metal construction and not only corrects angular and parallel misalignment, but also serves as a shock-absorber by transforming suddenly applied loads into gradually applied loads. This function reduces stresses imposed on shafting, gear teeth, keyways, and other details of a power transmission mechanism. The driving action of the coupling is effected by means of twelve laminated springs *A*, Fig. 2, which are held only at the inner ends. By this construction the springs have a freedom of movement, and there is a low fiber stress when the driving member of the coupling revolves and the driven member is rotated by the springs.

Reference to Fig. 2 will show that the arrangement of the springs permits the coupling to be rotated in either direction about its axis. The laminations of a spring unit are each provided with a notch into which the circular retaining ring *B* fits, the latter being held in place by means of screws. When it is necessary to replace one of the spring units, the retaining ring can be withdrawn from the notches after the screws have been removed, and any spring unit can be ejected by tapping with a light hammer.

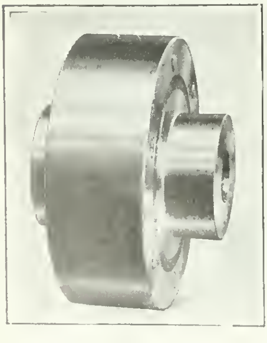


Fig. 1. Brown Flexible Coupling

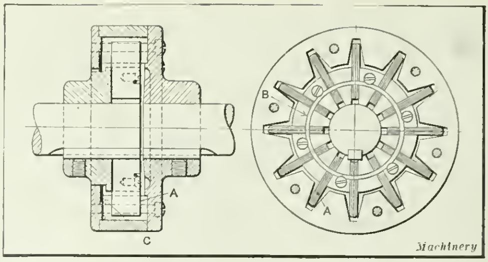
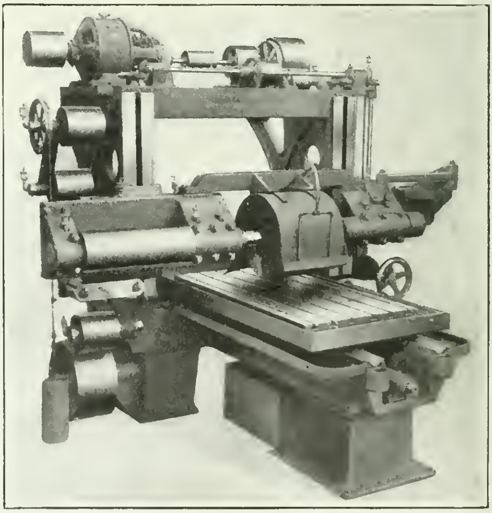


Fig. 2. Cross-sectional View of Brown Flexible Coupling, showing Laminated Driving Springs

The coupling is designed to correct angular misalignment up to 5 degrees. When two shafts are parallel but not absolutely on the same level, the coupling compensates for the error and relieves shafts and bearings from strains caused by such a condition. In instances of this sort, the smaller sizes of the coupling take care of a shaft offset of 1/16 inch, while the larger sizes compensate for an error of 3/16 inch. It will be noted that the coupling is entirely enclosed to permit the members to run constantly in a lubricant. The floating grease ring *C* prevents the lubricant from leaking. The coupling is made in eighteen sizes, the smallest of which is capable of transmitting up to ½ horsepower and may have a bore diameter of 11/16 inch, while the largest transmits 1000 horsepower and may have a bore diameter of 10 inches.

SPRINGFIELD OSCILLATING SURFACE GRINDER

A heavy-duty self-contained motor-driven oscillating surface grinder of new design has been added to the line of products of the Springfield Mfg. Co., Bridgeport, Conn. By reference to the illustration it will be noted that this machine is of heavy and substantial construction. It is provided with two wheels, 20 inches in diameter and 6½ inches wide, mounted on a spindle 3½ inches in diameter. The wheel-spindle is supported in bearings 18 inches long. One of the principal features of this machine is the direct motor drive to the oscillating spindle. This drive is made possible through the provision of a drum pulley on the left end of



Heavy-duty Surface Grinder built by the Springfield Mfg. Co.

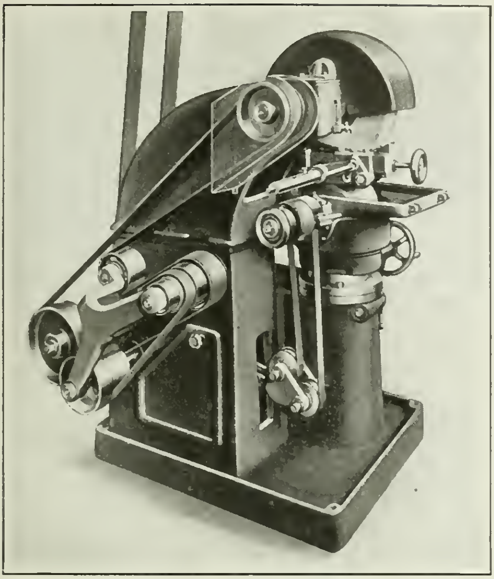


Fig. 1. Heavy-duty Centerless Grinder made by the Detroit Machine Tool Co.

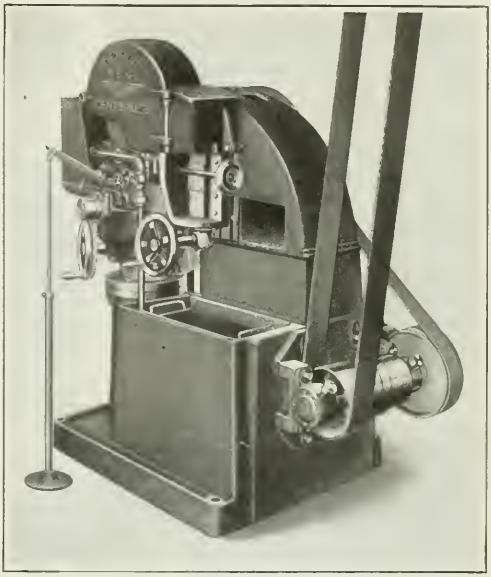


Fig. 2. Operating Side of the Detroit Heavy-duty Centerless Grinding Machine

the spindle, and by preventing the belt from moving sidewise with this pulley as the latter moves to and fro with the spindle. The entire grinding unit is oscillated by means of a crank attached to the right end of the cross-rail. This machine has a capacity for grinding work up to 5 feet in length, 30 inches in width, and 18 inches in height. Work up to 52 inches in width can be passed between the uprights. The weight of the machine is about 15,650 pounds.

DETROIT HEAVY-DUTY CENTERLESS GRINDING MACHINE

A new type of heavy-duty centerless grinding machine has lately been placed on the market by the Detroit Machine Tool Co., 6545 St. Antoine St., Detroit, Mich. A view of the left side of this machine from the front is shown in Fig. 1, while Fig. 2 shows a view of the right side from the rear. On this machine the work is placed between two revolving emery wheels, the lower of which causes the work to be rotated and fed past the upper or grinding wheel. The feeding movement of the work is accomplished by having the driving wheel swung around on the column supporting the wheel housing so that its axis is at an angle to that of the grinding wheel, the result being that the work is moved endwise at the same time that it rotates. This action should be clearly understood by reference to Fig. 3, in which the work is shown being fed between guide blocks. These blocks are adjusted by means of long screws actuated by handwheels. By changing the angle of the wheel from 0 to 6 degrees, the work is moved endwise at speeds ranging from 0 to 100 inches per minute. Thus it is possible to set the wheel at an angle that will cause work to be fed at the same feeds as on standard grinding machines.

Since the work lies on top of the driving wheel, it rotates whether it is being ground or not. If work varies in diameter, only those pieces that exceed the distance between the driving and grinding wheels will be ground. This feature permits an operator, when sizing pieces of cold-rolled steel, to tell at a glance which pieces are under size. The driving

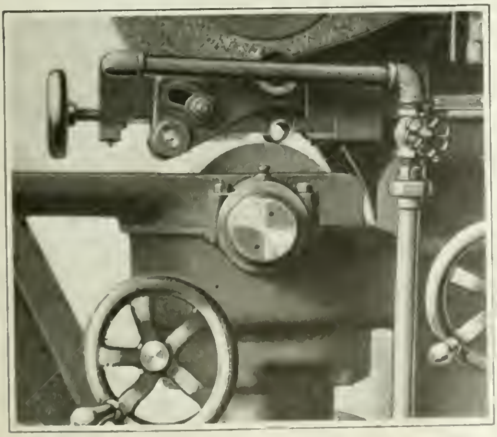


Fig. 3. Work being fed by Driving Wheel through Guide Blocks

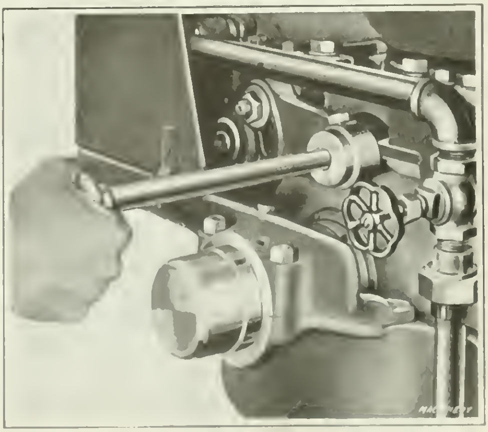


Fig. 4. Method of using the Diamond Wheel-truing Device

wheel is 8 inches wide, while the grinding wheel is only 4 inches wide, this arrangement causing the work to rotate before it comes in contact with the grinding wheel, and to continue to revolve after the grinding operation has been completed, thus being automatically drawn away from the grinding wheel. There is never any danger of one piece being fed faster than the piece ahead of it, a condition which would cause a disturbance resulting in chatter marks.

Work less than 4 inches in length can be fed into the machine by arranging the pieces in a row in the angle-iron feed trough seen in Fig. 2, this trough being set at an angle from the horizontal so that the work slides by gravity to the top of the driving wheel where it is caused to rotate and fed forward. This method of feeding keeps the pieces close together, so that the grinding wheel is constantly working along its entire width. The operator can place a sufficient number of pieces in the trough to give him enough time to inspect completed work coming through the opposite side of the machine. As the grinding wheel becomes worn the lower wheel column can be raised without stopping the feeding or grinding of work. Long pieces of work are fed through the machine one after the other, and when completed they roll through an opening in the frame and return to the operating side of the machine.

The depth of cut possible on this machine varies from 0.0001 to 1/64 inch, depending upon whether the work is soft or hardened. A high-grade finish can be obtained on work by increasing its speed of rotation. Roughing wheels can be placed on the machine and removed in five minutes. A special wheel-truing device with or without a diamond is furnished with each machine. This device is used by inserting it between the guide blocks and drawing it back and forth in the direction indicated in Fig. 4, which shows the hand of the operator holding one end of the device. The grinding wheel is driven by a 4-inch belt from a countershaft at the rear of the machine, while the driving wheel is driven through a small gear-box.

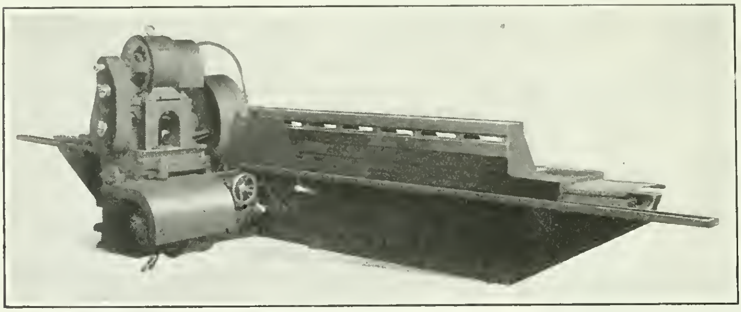
A generous bearing is provided for the grinding wheel spindle, phosphor-bronze boxes of the take-up type being fitted into adapters in the machine frame. Between these boxes is a large reservoir holding four quarts of oil, and in this reservoir are located the nuts that take care of the end thrust and take-up of the bearings. The driving wheel bearings are also phosphor-bronze boxes in cast-iron adapter sleeves of standard design. The spindle of this wheel seldom runs faster than about 50 revolutions per minute except when it is being trued with a diamond, at which time it runs about 1000 revolutions per minute.

A safety feature installed in the cylindrical extension of the lower wheel bearing, which can be seen in Fig. 1, consists of a clutch that is operated by pulling a handwheel endwise. An outward motion will cause the wheel to revolve at the proper work-rotating speed, while an extreme inward push will disengage a back-gear. The wheel will then rotate at a high speed for wheel-truing purposes. If work too large in diameter is presented to the machine by mistake, the moment the operator notices the heavy cut being taken he can push the handwheel toward the wheel and cause the latter to stop revolving instantly.

In grinding piston-pins 1¼ inches in diameter and 4 inches long, 180 pieces were finished per hour. On another operation consisting of sizing cold-rolled steel pins ⅜ inch in diameter by ⅞ inch long, 5140 pieces were ground per hour. It is stated that scratches or flat surfaces are not produced on the work while it is being ground, because it is constantly rotating. The capacity of the machine is for work from ¼ to 3 inches in diameter, and from ¼ to 16 inches in length. Brass rod and tubing have been ground in lengths up to 3 feet, supports being employed to hold the work in alignment.

SPRINGFIELD SHEAR BLADE AND FACE GRINDER

The heavy-duty reversing motor grinding machine illustrated is a recent development of the Springfield Mfg. Co., Bridgeport, Conn., and may be used for shear blade and face grinding operations. This machine is entirely self-contained being operated by three motors, one of 15 horsepower for driving the grinding wheel, another variable-speed 5-horsepower reversing motor for driving the table traversing mechanism, and a ½-horsepower motor for driving the pump. The variable-speed motor moves the table at different speeds ranging from 7 to 27 feet per minute, while the reversing feature of the motor dispenses with all belting. The operation of the machine is controlled by mechanical means from either the front or rear, and a push-button is provided for controlling the motors. This machine can also be furnished with a swivel knife-bar for grinding large paper and veneer knives, and by removing the work-holding angle-bar shown on the table it can be used for all kinds of face grinding operations within its capacity.

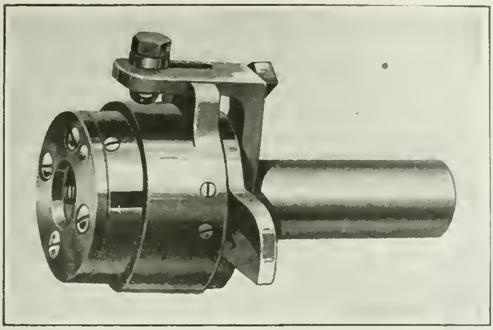


Shear Blade and Face Grinder with Reversing Motor, made by the Springfield Mfg. Co.

In the construction of this machine a modern design of bearing known as the "sleeve flange" type has been introduced. The bearings fit into bored holes and are bolted in place by means of flanges. These flanges are bronze-bushed, and can easily be replaced in case of wear without disturbing the original alignment. The machine as shown is arranged for wet grinding, and ample provision has been made to take care of spray and drainage. The wheel-head can be swiveled by means of a rack and pinion seen at the rear of the machine in the illustration, so as to permit the grinding of concave surfaces when desired. The machine has a grinding wheel 24 inches in diameter, and has a capacity for work up to 12 feet in length; however, it is also made in various lengths from 6 to 17 feet. The weight of the 12-foot machine is approximately 14,750 pounds.

EASTERN SELF-OPENING DIE-HEAD

The Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn., has recently made an improvement on the H & G self-opening die-head for use on Brown & Sharpe automatic screw machines. The illustration will suffice to show that changes have been made in the driving method and in the design of the trip-lever. On the previous type, the head was kept from turning in the floating shank by means of a pin through the shank proper engaging and

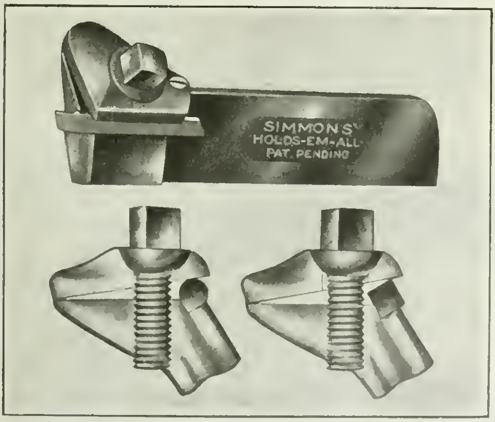


Improved Type of H & G Die-head made by the Eastern Machine Screw Corporation

traveling in diametrically opposite slots in the floating shank. As redesigned, the same result is obtained by an extension on the shell of the head which engages both sides of the arm of the floating shank that overhangs the body. This construction brings the drive farther from the axis of the die-head and decreases the friction to a negligible quantity, so that even a part to have the coarsest pitch that a machine will pull may be threaded without friction or cramp in the die-head. The design of the trip-lever has been changed to make the lever sensitive to the finest of threads up to about 90 per inch. It is a simple matter to install this head on any Brown & Sharpe automatic screw machine, practically no change being necessary.

SIMMONS TOOL-HOLDER

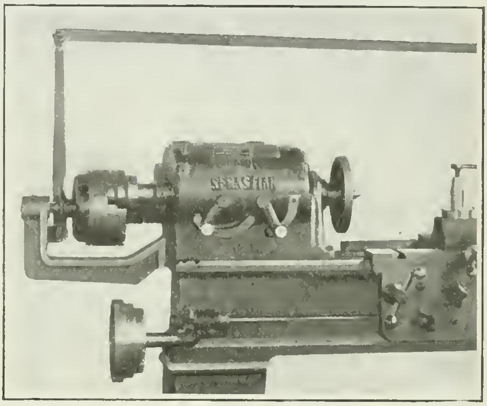
A new type of tool-holder known as the "Holds-em-all," which permits the use of very short bits, has recently been designed by the Simmons Economy Tool Corporation, 981 Broadway, Albany, N. Y., and is shown in the accompanying illustration. The holder is provided with a long shank, the front end of which is so constructed that a clamping member secures tool bits or the shanks of other tools, on a shoulder of the holder. The manner in which this clamp functions will be apparent by reference to the two views shown in the lower portion of the illustration, where a tool of circular cross-section is mounted in the holder at the left while one of square cross-section is secured in the holder at the right. Several sizes of bits may be used in each tool holder, as well as tools with straight or taper shanks, their rigidity being assured and chatter eliminated by the oscillating movement of the clamp on the binding screw and a supplementary screw which may be turned down by hand. The lower lip of the tool-holder is so constructed that the cutting edge of a bit is well supported. It will be obvious that this holder may be used in connection with taps, reamers, drills, countersinks, etc.



Tool-holder made by the Simmons Economy Tool Corporation

SEBASTIAN PLAIN TURNING LATHE

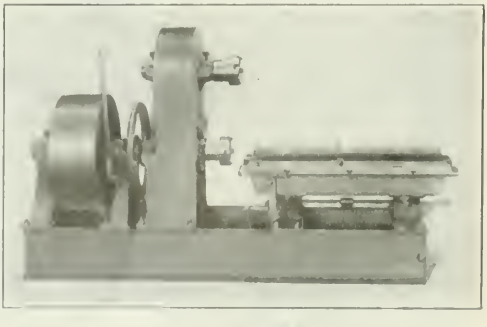
The Sebastian Lathe Co., Cincinnati, Ohio, is placing a machine on the market which is of the same design and specifications as the 13- and 15-inch types of geared-head lathe that were described in the September, 1917, number of MACHINERY, except that the lead-screw mechanism has been omitted and the driving arrangement altered. The machine as it is now designed is intended for plain turning operations only. The accompanying illustration shows the head end of the reconstructed lathe. The machine is driven by a 3-inch belt which may be connected directly to a line-shaft, because a countershaft is unnecessary due to the provision of a friction-clutch driving pulley. The clutch is operated by means of the overhead shifting device. In a test, a cut ⅝ inch deep in steel was taken with a 1/32 inch feed per revolution of the spindle. The new lathe is furnished with beds 4½, 5 or 6 feet in length



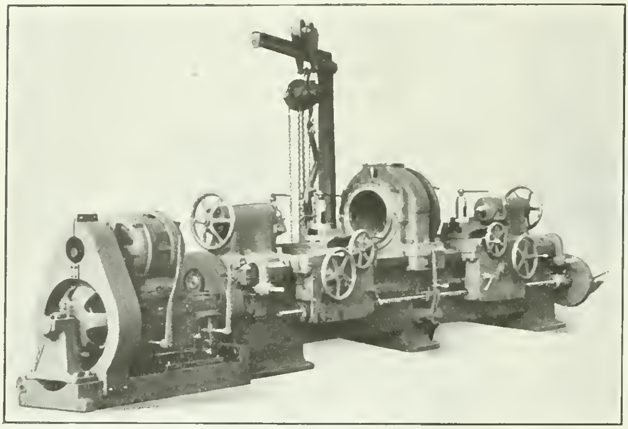
Head End of Plain Turning Lathe made by the Sebastian Lathe Co.

CANEDY-OTTO UNIVERSAL "BURNING IN" MACHINE

A machine intended for automobile manufacturing establishments and repair shops which has recently been developed by the Canedy-Otto Mfg. Co., Chicago Heights, Ill., is the "burning in" or "running in" machine shown in the



Machine designed by the Canedy-Otto Mfg. Co. for "burning in" the Bearings of Automobile Engines



Heavy-duty Double Axle Lathe which is a Recent Development of the Putnam Machine Works of Manning, Maxwell & Moore, Inc.

accompanying illustration. This equipment is intended for "burning in" or "wearing in" new bearings placed in any type of automobile engine. The table of the machine may be raised and lowered to suit conditions, and is provided with clamps which may be adjusted to suit any engine. The table also serves as a sump or crankcase for the engine so that a crankshaft may splash in fresh oil. A 20-horsepower motor is sufficient to run the machine under the most severe conditions.

PUTNAM HEAVY-DUTY AXLE LATHE

The Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., have recently placed on the market the heavy-duty double axle lathe here illustrated. An axle placed on this machine is supported at each end by the center of a tailstock, and is driven at the middle by means of a special driving head having a drum with an opening 16 inches in diameter through which an axle can be passed. This drum is driven by a set of broad-faced herringbone gears, the pinion running in oil so that constant lubrication is afforded. Rotation is imparted to an axle by means of a double-tailed steel dog which bears against lugs on an equalizing plate. The driving head is clamped to the bed by means of six bolts.

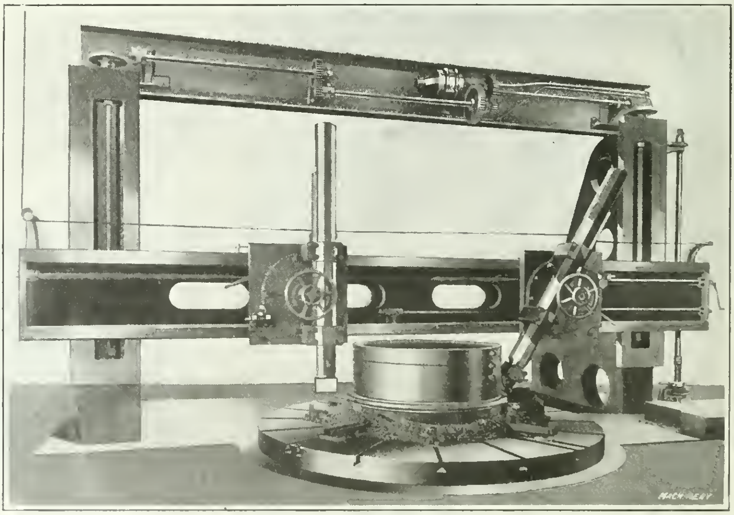
The two carriages are guided by large vees at the front and rear of the bed, and an additional flat bearing is provided directly beneath the toolpost. This construction furnishes a rigid support for the tools and reduces the span of the carriage bridge between the ways, eliminating distortion and binding of the carriage. The aprons are of double-wall construction and furnish support for shafts at both ends. The apron feeds are transmitted through worm and worm-wheel drives, each worm receiving its power from a shaft in the front of the bed. The feed is thrown in and out of engagement by a lever which operates a positive jaw clutch, and an automatic stop disengages the feeds at predetermined points. The feed change-gears are located at the right-hand end of the bed, and instantaneous feed changes are accomplished by operating a lever conveniently located at the center.

Both tailstocks are adjusted along the bed by means of racks and pinions, and permanent alignment of the spindles is maintained by means of tapered gibs. Pawls attached to the tailstocks engage racks on the bed and prevent slippage under heavy cuts. A one-man crane equipped with a one-ton quick-acting hoist can be furnished for placing axles on or removing them from the machine. Cutting lubricant is supplied to the tools by means of a centrifugal pump, which draws lubricant from a tank at the back of the bed. This machine can be furnished with any one of the four following types of drives: Single-pulley belt drive, four-step cone-pulley belt drive, constant-speed motor drive, and variable-speed motor drive.

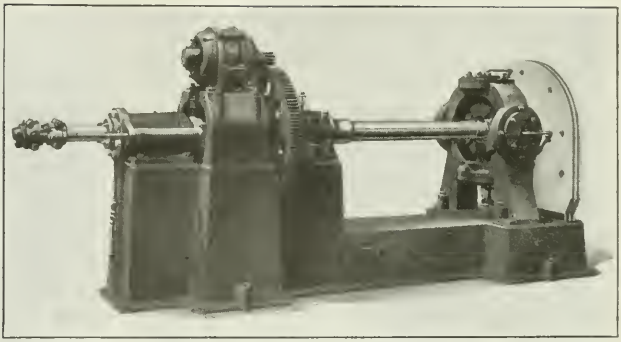
PULASKI VERTICAL BORING AND TURNING MILL

The Pulaski Foundry & Mfg. Corporation, 2422 Euclid Ave., Cleveland, Ohio, has placed on the market a new vertical boring and turning mill of the type illustrated. This machine is made in four sizes with swing ranging from 16 to 22 feet. The machine will be of special interest to jobbing and repair shops, shipyards, and large foundries handling roughly machined castings. The 20-foot size shown has an actual swing of 20 feet 4 inches, and has been in operation for a period of one year. The table is set just above the floor level with the base and spindle housing in a pit below the floor, but the machine may be set at a higher level if desired. The table is driven through an external gear of large diameter, the table spindle running in upper and lower bearings of liberal size, which are adjustable for wear. The table on the machine illustrated is 12 feet in diameter and can be provided with extension arms to carry extra large work. However, a larger table can also be furnished.

The boring-bars are carried by heavy saddles, and can be tilted up to an angle of 90 degrees in one direction and to



Vertical Boring and Turning Mill built by the Pulaski Foundry & Mfg. Corporation an angle of 45 degrees in the opposite direction. Adjustable feeds from 0 to ¾ inch per revolution of the table are continuous and independent for each head. Vertical, cross, and angular feeds may be secured. Nine table speeds are available with a constant-speed driving motor. These speeds will usually meet all ordinary requirements, but should additional speeds be necessary, they may be obtained by using a variable-speed motor. The cross-rail is elevated and lowered by a separate 10-horsepower motor mounted on the housing brace, the power being transmitted through a train of gears to two elevating screws in the housings, carried on ball bearings. The maximum height under the tool-holders of all machines is 9 feet 3 inches, while the maximum height under the cross-rail is 10 feet. The minimum table speed obtainable is approximately 0.3 revolution per minute, while the maximum speed is about 8 revolutions per minute. Each machine is driven by a 40-horsepower motor.


Improved Type of Flue Welder built by the Southwark Foundry & Machine Co.

SOUTHWARK UNIVERSAL FLUE WELDER

An improved type of flue welder, built to meet the requirements of railroad shops, has lately been developed by the Southwark Foundry & Machine Co., Philadelphia, Pa., and is shown in the accompanying illustration. This machine embodies features essential to meet conditions that have arisen since the general adoption of the locomotive superheater. The principal feature of the machine is that it welds a flue on the inside, thus making the inside diameter of the flue at the weld the same as throughout the entire length. This method of welding is made possible by clamping the flue on the outside by four jaws or sections of a die, and rolling it with an expanding and collapsible mandrel.

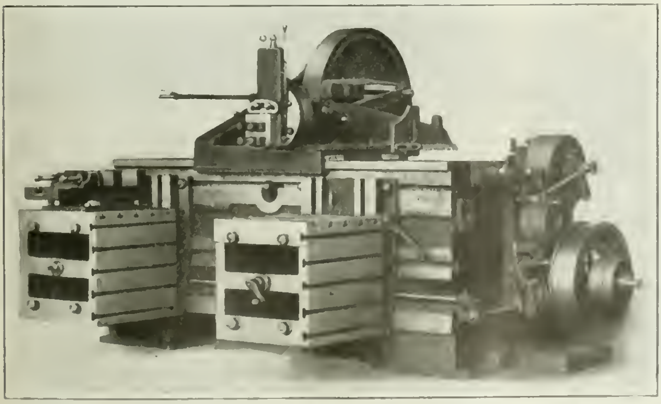
The clamping head of the machine is at the front, and the driving mechanism at the rear. Four air cylinders are mounted in the clamping head in such a manner that the cylinder heads can be removed from the outside. The pistons are fitted with metal snap rings, and the front end of each piston-rod is equipped with a clamping jaw or die section. A welding mandrel which fits the inside of the flue runs through the center of the head longitudinally with the machine. The body of this mandrel is hollow and contains three tapered rollers which can be moved radially by inserting a tapered arbor that reaches through the middle of the spindle from the rear of the machine. This arbor is operated by an air cylinder controlled by means of a foot-valve. A triple baffle of asbestos pressed board is furnished for deflecting the heat of the furnace from the welding head

As the four clamping cylinders are connected to a single air line, they operate simultaneously with the opening of a single foot-valve, which controls all operations. This valve is usually placed in front of the furnace and on the left-hand side of the machine. The timing of different operations is controlled by the piping to this foot-valve, which is so arranged that the clamping head first comes in contact with the outside of the flues, then the clutch which rotates the mandrel is engaged and, finally, the expanding arbor is forced between the three rotating rolls in the mandrel, these rolls working the weld out against the clamping dies which also serve as an anvil. The time required for the actual rolling of a weld is from six to eight seconds. The total time for making a weld depends, of course, upon a number of factors, such as, for example, the size of the flue.

PUTNAM TRAVERSING-HEAD SHAPER

A 26-inch traversing-head shaper suitable for application in machine shops to general operations of the class for which this type of machine is generally employed, but intended particularly for railroad shops to be used in machining driving-boxes, shoes, wedges and driving-box crown bearings, has recently been added to the line of machine tools made by the Putnam Machine Works of Manning, Maxwell and Moore, Inc., of Fitchburg, Mass. The head of this machine is traversed across the bed by means of a large screw provided with a ratchet at the right end for engaging, disengaging, or reversing the various feeds which range from 0.01 to 0.17 inch. This head has a liberal bearing surface on the bed and is gibbed to compensate for wear. A nut in the head provides a ready means of disengaging the feed-screw when it is desired to traverse the head quickly along the bed by hand, through the employment of a handle on the end of the screw.

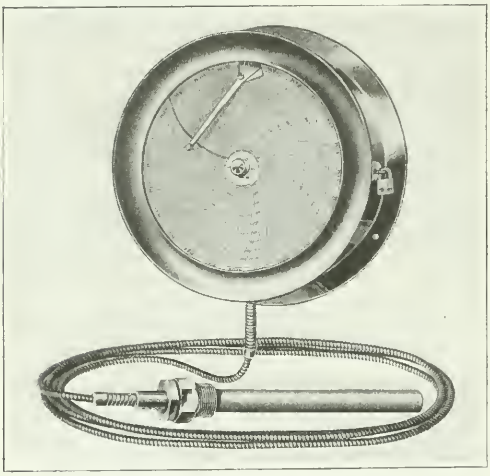
The ram is operated by a type of quick return mechanism which practically insures a uniform cutting speed. Facilities are provided for quickly and conveniently setting the ram to any desired stroke or position. The tables are mounted on individual saddles, and may be adjusted vertically by rotating screws mounted on ball bearings. Longitudinal adjustments of the table are accomplished by ratchet handles attached to the saddles. A circular attachment may be supplied with this shaper. The machine may be driven by belt or constant-speed motor, being so arranged that the speed changes are


Traversing-head Shaper made by the Putnam Machine Works of Manning, Maxwell & Moore, Inc

obtained through a selective-type gear-box. When furnished with beds 14 feet in length or longer, the machine is generally constructed double, the two heads being driven independently by separate motors.

BROWN RECORDING THERMOMETER

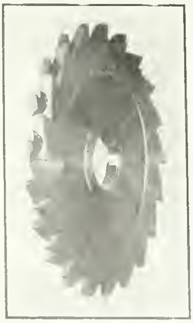
A recording thermometer for measuring the temperature of quenching and oil-tempering baths, etc., has lately been developed by the Brown Instrument Co., 4510 Wayne Ave., Philadelphia, Pa. The inverted pen arm on this instrument is adjustable by means of set-screws, and the pen is lifted automatically when the door of the case is opened. Patented clips automatically lock the chart when the door is closed. A Seth Thomas eight-day clock movement is attached to a front plate and can readily be removed when cleaning is necessary. The various charts carried as standard equipment range from those suitable for indicating temperatures of minus 40 degrees F. up to those for indicating temperatures of 1000 degrees F. Every instrument is furnished with a moisture-proof case.



Recording Thermometer made by the Brown Instrument Co.

BRIDGEPORT HERRINGBONE MILLING CUTTERS

A new line of general-purpose herringbone milling cutters has been placed on the market by the Bridgeport Cutter Works, Inc., 50 Remer St., Bridgeport, Conn. Each complete cutter consists of two opposite-angle spiral cutters fastened together with the teeth spaced alternately, the teeth overlapping slightly at the joint. A slight recess is provided opposite the inner cutting edge of each section to furnish adequate chip clearance. The angle of the cutting edges is about 20 degrees, and is usually slightly under-cut. The number of teeth on a cutter corresponds to general practice, and these teeth are made in either the standard or coarse type. The cutters are made in all standard sizes in widths up to 1½ inches. It is stated that this form of cutter makes it possible to take cuts at unusually high speeds and depths.



Milling Cutter made by the Bridgeport Cutter Works

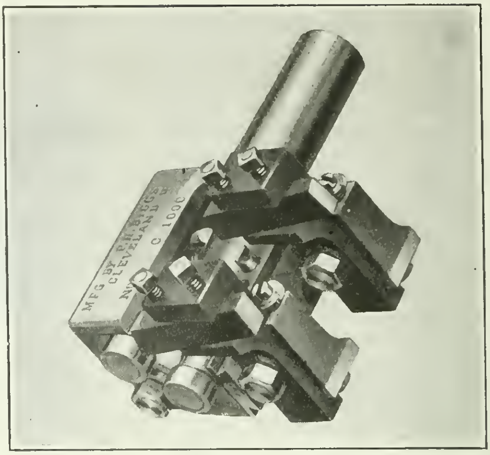


Fig. 1. Tangent-cut Box-tool made by the P. H. Biggs Machine Co.

BIGGS TANGENT-CUT BOX-TOOLS

Two styles of tangent-cut box-tools intended for high-speed production of screw products and other turned parts machined on automatic and hand screw machines and turret lathes have recently been placed on the market by the P. H. Biggs Machine Co., 1235-1237 W. 9th St., Cleveland, Ohio. These tools are made entirely of steel, and each component part is hardened. The style shown in Fig. 1 is intended for machining work of more than one diameter, while that shown in Fig. 2 is designed for turning work of a single diameter. Both styles can be furnished in right- and left-hand types. The cutting tools may be removed, sharpened, and replaced without disturbing the original adjustments, and the carriers of the box-tool shown in Fig. 1 are identical and interchangeable. The shank of each tool is hollow. The two styles are made in a number of sizes, and repair parts are carried in stock.

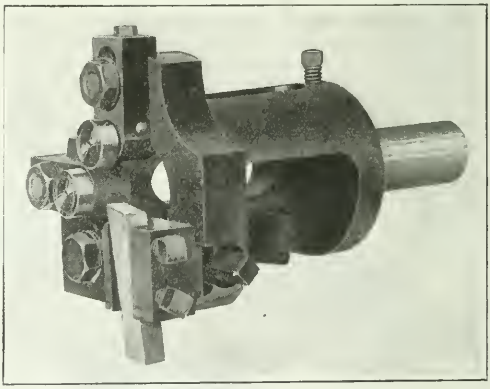
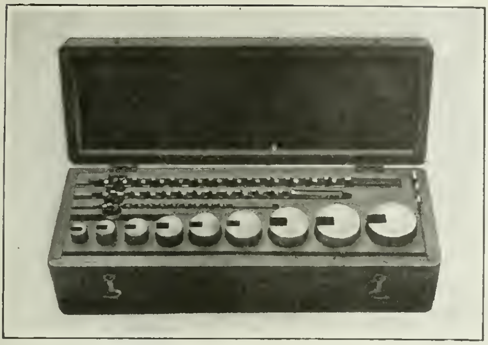


Fig. 2. Box-tool for machining Work of a Single Diameter

VELCO KEYWAY BROACHING SET

A keyway broaching set designated as the "Broach-well," which will be of especial interest to repair men and millwrights in garages and other shops where keyways are cut but where the amount of work does not warrant the purchase of a broaching machine, is shown in the illustration. This set of broaches has just been placed on the market by the Velco Mfg. Co., Inc., Greenfield, Mass. The tools are grouped in convenient sizes, permitting a wide range of

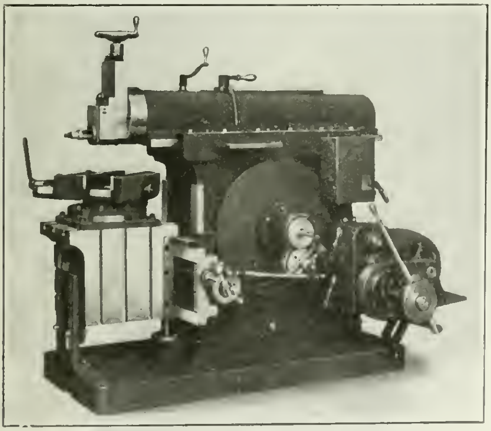


Handy Set of Keyway Broaches made by the Velco Mfg. Co., Inc.

keyways to be cut; and by the use of extra broaches which can be furnished, keyways of special shapes, such as dovetail and half round, may also be broached. The broaches are made of tool steel and have patented teeth. They are guided in an accurately sized bushing which adapts a broach to the desired depth of keyway. The method of using a broach in cutting a keyway is to place a bushing beneath an arbor press and force the broach through the work in exactly the same manner that an arbor would be removed from another part. Should more than one keyway be required in a piece, it is only necessary to turn the piece to the required angle on the bushing and repeat the operation.

HOLLINGWORTH HEAVY-DUTY SHAPER

A recent product of the Hollingworth Machine Tool Co., Covington, Ky., is the heavy-duty shaper here illustrated,

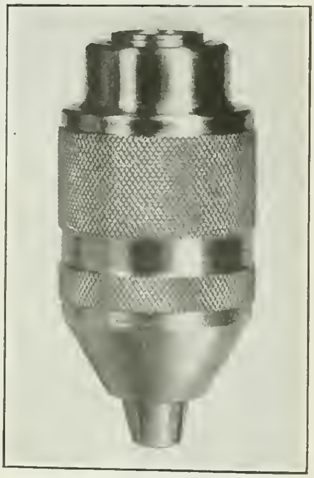


Heavy-duty Shaper made by the Hollingworth Machine Tool Co.

which is made in seven sizes ranging from 12 to 28 inches the illustration showing a 28-inch size. During the designing stage endeavors were made to produce an especially rigid and accurate machine. For this reason it has been provided with taper gibs throughout and a number of graduated dials. The harp and vise swivels are provided with graduations to facilitate accurate settings of these units The crank for operating the feeding mechanism is also furnished with graduations so that a predetermined feed can be instantly obtained. Feeding movements are reversed instantly by means of a plunger on the feed gearing The length of stroke can be set accurately by means of a graduated scale on the column, and the ram is quickly positioned through miter gears and a screw All the main bearings are bronze-bushed, and can be easily removed for replacement, while the driving gears are made of semi-steel, and the pinions of hammered steel.

KNEBEL SELF-TIGHTENING DRILL CHUCK

The Knebel Mfg. Co., Inc., 352 N. Burritt St., New Britain, Conn., is making the self-tightening drill chuck shown in the accompanying illustration, in which the jaws are driven through toggles, it being claimed that by the employment of this principle an unusually efficient drive is obtained. The thrusts on the chuck are absorbed by two sets of hardened steel balls, so located as to permit the easy removal of a drill. It is unnecessary to provide flats on a drill shank in order to prevent slippage when drilling a part, as the chuck will hold a drill securely without this provision. This chuck has a capacity for drills ranging from No. 60 to 17/32 inch in diameter. The greater the resistance met by the drill, the tighter the chuck grips, but it can be released by one hand.



Self-tightening Drill Chuck placed on the Market by the Knebel Mfg. Co., Inc.

TITAN QUICK-CHANGE COLLET CHUCKS AND SOCKETS

Improvements have been made in the design of the quick-change drill chucks and sockets made by the Titan Tool Co., 26th and Holland Sts., Erie, Pa., which were described in the May and July, 1920, numbers of MACHINERY. The improved types are shown in Figs. 1 and 2. The principal additional feature in the straight-shank drill chuck and socket shown in Fig. 1 is that the spring which actuates the sliding sleeve when the hand of the operator is released is now entirely enclosed. In the tapered-shank drill chuck and socket shown in Fig. 2, it will be seen that the tang of the drill extends through a slot in the closed end of the collet.

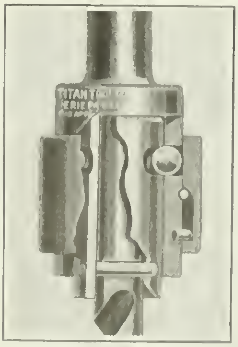


Fig. 1. Quick-change Drill Chuck and Socket made by the Titan Tool Co.

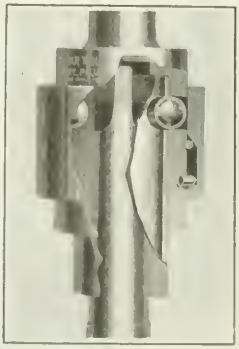
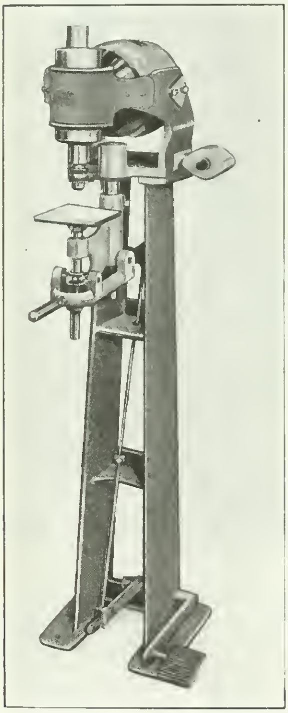


Fig. 2. Taper-shank Quick-change Drill Chuck and Socket

This construction permits easy removal of a drill from the collet by tapping the end of the tang. These chucks and sockets are equally adaptable to single-spindle and multiple-spindle drilling machines. They are made in two sizes, the smaller having a capacity for drills up to 5/16 inch in diameter, and the larger having a capacity for drills up to ½ inch in diameter.

ANDERSON VERTICAL TAPPING MACHINE

The Anderson Die Machine Co., Bridgeport, Conn., has recently developed a sensitive vertical tapping machine which is made in three styles, one of which is here illustrated. The other two styles are bench types, one being arranged so that the table is approximately on the level with the top of the bench, while the other is mounted on a short pedestal to bring the entire table mechanism above the bench level. The work is placed on the table or in a special fixture, and brought by means of either the hand or foot mechanism in contact with the tap carried in the chuck. The machine has an independent motor drive so that belt troubles are eliminated. The motor can be operated from an ordinary lamp socket. An advantage of this machine is that it can be moved from department to department easily. The size of the table is 4 by 4 inches, and its maximum adjustment, 6 inches. The machine has a capacity for tapping threads up to No. 6-32 in any material, and up to No. 10-32 in brass.

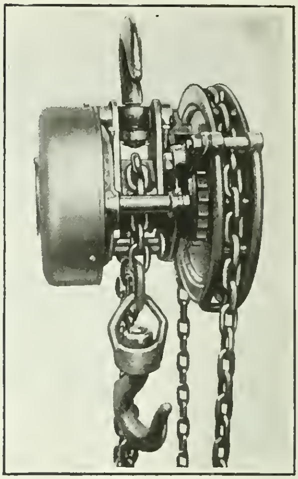


Sensitive Vertical Tapping Machine which is a Recent Product of the Anderson Die Machine Co.

G. B. SPUR-GEARED CHAIN BLOCK

André Weill & Co., Inc., 149 Broadway, New York City, have just been appointed exclusive agents in the United States and Canada by the Etablissements Beccat, Paris, France, for the sale of G. B. chain blocks manufactured by the latter. The New York concern now has in stock a line of the G. B. spur-geared chain blocks of the type illustrated, which are made in various sizes having capacities up to 20 tons. This chain block is provided with electrically welded chains, and the internal gear is a finished steel forging. In blocks up to 1-ton capacity, the driving pinion and load-sheave axle are a single drop-forging. On blocks of greater capacity the pinion and axle are two separate parts, but are assembled in such a manner that for power transmission purposes, the two parts serve as an integral piece.

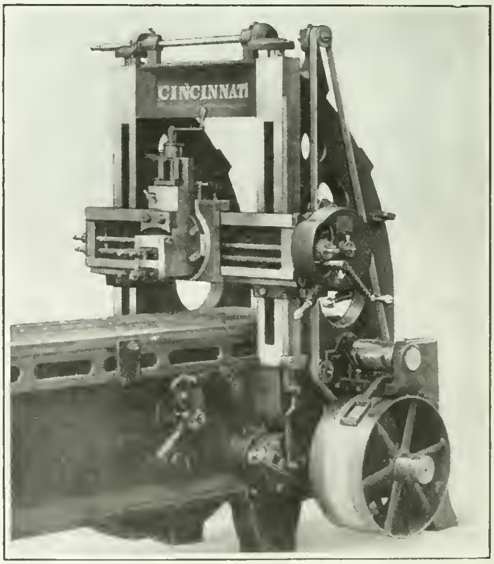
The load sheave is a steel drop-forging, machined carefully so that the chain links fit the corresponding depressions on the sheave without play, thus reducing wear to a minimum. The chain guides are hinged in order that the chain may be pulled from any angle without difficulty. It is claimed that by the exclusive employment of steel spur gears correctly cut, efficiencies of from 80 to 88 per cent are secured, and that the gear ratios are so calculated that the maximum lift speed is obtained with a minimum chain pull. Power is transmitted through the block by a planetary system of gearing. All gears are enclosed to protect them against injury from knocks, dirt, or weather. Each chain block is tested before leaving the factory at an overload of at least 50 per cent.



Chain Block for which Andre Weill & Co., Inc., are Sales Agents

CINCINNATI PLANER POWER TRAVERSE

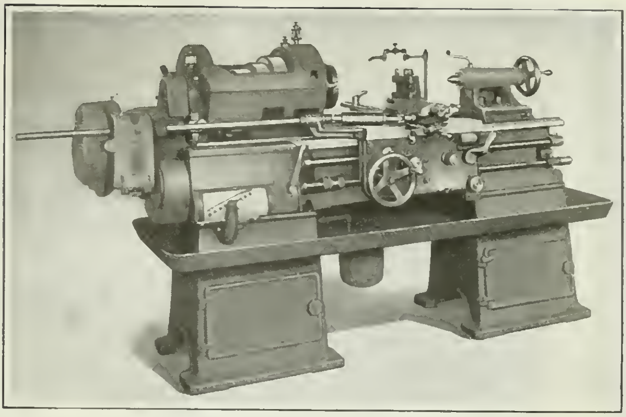
The Cincinnati Planer Co., Cincinnati, Ohio, has included a rapid power traversing mechanism on its 24- by 24-inch heavy-pattern planer. The work performed on machines of this size is usually small and the cuts are of short duration, a condition which necessitates frequent moving of the heads and changing of the tools. By means of the power traversing mechanism, which is shown in the accompanying illustration, constant winding of the crank handle is eliminated. The rapid power traverse can be engaged instantly, and when in operation the crank handle at the end of the traversing screw does not revolve. The new feature is provided on planers having either one or two heads on the cross-rail, and in the latter case, either head can be moved independently of the other or both can be moved simultaneously in either direction. All gearing is enclosed.



Rapid Power Traverse on Planer built by the Cincinnati Planer Co.

REED-PRENTICE CONE-HEAD LATHE

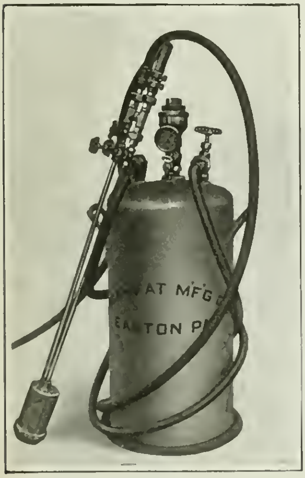
A description of the 14-inch geared-head lathe manufactured by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass., appeared in the February, 1920, number of MACHINERY. A machine of the same type but provided with a four-step cone pulley and a relieving attachment is shown in the accompanying illustration. This relieving attachment, however, is only furnished as special equipment. The swing over the ways of this machine is 16½ inches; the distance between centers on a 6-foot bed, 37 inches; the number of thread changes, 44; and the range of feeds, 0.0045 to 0.0667 inch. The weight of the machine equipped with a 6-foot bed and a compound rest is about 2850 pounds.



Fourteen-inch Cone-head Lathe built by the Reed-Prentice Co.

McKNEAT OIL-BURNING EQUIPMENT

The McKneat Mfg. Co., Easton, Pa., has recently placed on the market the oil-burning equipment here illustrated, which will be found especially useful in machine and repair shops for heating pulleys, wheels, etc., in order to expand them so that they may be placed on shafts on which they are to have a shrink fit, or to remove them from such shafts; in melting babbitt from bearings; in straightening bent shafts or girders; in case-hardening, tempering, and annealing parts; and in many other similar operations. The equipment is made for using crude or fuel oil or kerosene when compressed air is available and for using kerosene when compressed air is not available. The head of the burner tip is removable to facilitate replacement as it becomes worn.



Oil-burning Equipment made by the McKneat Mfg. Co.

NEW MACHINERY AND TOOLS NOTES

Combination Wall and Portable Drill: Black & Decker Mfg. Co., Baltimore, Md. A wall or post device designed to take the ⅜-, ½-, 9/16-, ⅝- and ⅞-inch sizes of the portable electric drill manufactured by this concern. The drill can be detached for portable work and may be readily remounted afterward.

Adjustable Boring-bar: Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. An adjustable boring-bar which can be furnished with any desired size or shape of shank, and which is made in various sizes to bore holes from 1½ to 9 inches in diameter. The position of the cutters is adjustable by means of a micrometer screw. After an adjustment, the cutters are locked in place by a wedge.

Drilling Machine Chuck: John Chuck Co., Milwaukee, Wis. A device intended for holding work while performing such operations as drilling, reaming, spot-facing, milling centering, grinding, and tapping. This chuck is used chiefly on the tables of drilling machines. It is equipped with jaws made to conform to the work, which can be readily replaced to suit various shapes. The jaws are operated simultaneously by a right- and left-hand screw.

Tapping Chuck: John Chuck Co., Milwaukee, Wis. A reversing tapping chuck in which a tap is driven equally on each side of the shank. The chuck is equipped with a five-point positive and sensitive clutch, and it is stated that this clutch will disengage within a limit of 0.001 inch when the tap reaches a predetermined depth. The device may be used on any drilling machine without the necessity of providing a special counterweight on the machine spindle.

Combination Milling and Grinding Attachment: A. F. Robbins Co., 85 Moody St., Waltham, Mass. A combination adjustable milling and grinding attachment for bench and other small lathes, which permits the performance of milling and grinding operations without requiring the removal of work from the faceplate or the spindle. The base of this attachment is secured to the tool-block of the lathe, and the remainder of the device swivels upon a central stud on the base.

Radial Drilling Machine: Crescent Tool Co., Second and Elm Sts., Cincinnati, Ohio. A 2½-foot sensitive radial drilling machine intended for heavy-duty work. This machine is entirely gear-driven and furnished in two styles. One style is equipped with a hand feed only, but the other, in addition to the hand feed, has two changes of power feed and a quick-return motion. A variable-speed gear-box provides six spindle speeds in geometrical progression

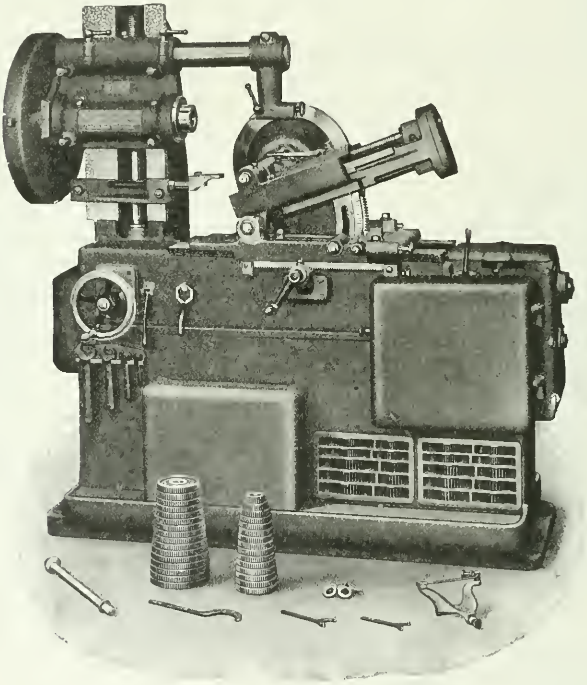
Camshaft Lathe: Walcott Lathe Co., 115 Calhoun St., Jackson, Mich. A lathe which simultaneously turns the cams of a camshaft, the work being centered between chucks of the collet type and driven by these chucks. A cutting tool is provided for each cam, and these tools are moved forward and backward by means of a master cam located at the back of the machine. Each tool has a tilting motion while cutting the sides of a lobe, in order that the clearance and top rake will always be the same.

Self-opening Die-head: Modern Tool Co., 2nd and State Sts., Erie, Pa. A self-opening die-head known as the Style H, which is intended for general threading work and can be used in the turrets of hand or automatic screw machines. It can be fitted with a closing device so that it can also be used on drilling or other machines having a revolving spindle. The chasers are supported at their outer edge by a cam ring which, it is claimed, renders impossible the shifting of chasers during a threading operation.

Drill Grinding Machine: Bellevue Industrial Furnace Co., 715-717 Bellevue Ave., Detroit, Mich. A self-contained semi-automatic drill grinding machine with the driving motor located in the pedestal and equipped with a two-step cone-pulley drive to the spindle. Drills are ground on the periphery of the wheel, and the machine may be furnished with a carriage to facilitate the grinding of left-hand drills as well as right-hand drills. An indexing arrangement is provided for setting the drill properly for grinding each lip when drills with two or more lips are being ground

Rotary Table for Milling Machine: Clark-Mesker Co., Cleveland, Ohio. A rotary table intended for the line of Cleveland milling machines built by this concern. The table

Brown & Sharpe Automatic Gear Cutting Machines

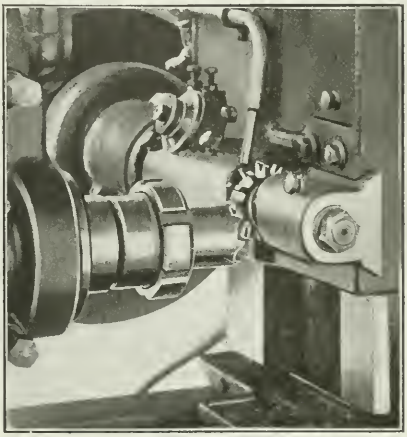


For the shop whose needs call for a machine to cut a variety of spur and bevel gears, clutches, sprockets, etc., we offer the No. 13 and 13 Heavy Automatic Gear Cutting Machines. These machines are a big choice in the average shop because of their adaptability to such a large range of work. They will accommodate spur and bevel gears up to 24-in. diameter, 6-in. face, which adequately fills the ordinary demands.

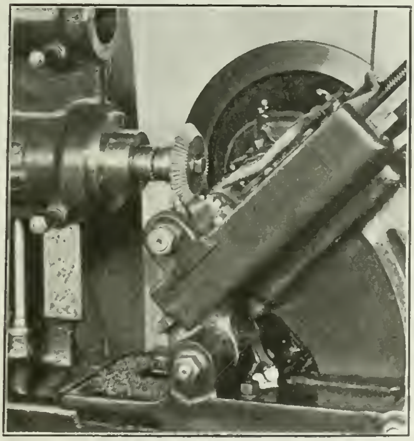
Brown & Sharpe Mfg. Co.,

Your Requirements in Gear Cutting

ACCURACY is one of the foremost requirements in gear-cutting. The indexing mechanism is positive in its action and operates without shock. The extreme accuracy of the index wheel together with its large diameter in proportion to the diameter of the work insures accuracy in spacing.



Cutting Clutches on a Brown & Sharpe No. 13 Automatic Gear Cutting Machine.



Cutting Bevel Gears on a Brown & Sharpe No. 13 Automatic Gear Cutting Machine.

RAPID PRODUCTION is another important consideration. A machine that is limited merely to accuracy—one that is not capable of rapid production—would not prove economical in operation. The cutter feeds and speeds are independent of each other and the full range of feeds is available for each cutter speed. The return of the cutter slide and the speed of indexing are constant and independent of the feed and speed of the cutter.

Send for catalog presenting our entire line.

Providence, R. I., U. S. A.

can be operated either by hand or power feed. There are sixteen changes of power feed controlled from the front of the knee by the same mechanism that controls the feed changes of the sliding table. The direction of rotation may be reversed by operating a lever. A crank and index-plate can be furnished for this attachment, and it may then be used in a similar way to ordinary dividing centers.

Tool-room Planer: Pratt & Whitney Co., Hartford, Conn. A planer intended for high-speed operation on tool-room work, which may be equipped with either a motor or belt drive. The table is driven by means of a rack and gear of the Maag form. The table dogs permit quick adjustments for the length of stroke without the use of a wrench and while the machine is running. When two heads are furnished on the cross-rail they are offset right and left to permit tools to be brought close together, and are provided with automatic feeds.

Tool-room Planer: George Gorton Machine Co., Racine, Wis. A planer especially designed for machining dies, jigs, and fixtures, which is built in two sizes, 24 by 24 inches and 30 by 30 inches, respectively. The machine may be furnished with one or two heads on the cross-rail and, in addition, has a side-head on the right-hand housing. In order to give greater strength and rigidity, the bed has been extended to the floor. The cross-rail heads are made right- and left-hand, and the vertical feed-screws have micrometer collars graduated in thousandths of an inch.

Form Grinding Machine: Bryant Chucking Grinder Co., Springfield, Vt. A form grinding machine which grinds pieces 10 inches long and of any diameter up to 12 inches by bringing the entire length of work simultaneously in contact with the wheel, the latter having no longitudinal movement. The work is carried on a bar and brought to the wheel by swinging the work-carrier, which is suspended from the bar. The wheel may be adjusted with respect to its distance from work-centers, but this adjustment is not used for feeding. After the wheel-head has been set for an operation, it has no further movement until it needs to be reset on account of wear.

* * *

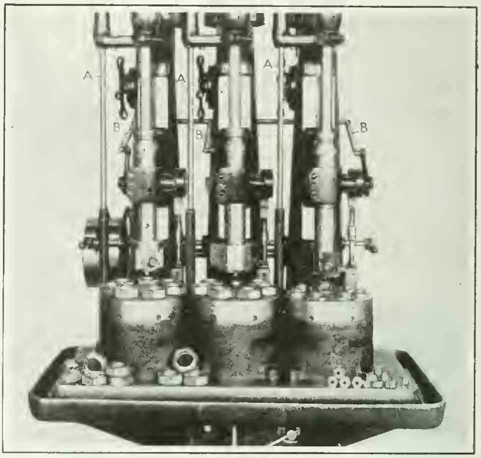
NUT FACING FIXTURE FOR DRILLING MACHINE

The fixtures with which the drilling machine here illustrated is equipped are used for facing the top surface and the bevel of hexagon, cast-brass, valve packing nuts, and will accommodate nuts from 1 inch to 2¼ inches across flats. They are designed to operate automatically, and are attached to a three-spindle No. 2B Edlund drilling machine, manufactured by the Edlund Machinery Co., Cortland, N. Y.

The machine is furnished with a standard drive, using four-step cone pulleys. The available spindle speeds are 510, 816, 1273, and 2038 revolutions per minute, with the drive pulley running at 500 revolutions per minute. The highest of these spindle speeds—2038 revolutions per minute—is too fast for the requirements of the job for which these fixtures are intended. Consequently, the high-speed step of the front cone pulley is utilized to furnish the power by means of which these automatic fixtures are operated. Extra large spindles were fitted to the machine, which were equipped with plain hardened steel and bronze thrust bearings at the lower end, for the purpose of taking the cutting thrust, and with ball thrust bearings at the upper end for supporting the weight of the spindle when running idle. It is necessary to remove about 1/16 inch of material in the facing operation, and the resulting finish must be smooth and free from chatter marks. Before loading in these fixtures, the work is faced on the bottom, drilled, and tapped.

These automatic fixtures consist of a revolving work-table, which may be indexed by a cam carried by a camshaft located at the rear of each fixture. This camshaft, which cannot be seen in the illustration, is driven by worm-gearing, the worm being attached to the vertical shaft *A*. This vertical shaft takes its power from the lower step of the front cone pulley, so that the drive for the fixture is governed by the previously selected spindle speed for the size of work being faced; thus any tendency to slow up or stop the spindle will also slow up or stop the operation of the fixture.

In addition to the cam that controls the indexing of the work-table through the medium of a pawl, the camshaft also carries two other cams. One of these cams operates a slide for locking and unlocking the work-table, and the other controls the feed of the spindle by means of the vertical turnbuckle and rack shown at the right of each spindle. The method of holding the smaller nuts from turning during the facing operation is clearly shown in the fixture at the right. For the larger size nuts, central plugs are employed, so located around the projecting center boss that one side of each nut will bear against it and prevent the nut from turning. The cam by means of which the spindle is fed is designed to approach the cut quickly, and then feed to the desired depth, allowing the tool to revolve several times after the facing operation is completed so as to give a smooth finish. The spindles are fed down against the tension of the long helical springs *B*, so that after the feed is completed, the spindle is returned by the pull exerted by these springs. A safety device has been incorporated in each fixture, which makes it impossible for the table to be indexed until the spindle returns to the end of its stroke.



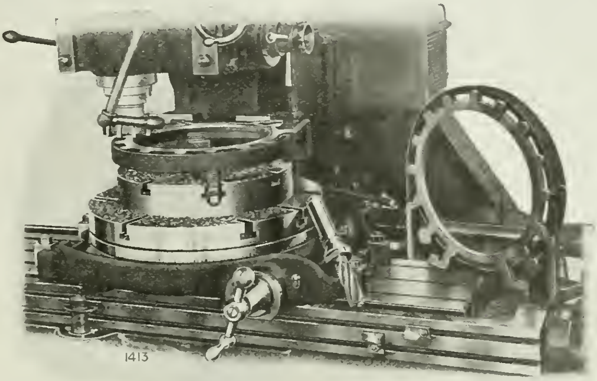
Edlund Three-spindle Drilling Machine with Automatic Fixtures for holding Nuts

Each work-table has accommodations for seven nuts, and the center plugs for each nut have guide holes in the center for engaging the pilots on the tools, so that they will be guided and steadied while the cut is being taken. The work-table may be revolved by hand when not in operation, so that the work-plugs may be conveniently changed for different sizes of nuts.

The operator's only duty is to load and unload the fixtures and give general attention to the running condition of the machine. All three fixtures can be used for one size of work, or each may be fitted to accommodate a different size, if so desired. When each jig is to be used for a different size of nut, it is an easy matter to change the tools and the work-plugs, and select the proper speed for the tool. The loading and unloading of the nuts can be done while indexing or during the cut.

The production time for the 1-inch nuts is 100 per hour when all fixtures are in operation on the same size. The spindle speed is 1273 revolutions per minute in this case, and the feed 0.006 inch per spindle revolution. For the large nuts—2¼ inches across flats—the output is 420 faced nuts per hour, with the three spindles running at 510 revolutions per minute and the same rate of feed as used for the smaller nuts. For medium sized nuts with a spindle speed of 816 revolutions per minute, and the same feed, the output is 672 per hour, for the three fixtures.

Our Service Department replaced two boring mills with one No. 4 Vertical Cincinnati Miller and cut the time from 55 to 9½ minutes

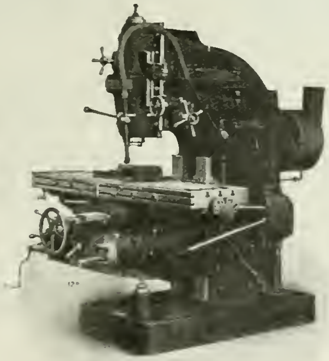


This is the end frame of an electric motor.

The large diameter is 20 in.

The diameter of the bore is 14½ in.

The rough casting is chucked on a 24-in. circular milling attachment.



This is the sequence of operations—

A 7½-in. face mill does the facing with one revolution of the attachment.

The work passes the cutter at the rate of 12½ in. per minute.

Our rapid traverse of 100 in. per minute clears the work from the cutter.

The quick change collet enables the operator to replace the face mill with an end mill in 30 seconds.

The knee is lowered until the end mill clears the work.

Note that in all adjustments the entire range of feeds is at the operator's finger tips and changes can be made in a second.

The work is carried to the cutting position at 100 inches per minute and stopped in place by an adjustable dog.

The end mill is lowered into the frame.

The frame passes the mill at 14¾ in. per minute.

The bore is finished with one revolution of the attachment.

The time from floor to floor is 9½ minutes.

Let our Service Department show you how to cut your production cost.

The Cincinnati Milling Machine Company

Cincinnati, Ohio, U. S. A.

BOOTH FOR SHOP TIMEKEEPER

A metallic booth intended to serve as an office for shop timekeepers, departmental foremen, and others requiring a convenient place for keeping records, etc., is shown in the accompanying illustration. This booth is a product of the Lyon Metallic Mfg. Co., Aurora, Ill., and is built from standardized sectional panels. It is furnished with a sliding window, and can also be provided with practically any arrangement of drawers, compartments, etc.

All-metal Booth built by the Lyon Metallic Mfg. Co. for the Use of Timekeepers, Foremen, etc.

* * *

PERSONALS

Carl W. Bettcher has been appointed sales manager of the Eastern Machine Screw Corporation, New Haven, Conn. He will give special attention to the expansion of the H & G die-head business.

R. B. Hubbell, formerly sales manager of Churchill-Morgan-Crittsinger, Inc., Worcester, Mass., has resumed his former position as assistant sales manager with the Heald Machine Co., Worcester, Mass.

Morrison Nemirovsky, who was formerly connected with the firm of S. Nemirovsky & Son, will hereafter do business under the name of Philadelphia Machinery Exchange, with headquarters at 117 N. Third St., Philadelphia, Pa.

Charles O. Dowding, formerly manager of the machine tool department of Patterson, Gottfried & Hunter, Inc., 211 Center St., New York City, is now associated with Peter A. Frasse & Co., 417 Canal St., New York City in a similar capacity.

Keith J. Evans, advertising manager of Joseph T. Ryerson & Son, Chicago, Ill., was elected president of the Engineering Advertisers' Association at the annual meeting in Chicago on March 8. Mr. Evans succeeds J. J. Arnsfield, advertising manager of Fairbanks Morse & Co.

E. L. Essley, president of the E. L. Essley Machinery Co., Chicago, Ill., has recently purchased the entire interests of Frank S. Shields and others in the Cleveland Planer Co., and is now sole owner, president, and treasurer. W. B. Currier, Jr., is vice-president, secretary, and general manager.

W. H. Ellis and C. B. Clarke have joined the sales force of the Hilo Varnish Corporation, Marcy and Flushing Aves., Brooklyn, N. Y. Mr. Ellis was connected with the Forbes Varnish Co. for many years, and Mr. Clarke was with the Bridgeport Wood Finishing Co. for a considerable period of time.

Robert C. Weller has been appointed general sales manager of the Lakewood Engineering Co., with headquarters at Cleveland, Ohio. Mr. Weller is in full charge of sales work. Carlton R. Dodge has been appointed western sales manager of the company with headquarters at 1215 Lumber Exchange Bldg., Chicago, Ill.

H. S. Greene has been elected vice-president in charge of sales of the Barber-Greene Co., Aurora, Ill., manufacturer of belt conveyors and bucket loaders. Mr. Greene was for several years assistant sales manager of the National Carbon Co. of Cleveland, Ohio, and has been a director of the Barber-Greene Co. for some time.

William Roberts, formerly connected with the engineering department of the Rolls-Royce Co. of America, has opened engineering offices at 457 Main St., Springfield, Mass., where he is specializing in production and efficiency work. He will be glad to receive catalogues and literature on various production machines and tools now on the market.

L. F. Nielsen has resigned as chief engineer of the Shaw-Enochs Tractor Co. to engage in private practice in the field of machine and tool designing and production engineering, in partnership with W. C. Joubert under the name of Equitable Engineering Co. at 101-103 First Ave. N. This firm is also manufacturing the Joubert water circulating pump for Ford cars.

Clarence Walter Ham has been appointed associate professor of machine design at the University of Illinois, Urbana, Ill. Professor Ham has been an instructor at the University of Kentucky and an instructor and assistant professor at Cornell University, and has also been employed by the General Electric Co., and by the Gleason Works at Rochester, N. Y.

E. H. Sackett, formerly president and general manager of the Telluride Iron Works Co., Telluride, Col., has sold his holdings in the company and is now located in Denver, making a specialty of mine transportation, both underground and aerial. Mr. Sackett is contemplating erecting a factory in Denver to manufacture the Sackett sand and tailings pump as well as the Sackett simplex system of aerial tramways.

Charles E. Hildreth, who recently resigned the position of president and general manager of the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., as mentioned in the November, 1920, number of Machinery, has been appointed general manager of Churchill-Morgan-Crittsinger, Inc., Worcester, Mass., manufacturer of grinding machines. He was also elected a director of the company. Mr. Hildreth is one of the most prominent machine tool men in the country, having been, as is well known, general manager of the National Machine Tool Builders' Association for five years.

M. Pierre Vassoille, general manager of the Société des Etablissements Beccat, Paris, France, is visiting this country in the interests of his firm, which is represented here by André Weill & Co., Inc., 149 Broadway, New York City. M. Vassoille and M. Maurice G. Roux, vice-president of André Weill & Co., are about to visit the larger cities in the United States and Canada to study trade conditions generally and to arrange for the representation and distribution of the G. B. line of chain blocks and hoists, one of the products of Etablissements Beccat, now carried in stock in New York by André Weill & Co., Inc.

A. S. Baldwin, 211 E. University Parkway, Baltimore, Md., has resigned as manager of ordnance and chief engineer of the Poole Engineering & Machine Co., Baltimore, Md. He has been in charge of all the munition work of the company during the last five years. During this period, Mr. Baldwin developed new guns for the army and navy, as well as special ammunition. Prior to his connection with the Poole Engineering & Machine Co., he was manager of one of the Westinghouse plants in Pittsburg, and previous to that was general manager of the Alberger Pump & Condenser Co., Newburgh, N. Y., for three years. He was general superintendent of the Driggs-Seabury Ordnance Corporation of Sharon, Pa., for four and a half years. Mr. Baldwin has not yet announced his future plans.

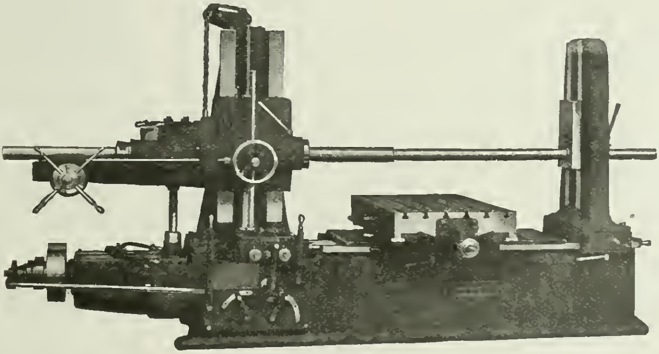
* * *

OBITUARIES

John Rahn, Jr., president and general manager of the Rahn-Larmon Co., Cincinnati, Ohio, died suddenly at his residence in Cincinnati on March 11, aged fifty-eight years. Mr. Rahn was born in Cincinnati in 1862, and was educated in the public schools of that city. At an early age he entered an apprenticeship course of the Sebastian Lathe Co. of Cincinnati. Later he became foreman and superintendent of the G. A. Gray Co. In 1898 he entered business for himself, manufacturing lathes in Cincinnati. The firm was known as the Rahn, Mayer, Carpenter Co., and Mr. Rahn held the position of vice-president and general manager. In 1910 he became president of the company, the name then being changed to the Rahn-Larmon Co., and held that position up to the time of his death.

THE LUCAS "PRECISION"

Boring, Drilling and MILLING MACHINE



As It Stands Today Is

"THE SUM OF SMALL HAPPENINGS"

of 20 Years' Experience

(but we are not too old to learn)

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U. S. A.**

FOREIGN AGENTS Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

COMING EVENTS

April 7—Monthly meeting of the Indianapolis Chapter of the American Association of Engineers at the Chamber of Commerce, 28 S. Meridian St., Indianapolis, Ind.

April 18-21—Convention of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples Gas Bldg., Chicago, Ill.

April 27-29—Convention of the Society of Industrial Engineers in Milwaukee, Wis. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

April 27-30—Fifth annual meeting of the American Gear Manufacturers Association in Cincinnati, Ohio; headquarters, Hotel Sinton. Secretary, Frank D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa.

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 18-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel.

May 19-20—Spring convention of the National Machine Tool Builders' Association in Atlantic City, N. J.; headquarters, Hotel Traymore. General manager, E. F. DuBrul, 817 Provident Bank Bldg., Cincinnati, Ohio.

May 23-26—Spring meeting of the American Society of Mechanical Engineers in Chicago, Ill.; headquarters, Congress Hotel. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 24-28—Summer meeting of the Society of Automotive Engineers in West Baden, Ind.; headquarters of the society, 29 W. 39th St., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. National office of the society, 4600 Prospect Ave., Cleveland, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

Grove City College, Grove City, Pa. Catalogue giving calendar and courses of study for the year 1920-1921.

Columbia University, Morningside Heights, New York City. Bulletin of information containing announcement of the day and evening courses offered at the twenty-second summer session, which begins July 5 and ends August 12. Registration in the summer session begins on June 30, and a statement of the regulations regarding registration by mail may be obtained from the Registrar, Columbia University.

NEW BOOKS AND PAMPHLETS

Weights and Measures. 200 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 43 of the Bureau of Standards. Price, 20 cents.

This pamphlet contains the minutes of the thirteenth annual conference on weights and measures attended by representatives from the various states, which was held at the Bureau of Standards, May 24-27, 1920. The conference discussed the standardization of units of weights and measures and methods of inspection for the detection of fraud.

Table for Computing Change-gears for Machines Hobbing Spiral Gears. By John M. Christman. 10 pages, 5¾ by 7¾ inches. Published by the author at 934 W. Philadelphia Ave., Detroit, Mich. Price, 50 cents.

This pamphlet contains formulas for computing lead of spiral for spiral gears, feed to be used in hobbing spiral gears, and ratio of index-gears and feed gears. The formulas and examples illustrating their use cover the first two pages of the book, and the remaining eight pages contain tables for computing change-gears for machines hobbing spiral gears, when cutting right-hand spirals with right-hand hobs, or left-hand spirals with left-hand hobs; and when cutting right-hand spirals with left-hand hobs, or left-hand spirals with right-hand hobs.

Cams—Elementary and Advanced. By Franklin DeRonde Furman. 234 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.

The first five sections of this book were published about three years ago under the title "Elementary Cams." The chief features of the earlier book were that it pointed out a classification, and the general method of solution of the well-known cams. It also gave a series of cam factors for base curves in common use, so that designers could compute proper cam sizes for specific running conditions, numerous examples of the use of these factors being given in the different kinds of cam problems presented. A further development of this subject, in addition to the original matter, is given in the present work. The chief original features of the advanced section include the development or use of the logarithmic, cube, circular, tangential, and involute base curves, the establishing of cam factors for such of these curves as have general factors, and the demonstration that the logarithmic base curve gives the smallest possible cam for given data. Numerous problems in cam design and their solution are included.

The Welding Encyclopedia (1921). 326 pages, 6 by 9 inches; 375 illustrations. Published by the Welding Engineer Publishing Co., 608 S. Dearborn St., Chicago, Ill. Price, $5.

This work, which is a reference book on autogenous welding, was compiled and edited by L. B. Mackenzie and H. S. Card of the editorial staff of the "Welding Engineer." One-third of the book comprises a dictionary, giving definitions of terms and trade names used in the welding industry, and containing short articles on welding topics. Then follow chapters on the oxy-acetylene, electric arc, electric resistance, and thermit processes, in which instructions are given for welding different kinds of metal. The use and care of the equipment are also discussed. A special chapter is devoted to boiler welding, and another to the heat-treatment of steel. Tables and charts show graphically the right and wrong methods of preparing welds. The last section is a catalogue section, containing announcements of various manufacturers of welding equipment and supplies, as well as a buyers' index, which enables the reader to locate readily the makers of all kinds of welding apparatus.

Export Packing. By C. C. Martin. 710 pages, 6 by 9 inches. Published by the "American Exporter," 370 Seventh Ave., New York City Price, $10.

The great importance of good packing as a factor in successful merchandising is emphasized in the present work, which should be of interest in view of the fact that so much attention is being given at the present time, to the development of foreign trade. American methods of packing goods for shipment to foreign markets have invoked considerable criticism for many years. In this book the author has made a constructive attempt to supply the knowledge and technique by means of which such criticism may be eliminated. The book explains the application of principles of economical and efficient packing to all classes of commodities, from fragile glassware to heavy machinery. More than 350 photographs, diagrams, and drawings are reproduced to illustrate the methods employed by successful exporters in every line. Aside from its usefulness to exporters, it contains much information applicable to the problems of domestic shippers, especially those who make use of coastwise lines.

Inorganic Chemistry. By James Lewis Howe. 443 pages, 6 by 9 inches. Published by the Chemical Publishing Co., Easton, Pa. Price, $4.

This book is an enlarged and revised edition of "Inorganic Chemistry According to the Periodic Law," by F. P. Venable and J. L. Howe. The material has been thoroughly revised and much of it has been rewritten in the light of recent developments of chemistry, but no attempt has been made to incorporate many of these advances into what is essentially a text-book of elementary chemistry for beginners, or for those who have had at the most a high school course. The experiments accompanying the text are those that have been found by experience to impress the subject upon the student. Elaborate experiments have been omitted, and those presented are intended to be carried out under the direct supervision of an instructor. The eleven chapters included are headed as follows: Hydrogen, Oxygen and Water; Salt, Sodium and Chlorine; Classification of the Elements; the Elements; the Compounds of Hydrogen; the Halides; Oxides and Sulphides; Binary Compounds of Group V; Binary Compounds of Groups IV and III; Alloys; and Outlines of Metallurgy.

Machine Shop Practice. By James A. Pratt. 320 pages, 6 by 9 inches; 205 illustrations. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2.50.

The elements of machine shop practice are presented in this book, which is intended to be used as a text for the machinist's trade. The work has been devoted to the trade fundamentals applicable both to the doing of bench work and to the operation of machine tools. The processes described are related to the bench, lathe, drilling machine, shaper, slotter, grinder, miller, and planer; and the construction of these machines is described, and illustrated by means of diagrammatic views on which all the various parts are numbered so that they can be readily designated. The author believes that a study of these machines will give a satisfactory understanding of the fundamental processes involved in the metal-working industries. The book contains fifteen chapters, headed as follows: The Bench and Bench Work; Supplies and Miscellaneous Tools; Hardening and Tempering—Machine Adjustments—Equipment—General Tools; Lathe Tools; the Lathe Back-rest—Follow-rest—Compound Rest—Eccentric Turning; the Driller or Drill Press; the Shaper; the Slotter; the Grinder; Grinding (Continued); the Milling Machine or Miller; Gearing; the Planer; Machine Shop Calculations; Machine Glossary—Tables—Bibliography—Course Outline.

Modern Apprenticeships and Shop Training Methods. By Erik Oberg. 118 pages, 6 by 9 inches; 38 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

The object of the present book is to describe in considerable detail the methods used in several well-known machine building plants in the country. As the machine tool industry is the basic industry in the whole machine building field, the examples have been mainly taken from the machine tool field. The book deals not only with regular apprentice systems and apprentice schools, but also with training shops for machine operators that do not serve regular apprenticeships. A chapter is included on the training of electric welders in order to indicate how specialists in various fields may be trained, and the book concludes with a chapter on the training of women for shop work, based upon the experience of several American machine shops during the war. It is the hope of the publishers and the author of this book that it may stimulate the interest in apprenticeships and training courses and that manufacturers and others interested in this work may be able to obtain from it a comprehensive idea of what has been done elsewhere in order to bring about more satisfactory means for the training of the men who will be mainly responsible for the output of American machine shops in the future.

NEW CATALOGUES AND CIRCULARS

E. C. Atkins & Co., Inc., Indianapolis, Ind. Revised list prices, supplementing Catalogue 18, of Atkins mill saws and specialties.

Albro-Clem Elevator Co., Erie Ave. and D St., Philadelphia, Pa. Loose-leaf circulars illustrating Hindley worm drives for heavy duty.

Metalwood Mfg. Co., Detroit, Mich. Circular B-38, containing price lists of drop-forged hydraulic fittings for working pressures of 3000 and 6000 pounds.

Wagner Electric & Mfg. Co., St. Louis, Mo. Bulletins 127 and 128, treating of Wagner single-phase motors, and distribution type transformers, respectively.

Trane Co., La Crosse, Wis. Bulletin 6-A, containing records of performance tests of Trane thermetal radiator traps, conducted by an eastern university and by the Trane Co. in its own laboratories.

Springfield Machine Tool Co., 631 Southern Ave., Springfield, Ohio. Catalogue illustrating and containing brief descriptions of the line of lathes, shapers, and straightening presses made by this company.

Griscom-Russell Co., 90 West St., New York City. Bulletin 615, illustrating and describing the G-R multi-screen filter, which is a new design of the Reilly multi-screen feed-water filter and grease extractor.

Nicholson File Co., Providence, R. I. Catalogue for 1921, containing the reproduction of an advertisement from MACHINERY, in which attention is called to the widespread use of Nicholson files in the city of Detroit.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Publication 2016 entitled "Start her up Bill," illustrating and describing the Cutler-Hammer enclosed "safety" switch, used for starting polyphase squirrel cage motors.

Baird Machine Co., Bridgeport, Conn. Circular treating of the Baird tandem press, which is made in double-action and single-action types, for performing two series of drawing, stamping, piercing and similar operations.

Crouse-Hinds Co., Syracuse, N. Y. Circular showing the application of ZY "Condulets" for the control of small motors; they are furnished with a 250- or 600-volt, 3- or 4-pole snap switch for motors of 2 horsepower or less.

Consolidated Instrument Co. of America, 461 Eighth Ave., New York City. Circulars illustrating and describing the Hasler speed indicator and Jones tachometers, for which this company has recently acquired the exclusive right of distribution in the United States.

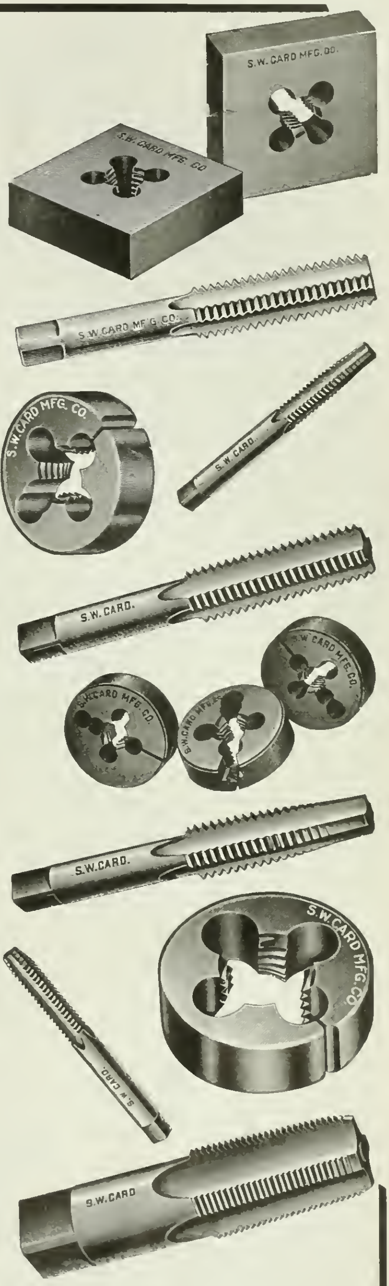
Cincinnati Electrical Tool Co., Cincinnati, Ohio. Catalogue 14, covering the company's complete line of portable electric drills, grinders, and buffers. The catalogue shows several new types of machines which have recently been brought out. Copies will be sent upon request.

Ratiometer Corporation, 366 Gerard Ave., New York City. Technical letter No. 1, containing a brief description of the construction and operation of the ratiometer, a mechanical device for the automatic proportioning of gaseous fuels and the air used for their combustion.

General Electric Co., Schenectady, N. Y. Bulletin 49714 C, treating of condensers of the static or stationary type, which have been developed to overcome the detrimental effect of a low power factor for comparatively small loads. Bulletin 48034 (superseding X-407), entitled "Electrical Equipments for Movable Highway and Railway Bridges," describing both alternating- and direct-current equipments.

OVERCOME YOUR TAPPING TROUBLES BY SPECIFYING

CARD TAPS and DIES



Exact in size, uniform in temper, true to pitch and in every possible way High Grade.

Our stock is well assorted and we are prepared to quote lowest current prices.

Please let us figure with you.

HAMMACHER, SCHLEMMER & CO.

Hardware, Tools and Factory Supplies

NEW YORK (Since 1848) 4th Avenue and 13th Street

Skelton Tool Co., 406 Ash St., Syracuse, N. Y. Circular illustrating several typical examples of the Skelton line of production tools, including high-speed roughing reamer, helical finishing reamer, high-speed taper pin reamer, and boring-bar with a high-speed cutting end welded to a nickel-steel shank.

Hercules Machine & Tool Co., Inc., Broome and Lafayette Sts., New York City. Bulletin illustrating and describing Hercules gear-hobbing machines, made in 8- and 24-inch sizes. Tables of gear tooth parts and rules for calculating spiral gear dimensions, as well as dimensions of standard hobs are included.

J. G. White Engineering Corporation, 43 Exchange Place, New York City. Catalogue entitled "Achievement," showing different classes of construction which this company has undertaken, including steam power plants, hydro-electric developments, transmission systems, industrial plants and buildings, etc.

Watson Mfg. Co., Toledo, Ohio. Catalogue describing the different types of Watson tangent-cut box-tools, illustrating and describing the different models of box-tools made by the company for automatic and hand screw machines, and giving complete dimensions of the tools, as well as directions for their setting and operation.

Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. Bulletin 607, containing a detailed description and showing several applications of Chicago pneumatic oil engine driven compressors, which are built in both stationary and portable types. The booklet gives a comparison of the operating costs of these machines and of steam-driven compressors.

American Roller Bearing Co., Pittsburg, Pa. Bulletin 1005 treating of standard and heavy-duty Type C roller bearings. Characteristics of the bearings are outlined, and information is given relating to the installation, lubrication, and load capacities. There are several pages of illustrations showing the wide application of Type C roller bearings to machinery and equipment in general.

Universal Boring Machine Co., Hudson, Mass. Instruction book containing instructions for operating Universal horizontal boring machines. The construction of the machine is made clear by both halftone and line illustrations, and the correct method of handling is shown graphically by a large number of illustrations. The instructions cover operating, leveling, adjusting, dismantling, and oiling. The list of parts of the machine is printed both in English and in French.

Neil & Smith Electric Tool Co., Cincinnati, Ohio. Drill Bulletin No. 9, containing data on the portable electric drills made by this company, which are furnished for operation on universal or direct current. The bulletin reproduces data covering a competitive test of portable drills, which gives an idea of the capacity of the Neil & Smith tools. A price list is issued in conjunction with the drill bulletin, giving prices of drills, grinders, or buffers; screwdrivers; circular wood saws, etc.

Sterling Grinding Wheel Co., Tiffin, Ohio. Circular containing price lists for Sterling grinding wheels from 1 to 24 inches in diameter, and from ¼ to 4 inches thick. The circular also contains a table of grinding wheel speeds and a grading table, showing the proper grain and grade of wheel to be used for different kinds of work. Circulars containing suggestions for care, operating, and stopping of grinding wheels; sizes of Sterling swing-frame grinders; and dimensions of Sterling No. ⅝ and ½ grinders.

Jones & Lamson Machine Co., Springfield, Vt. Cloth-bound book illustrating and describing in detail the construction and principle of operation of the Hartness screw thread comparator—a machine designed on the principle of the projection lantern, for use in measuring the essential elements of a screw during the course of manufacture and for inspecting threaded work accurately and rapidly. The book reproduces a large number of screw thread projections to illustrate the manner in which errors are revealed by the Hartness machine.

Taft-Peirce Mfg. Co., Woonsocket, R. I. Bulletin 114, descriptive of the line-reaming of bearings by the Martell system. The bulletin describes the construction of Martell reamers in detail, as well as their principle of operation. Illustrations show the use of the aligning reamer for reaming crankshaft bearings in multi-cylinder engines. Bulletin 115, illustrating and describing Martell adjustable reamers, of the hand, chucking and shell types. Instructions are given for grinding the blades of Martell reamers, as well as tables of dimensions f[illegible] different types.

Barnhart Bros. & Spir[illegible] Monroe & Throop Sts., Chicago, Ill. Circ[illegible] containing illustrations of parts produced from "Tenso" alloy by the die-casting process, as well as information relating to the physical properties and uses of these die-castings. The circular gives tables of comparative strength, lightness, and hardness of "Tenso" alloy and other metals. These die-castings are suitable for small parts, such as are used in the automobile and accessories trade, airplanes, electric motors, gasoline engines and pumps, typewriters, time recorders, vacuum cleaners, etc.

Bowen Products Corporation, Auburn, N. Y., has published two booklets relating to lubrication of motor cars and chassis, written by C. A. Bacon. One of the booklets, entitled "Chassis Lubrication," discusses methods of applying lubricants to chassis, and points out the conditions under which oil is most suitable and those under which grease is preferable. The other booklet entitled "Lubricants and their Application as Related to the Chassis" contains the results of a series of tests made to determine the best lubricant to use for automobile chassis, and its proper application.

TRADE NOTES

Progressive Mfg. Co. is a new concern organized in Cincinnati, Ohio, at 5th and Elm Sts. The specialty of the company will be diemaking and die designing.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has moved its Pittsburg office from 1208 Farmers Bank Bldg., to 718 Bessemer Bldg., corner of 6th St. and Duquesne Way.

Deutschle & McKinley is a new concern organized in Cincinnati, Ohio, at 1623 John St., to engage in work as general machinists, with lithographic and printing machinery as a specialty.

Wagner Electric Mfg. Co., St. Louis, Mo., has removed its Boston office and service station to larger quarters at 342 Newbury St., where it occupies the entire building. Brooks Faxon will continue in charge as district manager.

Southwark Foundry & Machine Co., Philadelphia, Pa., has opened a district office in Cleveland, Ohio, at 804 Swetland Bldg., which is under the management of Stewart Bolling, who has been engineering salesman for the company for seven years.

George B. Limbert Co., Chicago, Ill., manufacturer of pipe fittings, is offered for sale by the Northern Trust Co., trustee of the late George B. Limbert. The physical valuation made by the Sessions Engineering Co. shows a property of about $1,500,000.

Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City, have acquired the good will and all the physical assets of Patterson, Gottfried & Hunter, Inc., 211 Center St., New York City, dealers in machinery, metals, hardware, tools, and supplies.

Stewart Mfg. Corporation, 4500 Fullerton Ave., Chicago, Ill., manufacturer of die-molded castings and bronze-back bearings, announces the establishment of a permanent Cleveland office at 419 Bangor Bldg., 942 Prospect Ave. E. P. Grismer, who has long been identified with this industry, will be in charge of the Cleveland territory.

Greiner, Semon, Lowry Co., Syracuse, N. Y., has been organized as a copartnership for the manufacture of special machinery and tools, by John A. Greiner, Joseph C. Semon, and Edward N. Lowry. A new steel and brick factory, 40 by 126 feet, with an adjoining wing, 24 by 52 feet, of one-story construction, is being built at 419 W. Taylor St., Syracuse.

Conveyors Corporation of America (formerly the American Steam Conveyor Corporation) 326 W. Madison St., Chicago, Ill., manufacturer of the American trolley carrier and the American steam ash conveyor, announces that it has become necessary, owing to the steady increase in its business, to double the number employed in its South Bend, Ind., plant.

Bacharach Industrial Instrument Co., Pittsburg, Pa., is now situated in a new plant at Bennet St. and Murtland Ave., Homewood Station, Pittsburg, which is a brick building having a floor space of 18,000 square feet. The additional space was acquired by the purchase of the building, and has considerably increased the facilities of the concern. It is announced that manometers and engine indicators have been added to the company's regular line of products.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., has opened a New England branch office at 30 South St., Boston, Mass. Elmer J. McManus, who has had ten years' experience marketing leather belting and leather specialties in New England, is branch manager. The Boston branch carries a large stock of the company's brands of leather belting and leather specialties, and maintains a complete service department for installing belts, etc.

Charles Eisler Engineering Co. is successor to the **National Machine & Tool Co.**, of Newark, the assets of the latter company having been purchased by Charles Eisler, consulting engineer, 159 Clifton Ave., Newark, N. J. The company will manufacture gear testing machines, as well as incandescent lamp machinery, in addition to carrying on its regular consulting engineering and machine designing business. The factory and offices are located at 15 Kirk Place, Newark.

American Gas Furnace Co. announces that its entire personnel is now concentrated in a main office in Elizabeth, N. J., where the two plants of the company are located. This change was made to insure a more thorough cooperation of the various departments, and to place the entire organization more intimately at the disposal of its customers. It is also announced that the company has discontinued selling operations through its former sole agent E. P. Reichhelm & Co., Inc.

Myerstown Foundry & Mfg. Co., Myerstown, Pa., has recently purchased the plant that it has been operating for a number of years from the Treadwell Engineering Co., and intends to effect a number of improvements. During the last year the entire plant has been completely electrified. The company maintains a fully equipped gray iron foundry, pattern, forge, and machine shop, and expects to purchase a number of new tools in the near future. The officers are L. F. Krum, president; E. R. Euaton, vice-president; and S. P. Line, secretary-treasurer.

Smith Engineering Co., 1 Union Square, New York City, has been organized for the purpose of conducting a mechanical engineering and contracting service. The engineering service will provide facilities for the designing and building of automatic machinery, tools, dies, gages, etc., the planning and development of efficient production methods, and the handling of contract production work. The firm will also be in a position to equip and appraise manufacturing plants, conduct factory investigations, and plan and install refrigerating machinery and factory water cooling systems.

Dwight P. Robinson & Co., Inc., engineers and constructors, 125 E. 46th St., New York City, have recently opened branch offices in Montreal in the Dominion Express Building. Alexander C. Barker, vice-president, is in charge of the office. The company is a consolidation of Westinghouse, Church, Kerr & Co., Inc., and Dwight P. Robinson & Co., Inc., and has done extensive construction and engineering work in Canada for the Canadian Pacific Railway, Canadian Salt Co., Canadian Crocker-Wheeler Co., Dominion Government, Aetna Explosives Co., Grand Trunk Railway, and others.

Surface Combustion Co., Inc., 366 Gerard Ave., New York City, manufacturer of industrial furnaces, has acquired the entire rights and interests of the **Ratiometer Corporation**, Rochester, N. Y. The Surface Combustion Co., Inc., has established a separate manufacturing and sales organization in its own plant in New York, where it will continue this business under the name of the Ratiometer Corporation. Other patent rights recently acquired by the Surface Combustion Co., Inc., are the Clark principle of intermittent firing for enameling furnaces and the Langenberg-Fetterly furnace for heat-treating armor piercing shells.

Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York City, announce that they have found it advantageous to recapitalize and incorporate the company in the state of Delaware. Consequently it was necessary to dissolve the New Jersey corporation and sell all its interests to the Delaware corporation bearing the same name. There has been no change in the personnel or policy, except that the number of directors has been increased. The officers of the concern are William F. Schlemmer, president and treasurer; August Pahl, first vice-president: Herman Acher, second vice-president; and William H. Siebert, secretary.

J. H. Williams & Co., manufacturers of drop-forgings and drop-forged tools, with works at Brooklyn, Buffalo, Chicago, and St. Catharines, Ontario, Canada, have elected the following officers for the coming year: President, J. Harvey Williams; vice-president and general manager, A. D. Armitage; second vice-president, Frank W. Trabold; secretary and treasurer, W. A. Watson; controller and assistant treasurer, R. S. Baldwin; and assistant secretary, C. B. Harris. Mr. Armitage is also president of the Whitman & Barnes Mfg. Co., Akron, Ohio, but will be active in the management of J. H. Williams & Co. to which he will devote most of his time.

Defiance Machine Works, Defiance, Ohio, has just celebrated the fiftieth anniversary of its existence. Beginning in 1870 with one small building having 800 square feet of floor space, and with 15 men, the organization has developed until it covers 200,000 square feet of floor space and has 700 employes. From a localized business in woodworking machinery, an organization has been built up for designing and constructing both wood- and metal-working machinery of a great number of types. The company was organized by Peter Kettenring in 1870. His son, William A. Kettenring, was the active head of the organization from 1890 until 1912. Charles Henry Kettenring is now president, and Ransom P. Kettenring, vice-president of the company.

Tool Sales & Engineering Co. has been incorporated in Chicago, Ill., with an office and warehouse at 546 W. Washington Blvd., by T. J. Davis, C. E. Block, and C. B. Cole, to act as a tool distributing company. The concern will serve as direct factory representative for several states in the Middle West, having been appointed agent for the Gardner-Bryan Co., Cleveland, Ohio, manufacturer of taps, dies, and screw plates: the Fast-Feed Drill & Tool Corporation, Toledo, Ohio, manufacturer of high-speed drills, reamers, etc.: and Ibsen & Co., Milwaukee, Wis., manufacturer of gage-block sets. Complete stocks of the lines of these companies will be carried in Chicago to take care of the dealers' and consumers' trade in that territory. T. J. Davis was formerly connected with the Chicago office of the Union Twist Drill Co.; C. E. Block was formerly secretary and treasurer of the McMullen Machinery Co., Grand Rapids, Mich.; and C. B. Cole was previously manager of the Chicago office of the Union Twist Drill Co.

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The Editor's Monthly Talk

THE automobile industry, following several months of an almost complete shut-down, has passed through the worst of the crisis, and after readjustment to new conditions will emerge stronger and safer, occupying a more conservative position in the industries and being less subject to spectacular fluctuations.

The development of special machines, tools, and fixtures has become an essential part of automobile manufacturing practice. In automobile plants, where interchangeable manufacturing can be developed to the highest degree, the use of tools designed to perform a variety of operations not only reduces manufacturing costs, but also simplifies the whole problem of making duplicate interchangeable parts, because equipment designed for one kind of work only may have non-adjustable parts, fixed locating points, and other features not within the control of the operator, and hence is independent of the human element. This results in greater precision, because it places the quality of the product upon a mechanical, and therefore a more dependable, basis.

The leading article in May MACHINERY describes and illustrates a number of special devices used at the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., where the well-known Franklin car with its air-cooled engine is made. The examples of tools and equipment shown in this article represent principles in tool design applicable to other machine building plants that work on the interchangeable manufacturing plan.

Efficiency Factors in Production Planing

To obtain maximum output in the operation of machine tools, a careful study of all the conditions which affect production is necessary. The planer department presents problems that are no exception to this general rule. In the setting up and planing of work, particularly in the shops that are on a production rather than a jobbing basis, there are a great many points to be taken into consideration. These points may be designated as "efficiency factors," because they determine the rate of output and the consequent labor and overhead cost. The article on "Production Planing in Machine Tool Plants," in May MACHINERY, deals extensively with these factors and points out how maximum output may be obtained in planer operation by the observation of principles that experience has taught to be fundamental. This article will be continued in the June number.

Coming Articles in June MACHINERY

There are certain operations in metal-working which cannot be economically performed, if at all, by any other method than by swaging—the uniform rapid hammering of metal to change its shape—which may be performed either on hot or cold metals. In June MACHINERY, an article dealing with cold swaging methods will be published, which points out the possibilities of the application of swaging and its effect upon the quality of the metal, and contains a detailed description of the methods of making swaging dies. Practically every known metal can be successfully swaged, including not only steel, copper, and brass, but also such materials as tungsten and monel metal. It is not generally known that screw threads can be produced by swaging, but this is successfully and satisfactorily done. The characteristic of a swaged thread is its accuracy in lead rather than in thread form. Swaging is also the only process by which gold-plated base metal rods can be reduced in diameter from, say, ½ inch to the very small sizes extensively used in the optical and jewelry trades, without losing, as it is swaged into a fine wire, the protective quality of the thin gold covering or plating originally given to it.

A Successful Inspection System

In May MACHINERY, there is an article on "Principles of Inspection." In the June number this will be followed by an article on "The Delco Inspection System," which describes the methods used by the Dayton Engineering Laboratories Co., Dayton, Ohio, for the rational inspection of raw materials, purchased parts, tools, equipment, and gages, as well as of the manufactured product. There are many interesting features in this inspection system not generally known in the machine building industry, and the article will therefore prove of exceptional interest to mechanical men responsible for production and inspection. One of the methods peculiar to the Delco plant is the so-called "night tool inspection" described in this article. A tool inspector visits the various manufacturing departments after the closing hours and inspects all the gages that have been used during the day. In this way, it is possible to maintain the gaging equipment in first-class condition at all times. It insures the accuracy of the gages, saves a great deal of poor work, eliminates arguments with the men that their gages are incorrect, and therefore not only increases production but also creates a better spirit in the plant.

Among other articles of especial interest in the June number of MACHINERY, will be one on Milling Slender Castings, showing methods used for obtaining accuracy in machining parts of this kind where the springing action in the metal would be likely to cause difficulties.

Special Machines and Fixtures in the Franklin Plant

Mechanical Equipment Designed Either to Increase Production, Perform Special Operations, or Maintain Established Standards of Accuracy

By FRANKLIN D. JONES

AT the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., where the well-known air-cooled Franklin car is made, a considerable variety of special tool equipment is used in different departments. A number of these special devices are described and illustrated in this article, as they represent certain principles in tool design that can be applied in other machine-building plants producing interchangeable parts on a large enough scale to warrant the expense of special equipment. These devices are utilized for a wide variety of purposes and in different departments of the Franklin plant, so that no attempt will be made to present them in logical order, because the operations in many cases are entirely unrelated.

Nut-driving Machines

The work of assembling the motor and certain other parts of an automobile requires the screwing on and tightening of a large number of nuts. This is time-consuming work when done by hand, and at the Franklin plant nut-driving is done mechanically. The machines used for this purpose operate on the same principle, but differ in regard to their general arrangement and the method of manipulating the nut-driving spindle. The latest design installed in the Franklin plant is illustrated in Fig. 1. The spindle of this machine runs at a speed of nearly 1000 revolutions per minute, and yet, notwithstanding this high speed, the socket wrench at the lower end of the spindle will instantly drop on a nut without marring it, drive it home, and if necessary, loosen it and back it off the bolt. As soon as the wrench of the machine engages the nut, the latter is screwed on the stud and tightened with surprising rapidity.

> The development of special machines, tools, and fixtures has become an essential part of automobile manufacturing practice. The use of tools designed to perform a single operation as efficiently as possible not only reduces manufacturing costs greatly, but also simplifies the making of duplicate parts accurately, since equipment designed particularly for one kind of work may have non-adjustable members, fixed locating points, or other features all tending toward greater precision, thus placing the quality of the product upon a mechanical and more dependable basis.

The machine is driven by an air motor *A*, which revolves spline shaft *B* through spur gears. Shaft *B*, in turn, transmits motion to the vertical spindle *C* through spiral gears. Between this vertical spindle and the nut-driving end, there is a friction clutch which can be adjusted so that it will slip whenever the nuts have been tightened sufficiently. By means of this clutch, each nut is automatically subjected to the same pressure or torque, and the machine can also be adjusted for driving nuts of different sizes. Below the friction clutch there is a positive two-jaw clutch through which the nut wrench is driven. When the machine is running idly, the nut wrench at the lower end of the spindle hangs free, and would remain stationary if gripped by the hand. When the spindle is lowered by hand-lever *D*, the upper half of the positive clutch engages the lower one, and the wrench, which is already resting on the nut, at the first touch of the upper clutch member, drops on the nut.

One of the ingenious features of this machine is that part of the mechanism which comes into action when it is necessary to back a nut off after tightening it. When a tightened nut is to be removed, more power is required at the instant of starting it backward than at any time while driving the nut on consequently, additional tension must be applied to the friction clutch to keep it from slipping and thus prevent the machine from loosening the nut. This additional tension is provided automatically by a

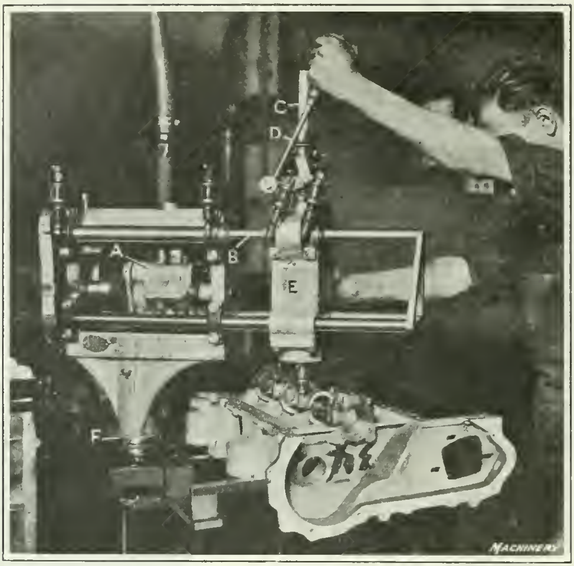


Fig. 1. Brown Nut-driving Machine with Radial Adjustment

simple arrangement, consisting chiefly of a spring and an auxiliary clutch, each member of which has three jaws of spiral or helical form. These teeth are so shaped that the two clutch members are positively locked when driving a nut forward, but if the spindle is reversed when the lower section is retarded by a tightened nut, the spiral clutch teeth slide up upon one another against the tension of the spring which normally holds them in engagement. As the result of this expansion of the two clutch members, the spring is compressed and this extra compression subjects the friction clutch to additional pressure so that it will transmit enough power for starting the tightened nut backward at the instant of reversal.

When the machine is in use, the spindle is manipulated vertically by lever *D*, which the workman seen in the illustration is holding with his left hand, while he moves the entire head *E* in or out along its three guide rods with his right hand, which grasps a suitable handle on the opposite side from that shown. In addition, the entire machine is free to swing about a vertical axis, and a ball thrust bearing is provided at *F* to give a free easy swinging movement. This machine is the invention of Spencer Brown who has developed a number of other time- and labor-saving devices for use in the Franklin plant.

Another design of nut-driving machine operating on the same general principle as the one described is used on classes of work not requiring radial or swinging adjustments, and the vertical movement of the nut-driving spindle is controlled by a foot-lever instead of a hand-lever. One of these machines operates at a speed of 1300 revolutions per minute, and notwithstanding this high speed, the wrench readily engages the nut and drives it home. On all of these machines, as soon as the nut is tightened and the spindle is raised either by a foot- or a hand-lever, according to the design, the positive clutch, which (as described in connection with the machine shown in Fig. 1) connects with the nut wrench, disengages so that the wrench hangs free and is simply lifted off the nut as the spindle moves upward.

Still another design of nut-driver that is extensively used in the assembling departments is shown in Figs. 2 and 3. This design is also driven by an air motor. The motor is suspended from an overhead track which enables the workmen to move the machine easily from one point to another. The framework supporting the motor (see Fig. 3) is pivoted to the end of a counterweighted lever (not shown) which balances the weight of the motor and driving mechanism and enables the workmen to easily manipulate the nut-driving end. The motor frame is supported by trunnions, and the motor itself has trunnion bearings located at right

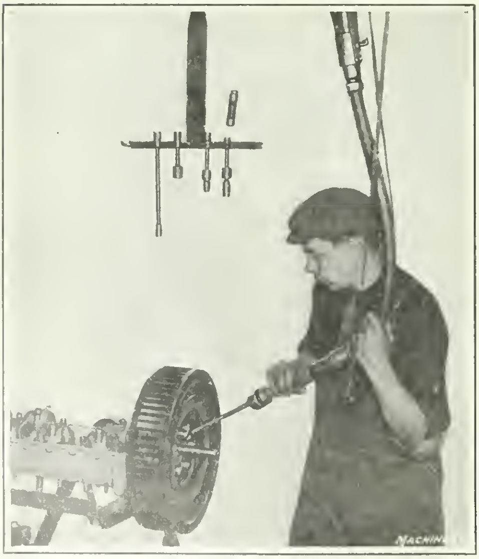


Fig. 2. Example of Work for which Overhead Type of Nut-driving Machine is adapted

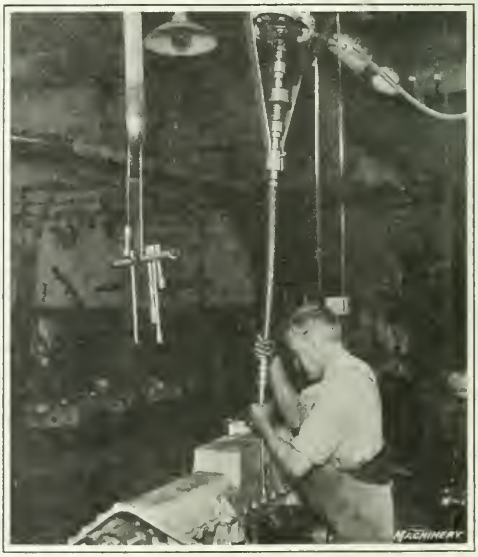


Fig. 3. Nut-driving Machine of Overhead Type with Flexible Shaft Drive

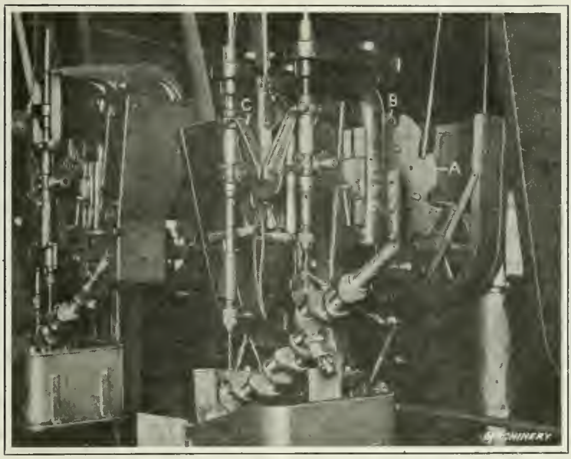


Fig. 4. Special Machines for drilling Crankshaft Oil-holes

angles to the frame bearings to give a universal movement. The drive is through an adjustable friction clutch which slips when the nut is tightened properly, the arrangement being practically the same as previously described. A flexible shaft connects the motor with the nut-driving end. This flexible shaft is needed when driving nuts which require holding the nut wrench in different positions, as when assembling the combination fan and flywheel shown in Fig. 2.

Spring Testing Fixtures

The valve springs of a Franklin motor are tested after heat-treatment to determine whether they exert the required pressure when compressed to a certain specified length. The apparatus used for this purpose is shown in Fig. 5. The first operation after heat-treatment is to set the springs, which is done by compressing them with the press seen at the left. An arbor press has been adapted for this work by attaching to the pinion-shaft a drum or pulley connecting with a belt which passes over an idler pulley and is attached at the lower end to a foot-lever. When the spring is compressed by forcing the foot-lever downward, the ram of the press is returned by the spring at the upper end. After this setting operation, the pressure exerted by each spring when compressed to the standard length is determined by the apparatus shown in use in the illustration. The springs must exert a pressure of from 25 to 30 pounds when compressed to a length of 1¾ inches. When a spring has been compressed to this length by turning a hand-lever which, through a pinion and rack forces the plunger downward, an electrical contact point attached to this plunger engages a fixed point, thus closing a circuit and lighting the electric lamp seen at the top of the fixture. Then the workman glances at the dial of the scale, which shows whether the pressure is within the prescribed limits.

Another spring-testing fixture which operates on the same principle as the one just described is shown in Fig. 6. This fixture is used for testing the clutch springs. It has the electrical contacts and light, the same as the valve spring fixture, but a handwheel is used for compressing the spring, which is quite long when fully extended and requires a comparatively large movement of the compressing member. These springs, when forced down' to the height shown in the illustration, must exert a pressure of about 230 pounds; this is the spring which normally holds the clutch members of the car in contact.

Special Machines for Drilling Oil-holes in Crankshafts

The oiling system of the Franklin motor is of the force-feed recirculating type, with a separate lead to each bearing. The path followed by the oil is from the oil reservoir to the pump, then through the oil-leads to the main bearings, then through the crankshaft to the connecting-rod bearings, and off the sides of the connecting-rods to the camshaft, cylinders, and wrist-pins. The flow of oil from the main bearings of the crankshaft to the crankpins is

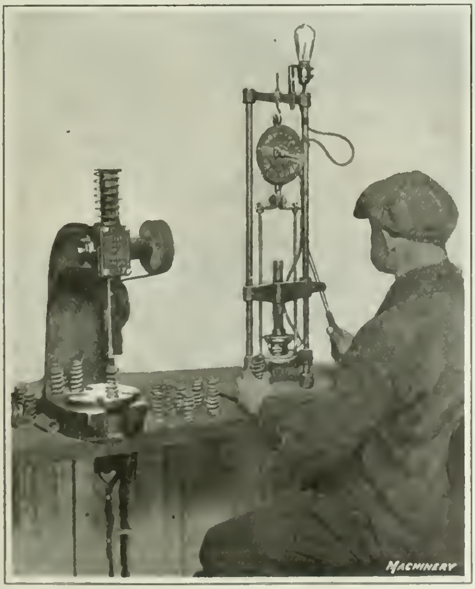


Fig 5. Apparatus used for setting and "weighing" Valve Springs

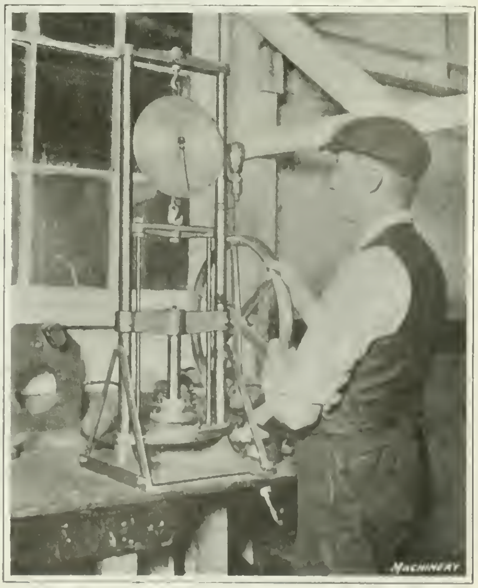


Fig. 6. Apparatus for determining Pressure exerted by Clutch Spring

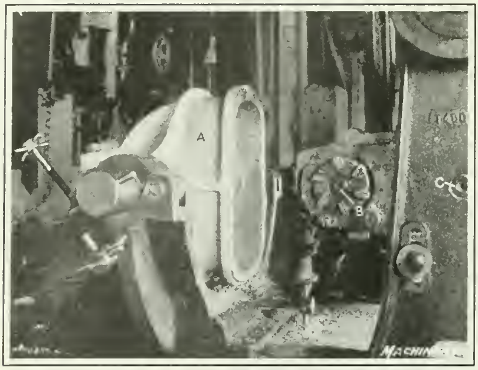


Fig. 7. Differential Housing and Special Attachment for Internal Milling

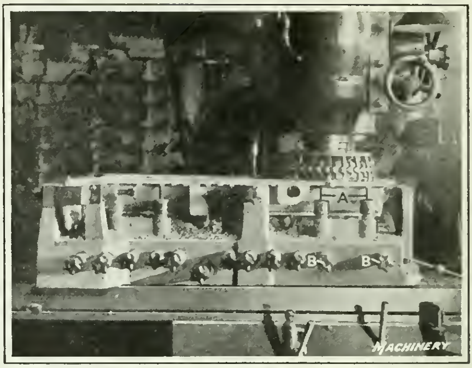


Fig. 8. Fixture used in performing Face-milling Operation on Engine Base

through holes which are drilled by machines equipped with special attachments for automatically backing out the drills at intervals to prevent the chips from clogging and breaking them. Two of these machines are shown in Fig. 4.

The progressive feeding and reversing movements are derived from cam *A*, which has several lobes for controlling the forward and backward motions. This cam engages a roller on lever *B*, which is pivoted in the center and connected at the opposite end through links with yoke *C*. The outer ends of this yoke are secured to the drill spindle sleeves or quills. The total vertical movement of the spindle necessary for drilling a hole is about 2¼ inches, and when a hole is being drilled, the spindle and drill are withdrawn four times to clear the hole of chips. When the hole has been drilled half way through the crankpin, the web, and the main bearing, the machine is stopped automatically by a trip at the rear, which engages and releases a latch, thus allowing the belt to be shifted to a loose pulley by the action of a spring. The crankshaft is then reversed in the fixture and the other half of the hole drilled, the two holes meeting in the center of the web. The crankshaft is held at an angle of about 37 degrees for this operation in the fixture shown in the illustration. The six oil-holes in each crankshaft are drilled on three separate machines, each having two spindles located at different center-to-center distances, depending on the spacing of the bearings.

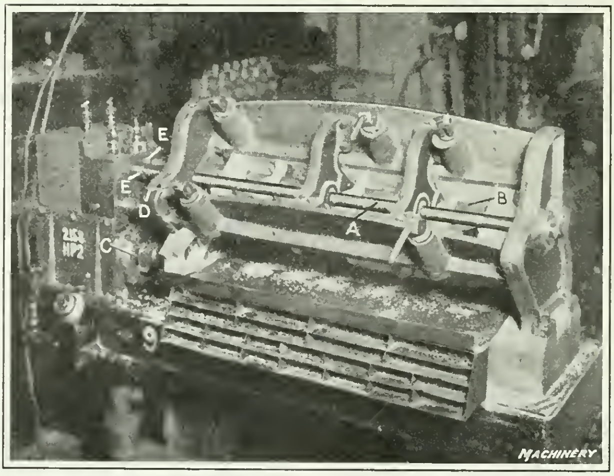


Fig. 9. Double-spindle Machine for boring Engine Base Bearings

Milling Attachments and Fixtures

A special attachment used for milling ball bearing seats in the differential housings is shown in Fig. 7. This seat is well within the housing *A*, so that it is necessary to use an attachment which is in the form of

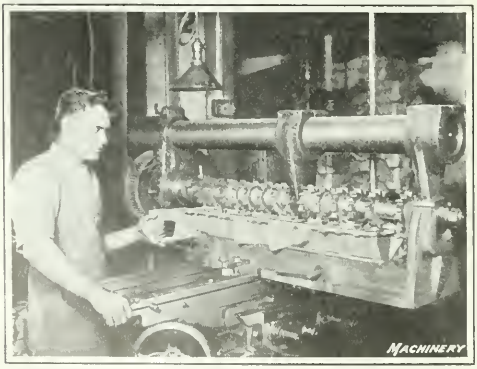


Fig. 10. Milling Ends of Engine Base Bearings

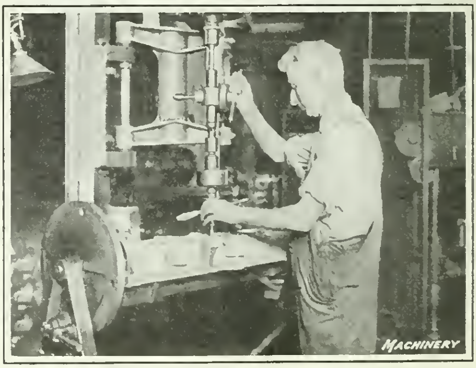


Fig. 11. Tapping Holes in Engine Base

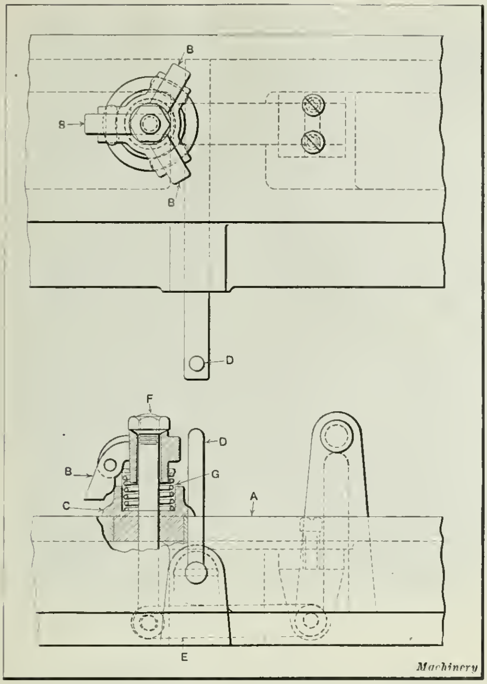


Fig. 12. Expanding Type of Clamp used on Engine Base Fixture shown in Fig. 10

an arm that carries at its end the two cutters and is long enough and narrow enough to reach within the housing. The end of this arm is shown in the illustration. The arbor *B* carrying the two cutters is driven from spindle *C* connecting with the main spindle, through three spur gears. Another internal facing attachment similar to the one described is used for milling certain interior surfaces on the transmission case.

A face-milling operation on the engine base casting is shown in Fig. 8. This is an aluminum alloy casting, and the bottom face is first milled on the vertical-spindle machine shown in this illustration. The fixture used is designed to hold the casting firmly by means of contact points engaging the rough surfaces. There are a number of these contact or locating points (like those shown at *A*) in the form of rods which are provided with springs that tend to push them upward; consequently, when the casting is placed in the fixture, all these spring-supported rods are held up into contact with it, and then they are locked in position by turning locking screws. The two locking screws for rods *A* are shown at *B*. Some of these screws lock the rods on the rear side. With this arrangement the contact points automatically adjust themselves to compensate for slight irregularities in the casting, which is firmly supported against the downward thrust of the milling cutter.

The fourteen sides of the seven main bearings of the engine base are all milled at one time by a gang of fourteen cutters arranged as shown in Fig. 10. The fixture used for this casting has two clamping devices of interesting design, arranged as shown in Fig. 12, which is a detail view of one of the clamps. The milled face of the casting rests upon the surface *A* of the fixture, and the three equally spaced clamping members *B* extend up through a circular opening in the casting and are tightened or released by levers *D*. When this lever is turned, a cam surface forces pivoted link *E* and bolt *F* downward; then cam surfaces on the lower sides of the three pivoted fingers *B* of each clamp engage the curved flange of part *C* and are forced outward far enough to grip the casting. When lever *D* is turned in the opposite direction, bolt *F* and the pivoted clamps are forced upward by spring *G*; then the fingers move inward far enough to pass through the hole as the casting is lifted up off the fixture.

Special Boring Machines for Engine Bases

The main-line and camshaft bearings in the engine base are bored by special machines designed exclusively for this work. One of the machines used for the first boring operation is illustrated in Fig. 9. This machine bores the camshaft bearings and the semicircular seats in the casting that receive the linings of the main crankshaft bearings. There are two boring-bars *A* and *B*, which are driven from a motor *C* through suitable reduction gearing. Bar *A* is for the main bearing seats and bar *B* for the camshaft bearings. These bars are supported by four bearings in the heavy frame of the machine, which serves as a fixture for locating and holding the casting. The milled face of the work is clamped against the under side of the fixture, and the work is located by two stops which engage the side of the casting at each end. These stops are held in the locating position by a form of bayonet lock, and by turning them a small part of a revolution they are forced by springs back out of the way, so that the casting can readily be inserted in or removed from the fixture. The five clamps for holding the casting in position are in the form of hook-bolts which are drawn up against the casting flange by eccentric levers *D*. Each bar passes through a threaded sleeve at *E*. These sleeves are revolved at a slower rate than the bars, and provide the feeding movement when engaged by segments of nuts which are controlled by small hand-levers. The boring operation on this machine requires only four minutes of actual cutting time.

The final operation on the main-line bearings of the engine base is illustrated in Fig. 13, and takes place after the linings and caps are assembled. This machine is of the same general design as the one illustrated in Fig. 9, except that it has a single boring-bar. The casting in this case is located by the milled face and by plugs, which enter the bored camshaft holes.

Tapping and Drilling Fixtures

When the engine base and oil tank are assembled, there is a short Acme thread in the main-bearing seat at one end.

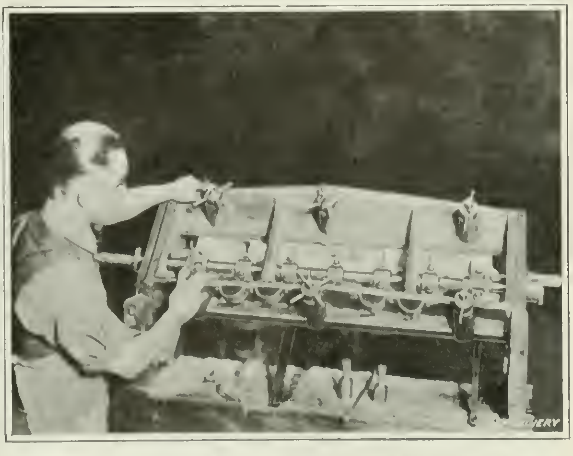


Fig. 13. Special Boring Machine used for finishing Main-line Bearings in Engine Base

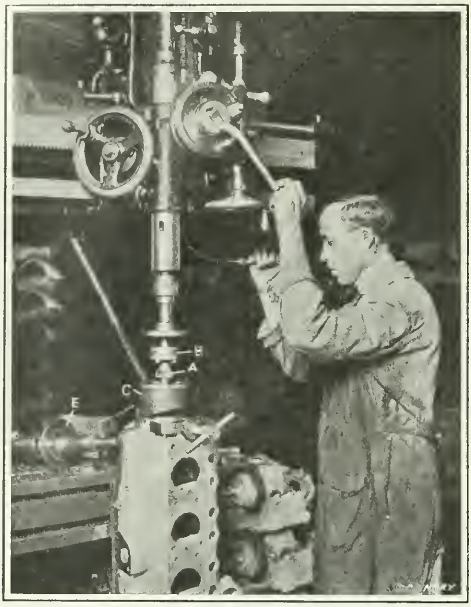


Fig 14. Special Tapping Attachment for cutting Thread in Semicircular Seat

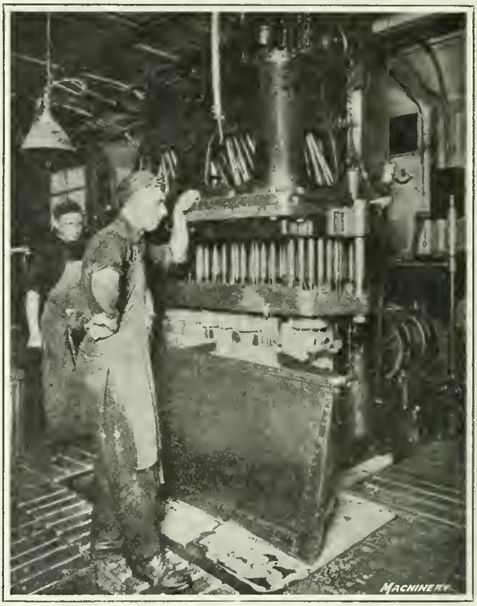


Fig. 15. Multiple-spindle Machine used for Drilling Operation on Engine Bases

The joint between the two parts divides this thread, one half being in the base and the other half in the tank casting. The thread must be cut in each casting before the two are assembled, and each half section must match to form a continuous thread, the same as though the tap were run through the hole formed when the parts are assembled. The fixture used for this operation is shown in Fig. 14. The casting is held in a vertical position against the fixture, and the thread in the semicircular section is cut by tap *A*, which has on its shank a short lead-screw *B*. As the tap is fed downward it is steadied by a pilot, and before it begins to cut the thread the lead-screw enters a nut in part *C* of the fixture. The tap and lead-screw always remain in the same relative positions, and as the work is also located the same in each case, the half thread is cut the same in each casting and it matches with the other half thread, because the latter is also cut by means of this fixture. Just below this threaded part of the casting there is a semicircular recess formed by the tool seen on the table at the left of the fixture. The cutter of this tool is pivoted approximately in the center and the upper end is tapering, so that when collar *E* slides upward on the shank of the tool, the lower end of the cutter swings outward. In use, the pilot enters the hole in the fixture and then collar *E* engages the top surface of part *C*, thus gradually forcing the tool outward and forming the recess to the required depth.

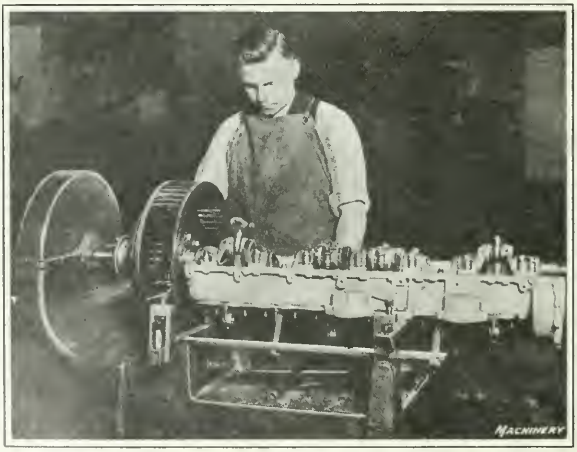


Fig. 16. Power-driven Stand for testing Crankcase Bearings

The construction of a modern automobile motor requires the drilling of a large number of holes, and this work must be done very rapidly in order to avoid an excessive overhead in the drilling department. One of the large multiple-spindle drilling machines used in the Franklin plant is shown in Fig. 15. This view shows how the machine is used for drilling engine bases on the bottom side, and at the same time for drilling the holes required in the end of the base, two castings being drilled simultaneously. One casting is clamped in a horizontal position, and the other is held in a vertical position against the end of the fixture. Seventy holes are drilled at one time in the bottom face and end. After one lot of castings has been drilled in this way, sixty-three spindles in other positions are provided with drills, and the same machine is used for drilling the top side of the base castings.

The machine and fixture used for tapping the engine base holes are illustrated in Fig. 11. The machine is a post-radial type, the frame being pivoted at the post or supporting end and also in the center. This machine has an aluminum alloy frame to reduce the weight and make it easier to manipulate. An Errington tapping attachment and a "Magic" chuck are used. The fixture is of the trunnion type and has an indexing disk and plunger for locating it in different positions. This simple equipment has proved very satisfactory and rapid. Thirty-four holes of different sizes are

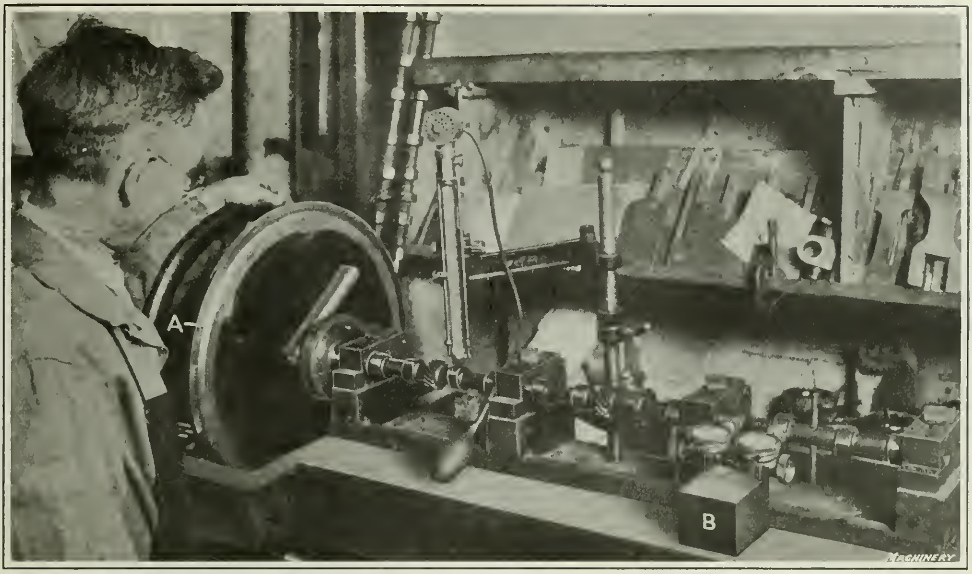


Fig. 17. Fixture for testing Accuracy of Camshafts

tapped on one side of the casting, and twenty-nine on another side in fifteen minutes.

Power-driven Fixture for Testing Main Crankshaft Bearings

Notwithstanding the great care with which the main bearings of the crankcase are hored, it is desirable to scrape them lightly at different points to relieve any high spots which may exist and secure an evenly distributed bearing surface and a perfectly free movement without play. In order to locate any bearing spots that require relieving slightly, the crankshaft is rotated slowly in the crankcase bearings. Formerly this was done by hand, hut now there is a battery of six machines in the engine assembling department for revolving the crankshafts by power. One of these machines is illustrated in Fig. 16. This machine, which is controlled by a hand-lever, revolves the crankshaft long enough to reveal any high spots in the bearings; then the crankshaft is removed and the crankcase bearings are examined and scraped wherever necessary.

Camshaft Testing Fixture

The camshafts are tested to check the shape and angular positions of the suction and exhaust valve cams by means of the fixture shown in Fig. 17. This view also shows the scleroscope employed for testing the hardness of the cam surfaces. The large dial at *A* has marks on the edge representing the opening and closing points of the suction and exhaust valves. When a camshaft to be tested is placed in the fixture, the mark representing suction valve No. 1 is set opposite the fixed zero mark; then the camshaft is turned until the dial gage on block *B* (which has previously been set to zero when in contact with the dwell of the cam) moves to the 0.015 inch graduation, which is the clearance allowance. The camshaft is then locked to the large graduated disk and the six pairs of suction and exhaust valves are tested, there being graduations on disk *A* for each cam. A limit of 8 degrees at the outer edge of disk *A* is allowed at the opening and closing points, which means a very slight allowance on the cam itself, since the disk is as large as the flywheel.

Valve Grinder

The special machine used for grinding-in cylinder valves has eight stations or working positions which are similar to that shown in Fig. 18. This machine is designed to revolve the valve rapidly, reverse its motion at frequent intervals, and change its position relative to the seat, so that

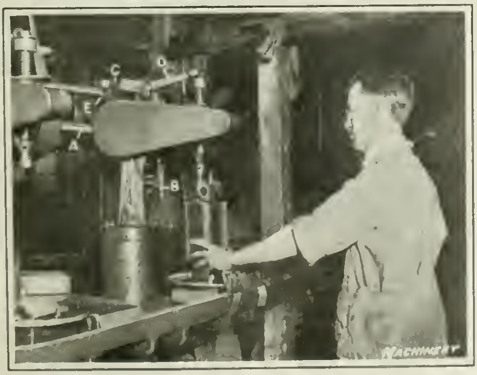


Fig. 18. One Head of the Multiple Valve Grinding Machine

Fig. 19. Rubbing a Franklin Hood with a Brown Rubbing Machine

the latter will be ground uniformly. The main shaft *A* drives a crank through spur gearing, when the crank is engaged by a clutch controlled by hand-lever *B*. This crank imparts a reciprocating movement to a rack which meshes with a pinion on the valve-grinding spindle, so that the latter revolves first in one direction and then in the other. Between the upper and lower sections of the spindle there is a universal joint which allows the valve to align itself and rest evenly on the seat. When the crank mechanism is engaged by shifting hand-lever *B*, the sections *C* and *D* of a cam-lever are also locked, so that cam *E*, at every revolution, exerts pressure on the grinding spindle through the spring shown. Ground flint is used as a grinding abrasive, and about 1½ minutes time is required to grind the seat. Immediately after the grinding operation each cylinder is tested under air pressure to make sure that the grinding has been done properly.

Power-driven Machines for Rubbing Painted Surfaces

The fine finish on the car bodies, door panels, hoods, etc., of the Franklin cars is obtained by rubbing down the different coats of paint until perfectly smooth surfaces are secured. This work, when done by hand, is slow and laborious, and this fact led to the design of the Brown rubbing machine. Fig. 19 shows one of these machines rubbing down the painted surface of a hood. The machine has two rubbers which are given a reciprocating motion. These rubbers move in opposite directions, and are driven by compressed air which enters cylinders containing aluminum pistons connecting with the rubbers. The machine is controlled by a small latch operated by the thumb of the right hand. The water used flows down to the surface being rubbed, through a small pipe connecting with an overhead reservoir. The machine weighs twenty pounds and is supported by the two rubbers and a flat base; the operator simply has to guide it over the surface. The rubbing members are so arranged that it is possible to rub an uneven or a rounded surface, and the machine can be used on vertical as well as horizontal surfaces. The first rubbing operation on the aluminum bodies is on a metal surface, and an abrasive is used. When rubbing color varnish coats, felt is employed. This machine has made it possible to rub about twice as much work as was formerly done by hand.

* * *

DYNAMIC BALANCING STAND

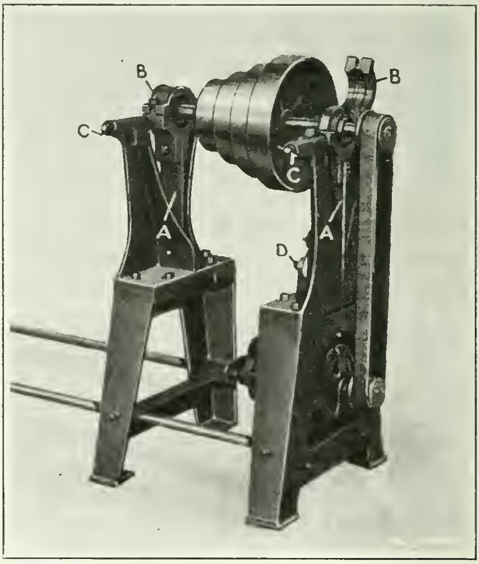
In an article "Dynamic and Static Balancing," published in the December, 1918, number of MACHINERY, an explanation was given of the requirements that must be fulfilled in order to bring a rotating member into dynamic and static balance. Equipment used by various manufacturers for the purpose of obtaining dynamic balance was also described in this article and in the subsequent article on this subject which appeared in the January, 1919, number.

In the accompanying illustration is shown a balancing stand developed by William S. Gould, works manager of Fay & Scott, Dexter, Me., and used by that company in obtaining a condition of running or dynamic balance in cone pulleys and other rotating machine parts. While this machine differs little in principle from the machines already described in MACHINERY, the structural details are somewhat different.

It will be seen that the two bearing housings are supported by flat springs *A*. These springs are 2¼ inches wide by 3/16 inch thick. The bearing housing caps *B* are hinged in order to facilitate the insertion and removal of the arbors on which the work is held. The housings are equipped with light-weight self-aligning S K F ball bearings, which are fitted to the balancing arbor by means of adapters. By the use of adapters of different sizes, any balancing arbor up to 1 15/16 inches in diameter can be employed.

The bearings are backed up on each side by cushions consisting of a plunger actuated by a coil spring, the tension of which may be adjusted by screws *C*. It will be noted that provision has been made for extending the stand to take work of various lengths. To change the distance between the stands, it is only necessary to loosen two set-screws and slide the left-hand stand along the two 1-inch rods which tie the stands together. The arbor that supports the work is driven by a ¼-horsepower motor, running at 1200 revolutions per minute, which is mounted in the lower frame of the right-hand stand. The motor starting switch is located at *D*. The balancing arbor is driven by a belt which runs on a pulley attached to the end of the arbor.

The procedure in balancing a cone pulley, for instance, is as follows: After the cone pulley has been finished all over, it is mounted on a balancing arbor. Adapters of the proper size are then placed at each end of the arbor, the S K F ball bearings being mounted on the adapters. After attaching the pulley at the end of the arbor, this completely assembled unit is placed in the balancing stand. The ball bearings are then clamped securely in place by means of caps *B*. After coating the exposed surfaces of the balancing arbor at each end of the cone pulley with Prussian blue, the driving belt is attached and the motor started. If the pulley is out of dynamic balance, the vibration resulting from this condition will be transmitted to the bearing housings. The housings being supported by flat springs *A*, are, in turn, vibrated, the magnitude of the vibrations being somewhat limited by the cushion springs at each side of the bearing housings. When the motor has attained the required speed, two fine-pointed scribers are advanced at each side of the pulley until they reach a point that leaves a slight mark in the Prussian blue. The direction of rotation is then reversed and the scribers again advanced, after being moved a sufficient distance along the arbor to prevent the second set of scribed marks from coinciding with the first set. These marks enable the operator to determine the light and heavy portions of the pulley so that he can either attach weights to the light side or remove material from the heavy side. The amount of weight to be added or the material to be removed must, of course, be determined by experiment. After adding weights or removing material, as the case may be, the pulley is again placed in the balancing machine, this operation being repeated until there is no vibration of the pulley.



Dynamic Balancing Stand for obtaining Balance of Cone Pulleys and Similar Parts

Progressive Assembly Conveyors

Advantages of System in which Products being Assembled are Conveyed Past the Assembler

By C. W. STARKER

THE fundamental idea of facilitating the transporting of material over relatively short distances by some form of conveyor dates back to early periods of engineering development. The use of conveyors for such hauling purposes broadened as labor costs rose and the quantities of material to be handled increased with the large-scale operation of modern plants. Accordingly, many different types of conveyors have been brought out, among which are power-driven conveyors using flat belts for carrying the material; power-driven chain-operated conveyors with buckets and various other suitable containers or supports; and gravity conveyors in which the material travels over freely revolving and closely spaced rollers, this type being used when it is possible to have the material travel down a slight incline.

Conveyors of these classes are applicable to a wide field. In connection with the generation of electrical energy in large central stations, conveyors are employed for hauling coal and ashes; building construction would be almost impossible without mechanical conveyors for handling gravel, and cement; and, finally, in large mail order houses or canning plants, etc., the handling of the thousands of barrels, boxes, and packages of all descriptions would be a tremendous problem if it were not for the so-called merchandise-distributing conveyors used.

Advantages of Material-hauling Conveyors

In most cases, the advantages gained by employing conveyors exceed what might be expected offhand. It is not merely a matter of substituting mechanical means for the physical efforts of men, with the corresponding saving in handling cost, but there are many other gains, depending to a certain extent on individual conditions. For instance, the systematic and continuous receiving and delivering of material is conducive to rapid and orderly production, and invariably results in a great saving of valuable floor space. Anyone who has had occasion to observe a crew of men handling material, as for example, unloading bundles from a freight car, by the hand method, in which each bundle is passed from man to man, and then has seen a crew handling the same material on a conveyor, will have noted the greater stimulus afforded toward speedier work and will have observed how much less monotonous and tedious the job becomes.

Conveyors on which Operations are Performed

From material-hauling and merchandise-distributing conveyors, the success of which has been demonstrated so long and in many industries, it would seem but a short and logical step to the application of the same principles for hauling parts during a manufacturing operation, or between one manufacturing step and the next one. However, it remained for the automobile industry with its progressive spirit to really make a start in this direction. In connection with the japanning of products, overhead conveyors have been developed. The parts on which the japan coating is to be baked, such as automobile fenders, etc., are supported on rods 5 or 6 feet long and spaced about 6 inches apart which are propelled by a chain at the desired speed. These are arranged as either intermittent or continuous conveyors.

In the former type, the parts to be enamelled are hung on a section of the conveyor equal to the length of the oven. When the conveyor is started, the work passes into the oven, while that which has been there passes out at the far end, where it is allowed to cool prior to receiving the next coat. The oven is closed during the time of baking, which varies from one to two hours, the baking temperatures ranging from 400 to 500 degrees F. The conveyor is in motion only during the loading stage, and as it travels about 20 feet per minute and the length of such ovens is about 20 feet, the time of loading is approximately one minute. By this method, therefore, the heat loss is minimum and the time required for loading and unloading is a fixed and readily controlled amount, so that steady and full production is assured.

The continuous type of japanning conveyor is in motion constantly at a rate of approximately 2 feet per minute, and so a correspondingly greater oven length is required than on the intermittent conveyor. The oven length depends upon the baking time required. The ovens, in this case, are usually installed overhead in order to conserve the heat.

Second and third japanning operations can be readily taken care of by adding other units as required, either in a straight line, or, if the available length of floor space is limited, by placing the ovens side by side and alternating the direction of conveyor movement.

Progressive Assembly Conveyors

The application of the same conveyor methods to assembling operations is obviously so advantageous that now, after they have been in use for some years, it is a wonder that they were not developed long before. Credit for first operating a progressive assembly conveyor is generally conceded to belong to the engineers of the Ford Motor Co. They were the first to realize that labor costs are less and assembly time is reduced when the unit being assembled is conveyed past supplies of component parts, than when the component parts are transported to a stationary assembling location. The first unit on which this method was tried by the Ford Motor Co. was not in the assembly of the chassis or in the final assembly of the car, as might have been expected, but rather in the assembling of magnetos. Skilled men were required on this job when it was done by the bench method, each man performing the entire assembling operation from beginning to end, and the resulting product, depending as it did on individual skill, was far from uniform.

With the progressive assembly method, however, a job is split up into many simple steps, each one of which may be performed by an operator generally termed unskilled, but who soon becomes an expert on the one step he performs. This being the case, it is possible to pay such a workman higher wages than he would be able to earn on a job requiring more all-around skill, and the consequence is that he is loath to leave the more profitable employment. In the case of the Ford magneto, the assembling operation was split up into twenty-nine different steps by which the original assembly time of 20 minutes per man by the bench method, was reduced first to 13, then to 7 and later to 5 minutes.

The proper conveyor speed is a matter that can only be determined by actual operation and can readily be adjusted as the perfecting of the process goes on. In the case cited, a travel of 5 feet per minute was soon found to be much too fast, and when reduced to 1 foot 6 inches per minute was found too slow. By trial the best speed was determined to be 3 feet 8 inches per minute. The assembling of automobile engines, when done at the bench, required 1100 men working nine hours per 1000 motors. A year later, by the use of a progressive assembly conveyor, the same amount of work was accomplished by 472 men working eight hours. Expressed in the number of minutes each man spent in the assembly of one motor, for easier comparison, the bench time was 594 minutes against 226 minutes conveyor time.

Advantages of Progressive Assembly Conveyors

Today progressive assembly conveyor methods are used by all large automobile manufacturers. The principal advantages of the system may be summed up as follows:

Use of unskilled help, highly trained and most proficient in the performance of individual tasks, as against the expert all-around workmen required in assembling a complete job at a bench.

A job carefully studied in every detail and segregated into operations of short periods of time, as against an assembly job left completely to each man with a consequent lack of control in the rate of output and a lack of uniformity in the parts assembled.

A continuous rate of production and a definite output. The operator does not lose time hunting up material, but has the job right before him. The lagging operators are helped by instructors to keep the established pace.

The necessity of the entire organization functioning with accuracy and reliability from the purchasing to the assembling and shipping departments. All departments must do their full share in order to maintain a continuous flow of supply parts to the assembling conveyor.

Ability to pay higher wages to operators than otherwise, as they work to better advantage on the segregated steps. They learn their individual tasks quickly, and as previously mentioned, are not inclined to leave a job when they earn more than they could on less detailed operations. The result is a low labor turnover—a factor which, in the past, has been a great and often under-rated source of expense.

Effect of System on Quality of Product

The full benefits of progressive assembly conveyors can only be secured when every component part delivered to the conveyor is made to the degree of perfection necessary for it to be assembled with the other parts, without losing time in excessive fitting. This has the beneficial effect of compelling each feeder section and each inspector in these sections, to maintain a high quality of the component parts, which results in a high quality of the assembled product.

In the same way, it may be said that a fairly standardized product, manufactured regularly in large quantities, is necessary in order to derive the full benefits from the progressive assembly conveyor plan. Special modifications of the product must not necessarily be eliminated, but it is only just that the greater cost entailed in their manufacture be charged to them. If, however, at any time the demand for some of these modified products becomes large enough, there is no objection to running the conveyor, at least part of the time, for these now standard articles.

Products need not be made in very large quantities to make this assembly procedure a paying proposition, or rather, conveyor assembly does not necessarily presuppose an unusually large volume of work. A broad general statement as to the required quantity of products cannot be made; each individual case must be studied and a cost comparison made, considering a possible reduction in the manufacturing cost of the product, together with the other gains that have been referred to.

New Fields for Progressive Assembly Conveyors

In view of all their advantages, there is no doubt that progressive assembly conveyors will be used much more extensively than they have been in the past. One interesting step in this direction has been made by a large manufacturer of stoves and ranges, and the conveyors in this plant have been in operation long enough to furnish reliable and interesting data. The installation consists of two conveyors of the type shown in the heading illustration, on which the work rests on chain-propelled hard maple slats 28 inches long, 6 inches wide and 2 inches thick. The working surface of the conveyors is 30 inches from the floor, each conveyor is 180 feet long, and driven by a 3-horsepower motor running at the rate of 1100 revolutions per minute. The motor is provided with an enclosed spur and worm gear reduction. The conveyors travel from 1½ to 2 feet per minute, and the ranges being assembled are spaced about 6 feet from center to center. At a travel of 1½ feet per minute, therefore, 15 ranges are assembled per hour or one every 4 minutes. Twenty men in nine hours produce from 240 to 270 stoves.

In addition to being now able to use unskilled help and to hold its men, the concern, through the installation of these two conveyors, has been able to transfer 100 men from assembling to other operations. At a saving of $7 a day a man, this means an annual saving of about $200,000. A more uniform output and an improved quality of product were noted from the beginning, and the saving in floor space was 27,000 square feet. In this instance, two hours of instruction have been found sufficient to train the average workman adequately to take his place on the line. Other industries that would no doubt be benefited by progressive assembly conveyor methods are the manufacture of agricultural implements, all classes of moderate-size machinery, furniture, pianos, electrical appliances, phonographs, etc.

Production Planing in Machine Tool Plants

Efficiency Factors in Production Planing—Points to Observe in Obtaining Maximum Output from Planers

It is the general practice to bring rough castings to the planer and make the work done on this machine the first operation; then the planed surface is frequently utilized as a locating point for subsequent operations. However, there is no definite reason for this procedure, and some shops make a practice of performing various milling, boring, and other operations on their work, after which it is brought to the planer that does the roughing and finishing operations on the surfaces that are finished on a machine of this type.

Methods of Setting up Planer Work

Owing to the great diversity of sizes of work to be planed, it is natural that many different methods are used in setting up planer jobs. Such methods must be adapted to both the size of the castings or forgings to be planed and the condition of the work when it comes to the planer, as well as the nature of the operation to be performed. In planing various small pieces of work, it is feasible to provide work-holding fixtures of suitable form, and typical examples of such fixtures have been illustrated and described in previous installments of this series of articles; but for handling large heavy castings, it is quite the general practice to set the work on a number of small blocks placed directly on the planer table, and the setting up of such work calls for far more judgment on the part of the planer-hand than is the case where work-holding fixtures are provided. This is quite naturally the case because not only are large pieces heavier and more difficult to handle, but as there is no fixture to assist the operator, it is chiefly his judgment that determines the accuracy of the finished work.

Importance of Solid Foundations

In setting up large heavy pieces of work, the points of primary importance are to provide a solid foundation; to have the work properly leveled up; and to arrange for finishing the planed surfaces in correct relation to the outside faces of the casting, and to the various bearing bosses and other fixed points. Obviously, it is important to have a solid foundation for the work, because if there is any tendency for a casting to move while being planed, accurate results cannot be secured. There is another important consideration, namely, the fact that all materials are flexible in amounts that vary according to their form, and this point is also of importance in connection with the leveling up of the work.

All men of experience in handling engineering materials know that even the heaviest castings, and other metal parts of considerable length, will sag to an appreciable extent if the method of support is such that there is a large amount of overhang from the point or points of support. Take the case of a large casting held on a planer table by blocks which raise the work sufficiently so that, if necessary, it is possible to plane the sides down to the bottom without damaging the planer table. Not only is it important for the height of the different blocks under the work to be so adjusted that each block comes into contact with the under side and carries its proper proportion of the load, but flexure of the casting must be taken into consideration, and the blocks must be located and adjusted in such a way that the work will be held in its normal position.

Application of Principle that Three Points Determine a Plane

In setting up planer work, as in the design of work-holding fixtures for use on various other types of machine tools, use is frequently made of the geometrical principle that three points determine a plane. To explain the value of this principle in the present instance, the old analogy is drawn between the facts that a three-legged stool will always stand firmly on the floor regardless of its inequalities, while a four-legged stool will almost invariably be found to rock back and forth, because one of its legs does not find a firm foundation. In setting up a large piece of work that is

Maximum output in the operation of any type of machine tool can only be obtained through a careful study of all conditions which affect production. In the setting up and planing of production work, there are many apparently trivial points which constitute what may be designated as "efficiency factors," because they determine the rates of output, and the consequent labor and overhead costs that must be charged against every piece turned out.

to be planed, many shops make a practice of first placing three blocks between the work and the planer table, which are used as a preliminary foundation for supporting the work.

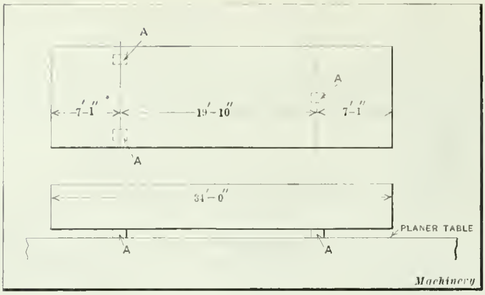


Fig. 1. Diagram illustrating Application of Rule for locating Three Primary Supporting Blocks under the Work

Determining Locations of Three Supporting Points

The Niles Tool Works Co., of Hamilton, Ohio, builds a great many heavy-duty machine tools in which there are parts made from large castings, and this company's methods of setting up these heavy pieces for planing are based upon knowledge gained through years of experience. In these shops, the three blocks on which the work is supported are located according to the following rule, the arrangement of blocks *A* being shown diagrammatically in Fig. 1. Two blocks are placed at one end and one block at the opposite end, these blocks being located a number of inches from each end of the work which is determined by multiplying the total length of the work expressed in feet by 2.5; thus, for a casting 34 feet long, the blocks will be located at a distance from each end of the casting which is:

$$2.5 \times 34 = 85 \text{ inches} = 7 \text{ feet } 1 \text{ inch}$$

Of course, this location for the three blocks upon which the work is first placed need only be approximate. The positions of the blocks are adjusted to take advantage of the shape of the work; for instance, if the work is ribbed, the blocks should be located beneath the ribs. The idea is to have them positioned in such a way that an approximately uniform amount of flexure will take place in the unsupported ends of the work and in that portion which bridges the distance between the blocks. After the three blocks have been placed under the casting, the method of procedure is to carefully level it up by placing paper packings or thin sheet metal shims between the blocks and the work, and also to bring the work into accurate alignment with the line of travel of the planer table. The method of procedure in accomplishing this leveling and lining up will vary according to the work, but it is important to note that in any case all adjustments of the position of the work on the planer table must be made relative to the bosses which will subsequently be machined to receive journal bearings, the positions at which slides etc., will be planed, and other similar fixed points.

Laying out Work Preparatory to Planing

Reliance cannot be placed upon the outside surfaces of castings or large forgings, as these are subject to a sufficient amount of variation to frequently make it impossible to "clean up" all finished surfaces in a satisfactory manner, if the outsides of the castings were used as reference points in setting up the work. In starting to line up a piece for planing, the first step according to the method followed by the Niles planer-hands in Hamilton, Ohio, is to lay out on each end of the work the outline of the surfaces which have to be finished. This is done by taking white chalk or crayon and marking heavily around the outline of the various holes and flat surfaces on the casting which have to be machined, an example of some work laid out ready for planing being shown in Fig. 2. Then, using straightedges squares, compasses, etc., the outline of these finished surfaces is carefully scribed on the work.

With such an outline for his guidance, it is then an easy matter for the planer-hand to level up the casting on the table of his machine and to make other necessary adjustments, so that he is sure that the various surfaces to be planed will not only "clean up" satisfactorily, but that they will also be properly located relative to other fixed points.

In most cases, such as that of the casting shown in Fig. 2, double lines are scribed on the upper and lower sides of the work, so that when the roughing cut is taken the inner line can be used as a "safety line." For the first roughing cut,

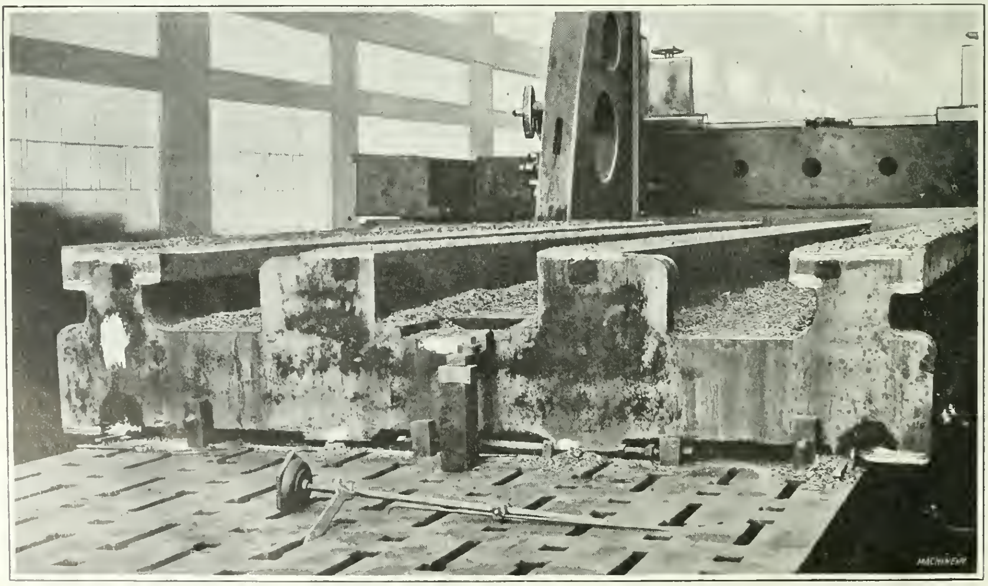


Fig. 2. Example of Work laid out preparatory to planing, to assure having All Finished Surfaces satisfactorily "cleaned up"

the tool is set to the outer line, and this leaves sufficient stock for the finishing cut. The inner or "safety" line remains on the work after the finishing cut is taken.

At the Niles Tool Works Co.'s plant all planer-hands operating machines with a capacity of 60 inches or upward between the housings are required to lay out their own work. Such is the procedure at present; but it is planned to install surface plates and have specialists who do nothing but lay out work, as it is believed that their intensive training in this important branch of machine shop practice would enable them to not only do better work, but also to effect a saving of time.

Supplementing the Three Primary Supporting Points

It has been explained that three blocks are used to hold the work while obtaining a preliminary setting, but before the actual work of planing is started, these points will be supplemented by numerous blocks placed to support the work at intermediate points. However, in putting these auxiliary packings in place, great care must be taken to bring each block to such a height that it will bear its due proportion of the load but will not extend high enough to prevent other blocks from performing their proper service. The placing of these supporting blocks in position and raising them to the correct heights is part of the work that calls for considerable judgment. In building up the height of the three primary supporting points on which the work is first placed, and in putting auxiliary supporting points in position, use will be made of either a pinch bar or a screw jack, according to the size of the work. The use of such tools has been explained in previous installments of this article, so that further description is unnecessary.

For packing beneath the supporting blocks used to hold moderate sized work, the best material to use is strips of tissue paper with sheared edges. It is important to note that the practice of tearing these papers is undesirable, because it leaves a fuzzy edge; and this shredded paper along the margins may be particularly objectionable in cases where the papers are used in conjunction with gages to check the accuracy of the work. The use of sheet metal shims between the supporting blocks and work is also discouraged among authorities on precision planing, because such strips of metal are likely to be concave or convex in form, thus creating a springy foundation instead of one that is perfectly rigid. Also, there is likely to be a considerable variation in the thickness of sheet metal shims, while those made of good tissue paper are practically uniform. However, in setting up large rough pieces of work, the use of sheet metal shims is advisable. The weight of the work takes up all spring in the shims; and they are not likely to be crushed, as is the case with paper packings.

Effect of Structural Readjustments on Accuracy of Planed Work

In order to be sure of obtaining accurate results in planing, it is necessary for the man who plans the order in which various operations are to be performed to possess a knowledge of the structural readjustments which are likely to occur in a piece of metal as subsequent machining operations are performed on it. The two most important examples of this kind are the following: Where a casting first comes to the machine shop and it is required to take a cut over only one of its surfaces, the removal of the outer scale will cause the strains imposed upon the metal to be relieved in such a way that the entire casting is likely to be sprung to a considerable extent. It takes time to accomplish this change of form and, as a result, if the finish-planing operation were to be performed directly after taking the roughing cut, the casting would tend to continue changing its form after the finishing operation had been completed, and thus the accuracy of the work would be seriously impaired.

Benefits Secured by Allowing Work to "Season" between Rough- and Finish-planing

Difficulty of this kind is readily overcome by setting the casting aside to allow it to "season" between the time that the roughing cut is completed and the starting of the finishing cut. Where such a practice is followed, all of the changes of form resulting from relieving the strains imposed upon the metal by removing the outer scale will be completed during the period of three weeks that is allowed for seasoning, and then the finishing cut can be taken with assurance that the work will remain in the form to which it is planed. This practice of allowing time for "seasoning" is not necessary, in all cases; but where the work is long and somewhat thin, the effect of relieving the strains by removing the scale at one side is most pronounced, and it is on such work that the allowing of time for "seasoning" before taking the finishing cut is most imperative.

Where a piece of work has been finish-planed with a high degree of accuracy, a careful inspection with the use of accurate gages may indicate that it is perfectly true to shape and size at the time it leaves the planer, but if subsequent machine work includes such operations as the boring of holes of considerable size, the relieving of internal strains resulting from the removal of a substantial volume of metal is likely to result in a structural readjustment that will seriously impair the accuracy of the planed work. As a result, pieces that have been planed within limits that will insure their interchangeability at the time they leave the planer may require scraping after the performance of subsequent boring and other operations, in order to make them fit the parts with which they are to be assembled.

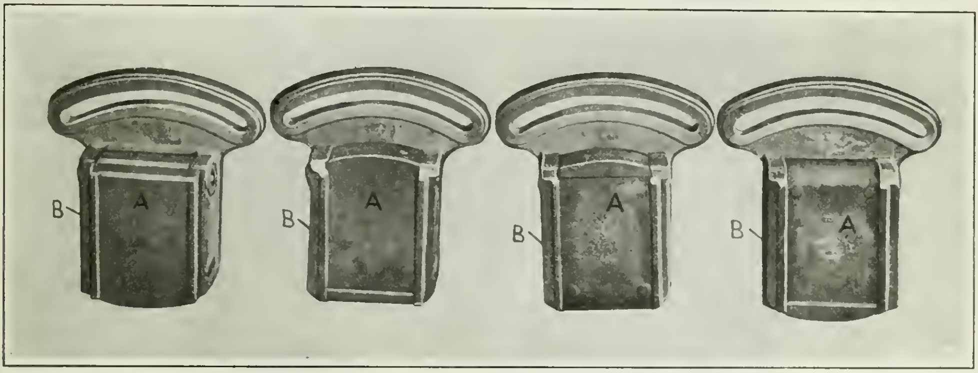


Fig 3. Example of Accuracy Attainable in planing. Aprons A assembled in Tool-boxes B in All Possible Ways, are a Push Fit in the Boxes without requiring Planed Sides of Aprons or Boxes to be scraped

Importance of Carefully Planning the Order in which Planing Operations are Performed

Careful planning of the order in which machining operations are performed may overcome a lot of trouble of this kind. For instance, in the case which has just been cited, if the boring had been done prior to performing the finish-planing operation, the exercise of sufficient care in planing would probably have made it possible to finish-plane down to a satisfactory bearing, without the necessity of scraping, which is an operation that consumes a considerable amount of time and is therefore expensive. But frequently the nature of the work will be such that it is far more desirable to locate from a planed surface for the performance of a boring operation than to attempt to locate the piece from a finished hole for performing subsequent planing operations. As a result, many shops having such work to handle consider it more desirable to first plane the work to size, allowing a sufficient volume of metal for scraping, so that compensation may be made for errors introduced by internal readjustments of the work of the nature to which reference has just been made.

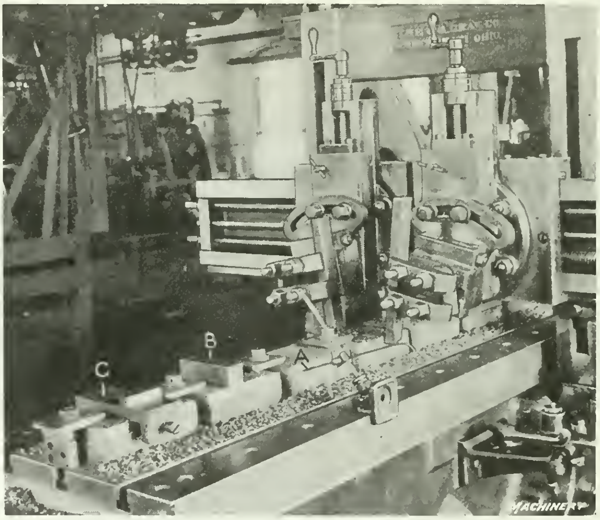


Fig. 4. Method of setting Tools and Work for rough-planing Sides of Aprons shown in Fig. 3

Degree of Accuracy Attainable in Planing

In many shops, the impression prevails that the planer is a machine which is only adapted for the economical performance of preliminary work on parts that have to be finished accurately, or for finishing the machine work where only a reasonable degree of accuracy is demanded. The opinion is also quite generally held that planed work requires subsequent scraping in order to bring it within close limits of accuracy. As a matter of fact, this impression is erroneous and has doubtless gained circulation through the fact that planers are widely employed for machining the vees on lathe beds and carriages, the ways on planer tables and beds, and for other work where a practice is made of subsequently scraping the planed surfaces to bring them to a bearing. However, keeping in mind the way in which scraping is done, a very little thought should make it evident that where close limits of accuracy are necessary and where the straightness of the finished surfaces is important, the result produced by performing a carefully conducted finish-planing operation should be far superior to any results that can be accomplished by the performance of scraping operations subsequent to finish-planing.

Careful consideration of this subject will make it apparent that, theoretically, the planer is ideally adapted for the production of perfectly straight flat surfaces; while scraping cannot do more than approximate the same results. It is estimated that under average conditions five strokes of a scraping tool are required to remove 0.001 inch from the surface of a piece of cast iron or soft steel, and the effect of scraping to bring two planed contacting members, such as a lathe bed and carriage, to a satisfactory running bearing, is that a series of hills and valleys is produced on the work. High points on the surfaces of two contacting members can be reduced by scraping so that a satisfactory bearing will be obtained. But surfaces reduced to the required form in this way can never be perfectly straight or flat like those obtained by finish-planing; and some authorities on this subject state that there are many classes of work where the highest accuracy is required, in which the exercise of proper care in planing will make it unnecessary to do any subsequent scraping. For instance, the G. A. Gray Co. of Cincinnati, Ohio, conducts its shop work along lines which afford some remarkable examples of results that can be attained in performing planing operations.

In building Gray planers the top brace, for instance, is planed on each end to fit a gage with such accuracy that these parts are absolutely interchangeable. The corresponding surfaces on the housings, to which the top brace is fastened, are also planed to fit precision gages. The operation of finish-planing completes these surfaces without any subsequent scraping. Similarly, the housings are planed to fit accurately on the bed, without scraping or hand fitting. The planing operations are performed with the greatest care, and by finishing the job on the planer instead of depending upon subsequent scraping to obtain the required fit, the G. A. Gray engineers claim that superior results are secured. For running bearings, such as those between the carriage and ways of a lathe, more leeway is available; but the fit between the housings and bed of a planer and between the housings and top brace must be absolutely accurate. The two contacting surfaces must not only have a good bearing, but they must be true with reference to other parts of the machine It is possible to scrape the two surfaces to get the desired bearing, but the resultant bearing surface may be out of vertical. It is essential not only that the parts be in firm contact for the sake of rigidity, but they must also be true. It is claimed by engineers of the G. A. Gray Co. that such accuracy can only be obtained by finishing the parts on a planer. Obviously, the top brace, rail, housings, and table of a planer must be square with each other in every way, or the work done by the rail- and side-heads will not square up within the limits of tolerance required by progressive shops. Attention is called to the planing of the tongue on the planer housing and the corresponding groove in the bed. That such work can be done shows the capabilities of the planer as a precision tool.

Fig. 3 shows in concrete form, the degree of accuracy that can be attained in the performance of planing operations, where the necessary care is exercised. In this illustration there are shown four aprons *A* and tool-boxes *B* (frequently known as clappers and clapper-boxes). These pieces were regular production parts taken from a planer in the G. A. Gray Co.'s shops, and from left to right are shown, first, an apron assembled in the tool-box in the regular way; second, an assembly in which the apron is put into the tool-box reversed end for end; third, an assembly in which the apron has been turned upside down and reversed end for end; and fourth, the apron turned upside down.

In every case, the fit between the apron and tool-box is such that the greatest care has to be exercised in putting them together to avoid turning up the slightest burr at either edge, as this would greatly retard assembling the apron in its tool-box. Also, after the apron has been started in its box, considerable pressure is required to push it into place. Certainly, the degree of accuracy obtained in the performance of the planing operations on these aprons and tool-boxes is far greater than 0.001 inch, and while it is a dangerous practice to estimate fractions of a thousandth, without having accurate means for their determination, experienced shopmen in the Gray plant express the opinion that the results obtained on this job are well within a limit of twenty-five hundred-thousandths of an inch.

Method of Procedure in Planing Aprons

Fig. 4 illustrates the performance of the rough-planing operation on the sides of a string of thirteen G. A. Gray planer aprons of the type shown assembled in tool-boxes in Fig. 3. Prior to the performance of this operation, the castings have been rough- and finish-planed on their upper and lower sides; and the finished pads on the upper side of the blocks are utilized as locating points for setting up the work for rough- and finish-planing the edges that are the points on which accuracy must be attained. In setting up the work for the performance of this operation, the first step is to line up the castings with a surface gage *A*, the base of which is furnished with a shoulder that fits over the edge of the planer table. Lying across the top of the work to be planed, there will be seen an end gage *B* that is of the same length as the width to which the tool-blocks must be planed.

Method of Setting the Rough-planing Tools

In setting the square-nosed rough-cutting tools, the method of procedure is to lay this gage *B* across the work so that it is in contact with one tool, and then to run the rail-head carrying the second tool over until it engages an ordinary machinist's steel scale held in contact with the end of the gage. This scale is 1/16 inch in thickness, so that there is an allowance of 1/32 or approximately 0.031 inch for the straightening out and finishing cuts which will subsequently be taken down the sides of these castings. Having obtained the proper spacing for the tools, the next step is to provide for feeding them down to the desired depth. It is required to plane to the bottom of the castings, but care must be taken not to damage the planer table. This result is accomplished by using two thicknesses of paper, each of which is approximately 0.003 inch thick, that are laid on the planer table so the tools may be run down on these papers. When set in this position, the micrometer collar on the vertical feed-screw of each tool-head is turned to the zero position and then clamped to the screw, so that when the tool has been fed down so that its point is within 0.006 inch of the table, the micrometer collar will be at zero and the operator then stops the downward feed. Both tools are set in this manner, after which they are centered over the work, so that the sides are planed symmetrical with the center of the block The roughing cut is then started.

Resetting Tools for Taking an Intermediate Cut

After the roughing cut has been completed, the same tools are reset on gage *B* in the manner just described, except that three sheets of tissue paper, each of which is 0.001 inch in thickness, are placed between each end of the gage and the tool which is brought in contact with it, thus allowing 0.003 inch of surplus metal at each side of the work for the final finishing cut. After this second roughing or straightening out cut has been completed, gage *C* is used for setting a pair of side finishing tools which perform the final operations. These tools are set to run down the table in the same manner as previously described, except that in the present instance tissue paper feelers are used to provide for running the tools down to within 0.002 inch of the table. The spacing between the finishing tools is set on gage *C* which is ground to indicate a distance 0.001 inch less than the length of gage *B*. As a result, the side finishing tools set against a tissue paper feeler complete the planing operation and assure bringing the work to a width exactly equal to the length of gage *B*. Dependence is placed upon the accuracy of the tool setting to bring the work to the required size, and no gages are used to test the dimensions of the finish-planed tool-blocks after the final cut.

It is blocks planed in this way which go together in any of the four possible positions to which attention was called in connection with the four assembled tool-boxes and aprons shown in Fig. 3, and for all positions the apron is a tight push fit in its box. However, it is necessary to bore holes in the apron to provide for securing the toolpost in place, and as previously mentioned, the removal of metal in this way causes an internal readjustment that is likely to result in substantial changes in the form of the finish-planed work. For that reason, the aprons and tool-boxes will often have to be scraped to a fit; but it is important to note that in the condition in which they leave the planer, these parts fit together accurately, as shown by the four different assemblies in Fig. 3.

* * *

COST OF CHANGING TO THE METRIC SYSTEM

According to information given out by the American Institute of Weights and Measures, 115 Broadway, New York City, W. M. McFarland, manager of the marine department of the Babcock & Wilcox Co., is quoted as stating: "While I was with the Westinghouse Electric & Mfg. Co., we made a careful estimate, about fifteen years ago, when the business of that company was much smaller than at present, that the direct and immediate cost of the change from the English to the metric system of measurement to that company would be between $500,000 and $750,000, without allowing for the loss due to inconvenience and reduced efficiency during the period of change."

C. D. Morse, president and general manager of the Dependable Truck & Tractor Co., is quoted as follows: "The writer had occasion to make a change in the system of measurements while connected with the American Locomotive Co. at Providence, R. I., where the 'Alco' pleasure car and truck were manufactured. . . . The company took over the Bleriot car, a French product, using the metric system, and incorporated the design in their own pleasure cars and trucks, but finally decided to change from the metric to the English system. . . . The tools, jigs, and fixtures for this alteration cost approximately $90,000."

The Cleveland Chamber of Commerce, in its report against the adoption of the metric system, gives an elaborate and detailed estimate of the cost of such a change as applied to a prominent Cleveland manufacturing concern. According to this estimate, the expenditures incurred in a change from the English to the metric system would be $380,000 in the engineering, factory office, production, sales, and general office departments. In addition there would be an estimated annual expenditure of $93,000 due to the persistence of the use of old standards and the carrying in stock of both old and new standard products.

* * *

It is reported that fifty of the largest firms in Holland have combined and founded the Netherlands-Baltic Trading Co., with the object of establishing business relations and carrying on trade with the East European countries, including Russia. Representatives of the company are leaving Holland to establish offices in Finland, Esthonia, Lithuania and Poland, and to enter into negotiations with representatives of the Russian Soviet at Berlin.

Developing a Machine Tool Market in China

By O. H. BROXTERMAN, President, John Steptoe Co., Cincinnati, Ohio

IN times of prosperity the American manufacturer of machine tools is naturally inclined to look first to the American market for business and to consider the foreign market only as a matter of secondary importance. This condition should be reversed; in times of prosperity we should give to the foreign market our first consideration, and spend such time and money as might be necessary to establish a future market for machine tools when trade depressions in America prevent us from getting enough domestic business to run our plants. It is quite natural for us to look to foreign markets in periods of depression in America, but if we have neglected our foreign opportunities during times of prosperity, we cannot hope to build up in a few days a market that will enable us to keep our plants running in periods of depression.

Under present conditions the European market affords little opportunity for machine tool manufacturers. Most European countries are experiencing the same depression that we are, with the additional disadvantage of an unfavorable rate of exchange.

Russia at some time in the future will probably be a favorable market for machine tools, but Germany has always had the advantage in this market, and at present, with the low value of the mark and the unsettled conditions in Russia, we can hope for little from that market. Japan is proving very aggressive in Russia, and if the newspaper reports are true, with Japanese soldiers controlling a large section of Russian territory, they are undoubtedly going to receive a portion of the trade when the opportunity presents itself. There does not, however, appear to be any possibility of business in Russia for some years to come.

French Efforts to Obtain Chinese Trade

There is, however, one market which looms up very favorably and where Americans will always receive consideration. I refer to China. China with her four hundred million of population is beginning to realize the advantages of modern methods and efficiency. This is probably due, in a great measure, to the thousands of Chinese who worked behind the armies in France during the great war, and a plan of cooperation that has been agreed upon between the Chinese and French Government, by which France is to receive from ten to twelve thousand Chinese students for a one year's training in European civilization. These Chinese students return to their country at the end of one year and spread the gospel of French civilization, French methods and efficiency. The French steamship companies offer an exceptionally low rate to these Chinese students, and it is said that the students come from the better classes of Chinese families.

Japan for a long time received by far the greater portion of Chinese students into her colleges and universities, and had a very strong hold on the Chinese trade. However, since the great war, Japan has lost her advantage by her acts of aggression, and a severe boycott was instituted against everything Japanese; as a consequence, students instead of going to Japan for training are going to France and America. France was undoubtedly actuated by a desire, immediately after the war, to get labor into her mines and mills, thereby increasing their production. After spending one year in the French factories, the Chinese students would naturally go back to their country enthusiastic about French products.

Chinese Students in America Should be Taught Engineering

Chinese students have been coming to America as a result of the Boxer indemnity fund, but we have been teaching the Chinese students to become doctors of medicine, philosophy, or law, while in France, Chinese students are being trained in the handling of machine tools and educated by doing things by French methods. While we are turning out doctors and lawyers, France is producing mechanics to go back to China and herald the advantages of French machinery. It is only natural that being taught engineering in French and English schools, they will go back to China and demand European tools and other machinery which they have been accustomed to handling. American manufacturers must begin to act, since the foreign manufacturers, by the aid of their governments, are making every effort to gain a foothold and establish a firm foundation for their business.

The movement on the part of the French manufacturer and the French Government, however, has not worked out altogether advantageously. Students by the thousands have flocked to France, and I understand that at the present time they are having a very hard time to make a living and support themselves, due to the stagnation of business in France They are also unable to return to their own country, because of lack of funds, and I believe that this movement will eventually prove a boomerang, as the Chinese Government has stopped the students from going to France.

Efforts Made to Train Chinese Engineering Students in America

The feeling toward America, on the part of China, is very favorable, but we have been seriously handicapped due to the Chinese Exclusion Act and a decision by the Department of Labor preventing students from coming to America and working in shops as a part of their practical training. These difficulties, however, have been overcome by hard work on the part of Elmer Yelton, secretary of the Committee on Friendly Relations among Foreign Students, of the Y. M. C. A., in New York. The Department of Labor has recently ruled that Chinese students can come to this country, and they can also work in machine shops or other establishments, as long as they do not work for wages.

This has opened for America and the machine tool builders especially, an opportunity for securing Chinese students of high quality for practical education in the handling of American machine tools, and if the American manufacturer will cooperate by taking in these prospective Chinese students, we can return to China a number of these boys every year as missionaries of the advantages of American machine tools. If we can send these boys back full of enthusiasm for the American products, there will be little opportunity for other makes of machine tools.

Methods Used by Other Nations in Developing Trade

The English have established the Anglo-Chinese College at Foochow, which naturally teaches the advantages of English products. In addition to this, there are a number of English papers published in China which are continually showing the advantages of English-made goods. On the other hand, there are also some influences at work that in a measure assist us. The Y. M. C. A. has a very large organization in China, which through its charitable and religious work is a very influential factor. This has created a feeling of good will for America. The Peking University, which is being conducted by the United Religious Bodies, is willing and even anxious to establish a machine shop in connection with the school and to assist in the selection of students in China for American schools and industries.

America has by far the greatest advantage in China, if we will make some effort to retain this advantage. Germany, before the war, secured her hold in South America by either selling very cheaply or donating to all the schools throughout South America such equipment as power plant, machine tools, agricultural machinery, etc., and we must do something similar in China, or bring the Chinese students to America and teach them the advantages of American machine tools. We should make a special effort to see that American machine tools are placed in every school machine shop in China. The thousands of students that go through these schools and operate our machines, having learned the advantages of American machine tools, will certainly give us the preference when they become purchasers.

It is estimated by reliable authorities that we have approximately 1500 Chinese students in the academic courses in the United States today. Approximately 150 to 200 of these students would be glad to take up mechanical engineering. All of these students have high school or college education, and could be placed in our shops under a cooperative plan of education, in which the student would spend part of the time in school and part of the time in the shop. Arrangements could be made for the selection of the highest grade of students in China, so that a definite number could come to America each year to enter our schools and colleges.

Possibilities for American Trade in China

To illustrate in a small way the possibilities of trade in China, I understand that in 1919 the Baldwin Locomotive Co., built sixty-two locomotives for China. On April 1, 1920, the American Locomotive Co. closed a contract for twelve passenger locomotives, the largest and most powerful in the Far East; on February 1, 1920, the American Locomotive Works closed a contract for twenty Mikado type engines, duplicating ten of the same type furnished in 1919. The first consignment of ten heavy freight locomotives has arrived in China. The Peking Fuiyuan Railway has purchased three Mallet and five Mikado type locomotives built by the same company.

China is at the present time importing a large number of airplanes, and airplane mail routes are being established. The automobile imports have increased enormously, and road making and textile machinery are in great demand. Telephone and telegraph lines are being extended. The government is purchasing machine tools for the arsenals and schools, and is rapidly learning the advantages of having machine shops connected with school work. All of this means an outlet for American machine tools and a future market that should not be overlooked. China has an abundance of coal, iron, and minerals, and with the rapid stride toward modern methods within the next ten years is certain to become a large purchaser of American machines.

The First Steps for Developing Chinese Trade

Frank A. Foster, an American mechanical engineer of 29 Branch Ave., Eden Park, Auburn, R. I., has assisted in the placing of some American machine tools in schools in China, and his long residence there makes him familiar with the situation. Mr. Foster expects shortly to return to China with the idea of possibly establishing a machine shop or a machine tool agency and will gladly cooperate.

The present administration at Washington has expressed a willingness to cooperate with the American manufacturer for the extension of our foreign trade, and it is therefore incumbent upon us as manufacturers not only to place in our shops as many of these students as we can conveniently employ, but also to assist in the complete equipment of machine shops in connection with schools in China.

INDUSTRIAL CONDITIONS IN CUBA AND MEXICO

By E. H. FARRELL, Foreign Representative of Sidney Industries, Sidney, Ohio

At the request of the editor of MACHINERY, the writer, having just returned from a business trip to Cuba and Mexico, will give in the following paragraphs, a brief review of the conditions as he found them in these countries, dwelling particularly upon such information as has a bearing upon the export trade in machine tools.

In Cuba, business is very much disorganized and all that can be said is that the general reports that have come to the United States concerning the difficulties there are correct. Nearly every importer of machine tools has overbought considerably, and the Cuban sugar crisis made it impossible for them to sell anything like a normal amount of equipment. Consequently, there are several hundred thousand dollars worth of machine tools in the warehouses of the machine tool importers, with very little hope of moving any of it for some time to come.

While most of the firms are sound financially, they are unable to pay immediately for equipment that they have bought, and it has been necessary to extend the time of payment. Very likely it will be from one to two years before Cuban buyers will be able to take care of their obligations in full, and probably two years before any considerable amount of machine tools will be imported again, as the stocks in the hands of importers and dealers are sufficient to take care of the normal requirements for at least that length of time.

Conditions in Mexico

In Mexico City, the writer found conditions just the reverse of the reports current in the United States before he went there. It seems that considerable propaganda has been spread in the United States advising manufacturers that now is the time to become firmly established in Mexico, and while missionary work at this time is not altogether lost, it cannot be said to be profitable, because importers of machinery are not in a receptive mood.

Money is scarce in Mexico, and it is difficult to borrow. Such banks as lend any money at all charge from 1½ to 2 per cent per month with the very best of security. The price of silver is very low and practically all of the mines are closed. The railways are in a deplorable condition as far as rolling stock is concerned, and a very large portion of the freight moved over the Mexican lines is transported by privately owned equipment and privately owned locomotives and with much delay. The railway conditions between Vera Cruz and Mexico City make it very difficult to get goods to the latter point, and while the dock situation in Vera Cruz has improved slightly, it will be several months before the docks are cleared of merchandise on account of the inadequate railway facilities.

Primarily, Mexico requires investment of outside capital to develop her resources, and until the present government in Mexico has been recognized by the United States, foreign capital will not be eager to enter the country. The government has very little money with which to buy, but is making a great effort through taxation to rehabilitate the federal treasury.

Incidentally, it may be mentioned that German firms are flooding Mexico with catalogues and price lists, and undoubtedly will claim a good share of the business there if Americans do not put in a strong bid for it as a nation.

* * *

American demand for automobile tires has grown from about 6,275,000 tires in 1913 to over 34,000,000 tires in the year 1919. Approximately 60 per cent of the india-rubber consumed in the United States in 1919 was used for tires as against 58 per cent of the imports for 1913.

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A DEPARTMENT OF ASSISTANCE TO BUSINESS

Unfortunately, for many years, the attitude of the government of the United States toward business has been principally that of regulation and repression. The new Secretary of Commerce has a broader view of the functions of the government in relation to the service it can and should render business, and believes that there are some services that can be adequately handled by no other agency than a government department. He believes the Department of Commerce can be transformed into a Department of Assistance to Business, provided business will cooperate with the department and bring pressure to bear upon Congress to make adequate appropriations for such work as the department can undertake to aid business.

The name of Hoover is one to conjure with, and when the industries realize what he proposes to do they should send him helpful suggestions and make every possible effort to secure for his department adequate appropriations for the work proposed.

The appropriation for the coming fiscal year for the Department of Commerce has already been made, but doubtless Mr. Hoover will request an additional modest amount —perhaps about one-tenth of one per cent of what has been appropriated for the Navy. Industry and commerce are entitled to consideration and encouragement, and they will receive them if manufacturers generally will stand back of Mr. Hoover in his efforts to serve them.

As soon as the Secretary makes his request for an additional appropriation every manufacturer who believes that the Department can be more helpful under his leadership than it ever has been, should write to the chairman of the Committee on Appropriations of the House and also of the Senate as well as to his Senators and Congressman, pointing out the necessity for such an appropriation if the Department is to be of real value to the industries.

* * *

MACHINE TOOL PRICE COMPARISONS

Machine tool manufacturers whose prices have been advanced conservatively during the past six years find it difficult to meet the demands now made for price reductions, by both dealers and possible customers. When conservative reductions are made, they are often compared with reductions in a different line, not only of machine tools but of general machinery.

To institute a fair comparison, 1914 prices should be considered. Some manufacturers have increased their prices less than 100 per cent since 1914; others from 100 to 170 per cent, and the reduction should be in proportion to the increase. If one manufacturer has reduced 10 per cent and the maker of a different line 25 per cent, the natural impression often is that the former is holding up his price unjustifiably; but this assumption may be erroneous.

As has been pointed out frequently in MACHINERY, and especially in the article "Machine Tool Prices" on page 527 of the February number, average machine tool prices are not high when the improvements made in the past seven years, the increased cost of materials and the high cost of labor are considered. Nevertheless, machine tool builders are making reductions in their prices wherever possible. If these reductions are not as great as the buyer sometimes looks for, especially as compared with other machinery lines, he should take into consideration the relative increases that have been made since 1914, the figures for which are readily obtainable.

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WAGES AND COSTS

One of the most prolific causes of misunderstanding between workmen and their employers is the misconception on the part of the average workman of the relation of wages to total costs. Employers are mainly responsible for this lack of understanding of a fundamental and vital economic principle, because, in the past, they have done little or nothing to educate or inform the workman of the fact that his wages constitute but a small part of the total cost of the product. Men familiar with the attitude of the shopman know how often expressions like this are heard: "I hear that the company charges $54 for that tool. It took me only thirty-two hours to make it and at $6 a day that is $24. Some profit!"

The workman, and sometimes even foremen and minor executives, fail to realize that in addition to wages the selling price of a tool or machine includes the cost of material, rent and taxes on the factory, state and federal business taxes, interest and depreciation on the plant, fire insurance, liability insurance for accidents to employes, salesmen's salaries and traveling expenses, and salaries for the necessary officials, superintendents and foremen who manage and supervise the work; and, unless the product is sold direct, there is a discount to jobber and retailer, as well as many other items included in the elastic expression "overhead." The total of all these items is usually greater than the wages paid the workmen.

One of the largest manufacturing companies in the country recently prepared a chart which it distributed to the employes, showing that wages, in the company's plants, are only 40 per cent of the total cost of the product, and giving, by percentages, accurate information as to all the other costs involved in operating the plants of the corporation. The arguments of political and labor agitators can best be met by statements of fact; and information of this kind is of great value in exposing their unsound economic doctrines. Secrecy has been one of the main causes of friction between employers and employes. The workman, ignorant of business procedure, usually exaggerates the profits made by his employer and the income of the men at the head of the corporation. The company referred to, which has taken its workmen into its confidence and given them definite information relative to costs, holds an enviable record for the number of employes who have been in its service continuously for long periods.

Observations During a Trip to Europe

By DONALD C. WATSON, Vice-president, Universal Boring Machine Co., Hudson, Mass.

The author of this article returned from a trip to Europe two weeks ago. He has summarized the conditions in Europe as he saw them during his travels in France, Belgium, Germany, and England. He deals especially with the conditions in the machine tool field on which he became well informed through men who are in close touch with those conditions. The European situation presents so many difficulties that Mr. Watson's views, based as they are upon recent observations, should be of value to every manufacturer interested in export trade.

HAVING just returned from a visit to France, Belgium, Germany, and England, I believe that some of the conditions I found there would interest those engaged in the manufacture and marketing of machine tools in the United States. Far more important than details affecting the machine tool industry are certain conditions that affect general business. I expect that there will be little activity until the Russian situation is settled, because all workmen have their eyes on the success or failure of the "Soviet Regime." One large steel manufacturer told me that he could tell better the current state of affairs in Russia by going out into a shop than by reading the papers. It can be readily seen that the people will not undertake any great enterprise until this condition is settled. I met no one who ventured to predict when the present state of Russia would end. The best informed seem to be divided in opinion as to what form the end would take. One view was that it would take the form of famine, and be a general starvation process, which would end in the fall of some year through the fear of the coming winter. None ventured to name the year, although none put it more than two years away.

The other view was that the original form of soviet government as conceived was already being found futile. As a result the government would gradually swing back to encouraging individual effort rather than "Communism." This would be a slow process, but would eventually evolve through recognition of individual ability into a government that would recognize the right of individual ownership, either materially or mentally, thus giving individuals their proportionate reward.

The Payment of the German Indemnity

The other element to consider, is the German Indemnity. Individuals in France, particularly, placed with their government their own securities, which were used by the government as collateral for loans. For these they received only a slip of paper, stating that so much had been deposited. It is necessary for the government to obtain the German Indemnities to pay this money back. Besides this, all governments have been attempting to take care of their men released from their vast armies, by giving them artificial employment on the railroads, highways, housing, and kindred work for the good of the community. This great burden, coming as it does on top of the war, makes it imperative that the Indemnity must be paid and paid promptly. These are only a few instances to illustrate this great need; besides there is the external foreign debt owed by each government.

These conditions have led to the governments attempting to get enough money to enable them to finance the needs that confront them. Severe measures of taxation have been adopted, and will have to be continued until something has been paid by the Germans. The British per capita tax is 28 per cent, the French 18 per cent, and the German 12 per cent. These are very heavy, as compared with our own tax of 8 per cent. As you can readily see, with this burden individuals can lay nothing away in the way of capital for new business. Until these taxes are reduced, I cannot see a growing purchasing power to start business of any volume.

France and England have found that they cannot get the Germans to admit their responsibility for the war. The Germans' attitude is one of seeing how much they can get off, rather than studying how much they could pay; therefore, the Allies have adopted a slow process of occupation to change the Germans point of view. Every day that we refrain from traveling side by side with France and England in this process, we are putting off the German change in view, because I found a strong sentiment existing in Germany trusting in the United States to decrease the size of the Indemnity. If we do feel that way, the present course is achieving that purpose. However, if we feel that war debts should be paid, we must take an active part in seeing that they are paid.

Present Outlook for American Machine Tools in Europe

The more detailed facts concerning our ability to market American machine tools in England and the Continent are as follows: With very few exceptions, I found dealers in France, Belgium, and England with a large stock of all varieties, for which they paid very high prices. Many of these were ordered to be paid for in foreign currency, when foreign currency was higher in relation to the dollar than at the time when the bill was paid. They have lost a large amount of interest on money tied up in this way, and as it appears that things will be quiet for some time to come, it looks as if they would lose a good deal more.

They are also competing against new goods that are being marketed at lower prices, as well as a tremendous number of auctions of machine shop equipment, which is selling at ridiculously low prices. In addition, they are competing against equipment bought by their own government for war and restoration purposes, which is now offering tools of all our best makes, both new and second-hand, at 60 per cent of the price that dealers can afford to sell them for with a 10 per cent profit. These governments are also selling on far easier terms than dealers can afford to offer. I have a book before me that has for sale 994 almost new tools, and 117 new tools. These are of all makes and constitute a very representative line. This is merely one list among many.

German Competition in Machine Tools

The dealers are also competing against German machine tools, which in many instances are exact copies of American machine tools. Some of the best are beautifully built and are of high quality, but others are not well built. Making a broad statement, I would say that the equivalent of an American tool may be sold in France and Belgium at 40 per cent of our prices. They may be sold in England at approximately 55 per cent of our prices. One can see even with sentiment against German competition, that it is very tempting for a buyer to put in two German tools for the same money that he could put in one American tool for. I was told that the Germans were making good profit at these prices, but I take this merely as hearsay, because I do not actually know.

I went to the Industrial Fair at Leipzig and saw there 122 machine tool manufacturers exhibiting. Many of the German war plants are now making machine tools that resemble closely American tools that they had in their shops. German tools are marketed at their factory at approximately the equivalent of 19 cents per pound. For your own amusement figure your price on this basis. Often, but not always they are sold under rules laid down by an organization of machine tool manufacturers. They are paid at least one-third with the order, one-third at the time of shipping, and the remainder according to agreement between sellers and buyers. Their prices are usually F. O. B. factory, exclusive of packing.

The purchaser is not allowed to cancel a contract, unless through delay in agreed upon delivery. The supplier is not allowed to recede from his contract, unless the purchaser is tardy in his payments, or unforeseen events, such as "acts of God, war, fire, flood, etc." In case of increase in wages or material the supplier has the right to abide by the contract, but charge a corresponding increase in the price originally agreed upon. The purchaser pays for the seller's erectors, traveling, and waiting time. The purchaser has to provide at his own expense the necessary masons, carpenters, etc. The manufacturer guarantees his machines against faulty material or workmanship for six months, or three months used on two shifts. Many dealers in France and Belgium handling American tools also deal in German tools, and are making sales, which they cannot do with American tools. They are confronted with a problem of keeping their organization together, and this is the only way they can do it. They do not like to sell German tools, but if they do not, someone else will, and I think they are justified in their view.

English Machine Tool Competition

In regard to competition with English machine tool builders, it is evident that henceforth it will be very keen. Their prices are not much lower than ours. Before the war this would not have made enough difference to stop marketing our tools. The English, however, during the war have learned a great deal about machine tool manufacture. I believe the resulting improvement in design and workmanship will make them keen competitors in certain lines.

Future for American Machine Tools

In regard to the tools sold by our War Department, I saw some of them in use, others are still at the debarkation ports. Many were lacking certain attachments, wrenches, etc., which have caused customers much inconvenience.

I am not at all pessimistic for the future of marketing our tools abroad, but there is a deadlock at present which may take some time to straighten out and to absorb the machines on hand. I found everywhere that American tools were greatly admired, and we must all do everything in our power to retain our high reputation for workmanship, finish, convenience, appearance, and above all accuracy. These principles will certainly tell above everything else in our foreign market. We must not sacrifice any of these qualities for price, but I do feel that prices must be lowered to help counterbalance the premium of the dollar in exchange. I believe that it will pay to publish some catalogues or circulars in foreign languages, particularly in French or Spanish.

It certainly will pay to make sure our packing is strong enough. If we can safely quote prices C. I. F. and at a definite rate of foreign exchange, it will aid. This is a great help to dealers, as it allows them to quote their product to a customer at a specified number of pounds or francs. The rate of exchange is so rapidly fluctuating that it is very difficult for a dealer to quote, except for immediate acceptance in foreign money.

QUALITY VERSUS FIRST COST IN MACHINE TOOLS

By W. C. McCONNELL

Commenting upon the article published in the March number of MACHINERY, entitled "Quality Versus First Cost in Machine Tools," the writer wishes to state that the reason why many purchasing agents are inclined to consider only the first cost in purchasing machinery, when a better grade of machine at a higher first cost would be cheaper in the long run, is due to the tendency present everywhere toward self-exploitation at the expense of the general welfare of the business. The purchasing agent hopes for promotion. To attain this, he must present a record in cold figures of having been able to purchase advantageously, even though he knows that the better grade of machine will be cheaper in the long run. He likewise knows that if figures show that he has been able to purchase cheaply he will probably be promoted long before the machine wears out or gives trouble; while if the figures show that he has paid a higher price for a machine when one that appears to be just about as good could have been purchased at less cost, he may fail to impress those to whom he is responsible with his value.

This same condition often exists in the shop. A foreman was once criticized by an employe because of permitting certain work to be done in a manner that did not seem to be to the best advantage of the company. He replied, "This way makes a better showing for our department." I have seen a machinist pick up a shop broom—a perfectly good broom—and saw off about a foot and a half from the end of the handle in order to obtain a piece of wood that he needed to do his work quickly. It made him look like a speedy man, but it made it very inconvenient to sweep with that broom ever after. Another machinist sawed off a drill shank to use it for a dowel-pin in order to get his work out quickly.

At one time the writer was employed in a street railway shop. A great many railroad motors constantly came in on account of electrical troubles. He suggested that the armature shafts and bearings should be more carefully attended to, which would do away with a great deal of the electrical troubles met with. This was done, and the total maintenance costs were greatly reduced, but the writer was discharged from his job because he had spent more time on each motor than had previously been spent.

The great difficulty is to introduce such conditions both in our offices and shops as will convince every man that if he works solely in the interest of the business in which he is engaged, cooperating with everybody, his own best interests will also be served. The men on the lower rungs of the ladder cannot be made to realize this unless those who manage are willing to investigate details carefully, in order to learn when apparently increased costs mean savings and vice versa.

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GERMAN TRADE WITH SWEDEN

According to a U. S. consular report from Sweden, advertisements frequently appear in Swedish newspapers and journals indicating that German manufacturers are ready to assume trade relations with Sweden. These advertisements cover a large range of goods, including machinery of all classes. The conditions of the German railroads appear especially favorable, as it requires only from ten to twelve days for the delivery of freight in all parts of Sweden from Germany by way of the Sassnitz-Trelleborg railway ferry. American goods shipped by way of Gothenburg are delivered in Germany and Austria within fourteen days after leaving the latter port. The gradual resumption of trade between Germany and Sweden is causing uneasiness in Swedish manufacturing circles, and the demands for higher tariffs are heard on all sides.

New Design of Die-sinking Machine

Billings & Spencer Die-sinking Machine Embodying Many Features Formerly not Incorporated in the Design of this Class of Machines

A NEW die-sinking machine, designed by B. M. W. Hanson, has been brought out by the Billings & Spencer Co., Hartford, Conn. This machine embodies in its design several noteworthy features, among which are particularly noticeable the wide range of work for which the machine is designed, its adaptability both to low and high cutter speeds, the method of holding and clamping the shanks of the cutters, the narrow guide principle as applied to all slides, the arrangement of all handwheels and levers so that they can be reached by the operator when standing in the operating position at the front of the machine, the method of transmitting power from the main driving pulley to the spindle, and the rigidity of the machine, due primarily to the design of the column.

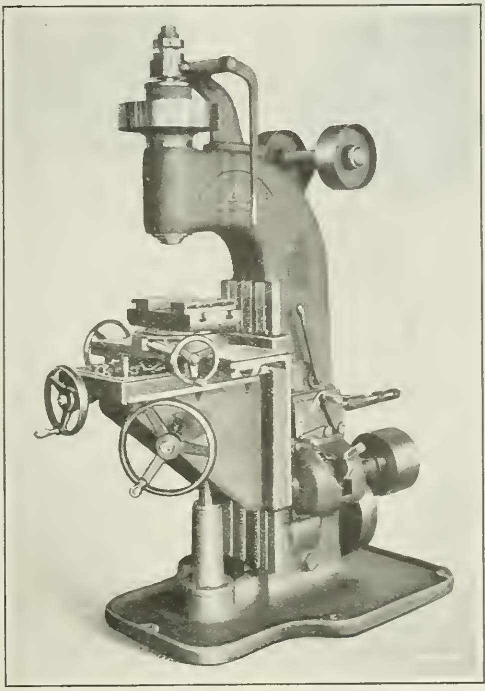


Fig. 1. Die-sinking Machine brought out by the Billings & Spencer Co.

Main Driving Features

The drive to the machine is by means of a belt operating on a fast and loose pulley. A belt shifter is provided as shown in Fig. 1, operated by a handle on the side of the machine. The shaft on which the belt shifter handle is mounted extends through the column of the machine and there is a handle on the opposite side as well, so that the belt shifter may be operated from either side of the column. A friction is provided in connection with the belt shifter so that it may be placed in any position desired—that is, the driving belt may be brought either full on the tight pulley or may be brought partly over and held in a position where it is only partially engaged on the driving pulley, while part of it still remains on the loose pulley. In this manner, a drive is provided for cutters like cherrying cutters, applicable according to the judgment of the operator, so that when "cherries" are employed and only a portion of the face of the driving pulley is engaged, the belt can still slip before the shank breaks, should it encounter an unusual resistance. This is an important consideration in a die-sinking machine where sometimes "cherries" with small tangs are employed and at other times heavy end-mills.

A gear-box is provided for obtaining the different spindle speeds. Through double back-gears and a tumbler gear, sixteen speeds of the spindle are obtainable varying from 11 to 1133 revolutions per minute. A simple clutch arrangement, as shown in Fig. 4, is provided for transmitting power between the gear-box and the spindle driving pulley, the object being to provide a means whereby the main driving pulley and the gear-box may be stopped almost instantly, although the momentum of the moving parts of the spindle and its driving

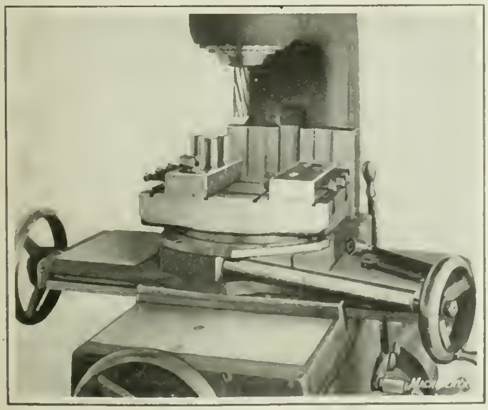


Fig. 2. Slides, Swivel, and Vise of Die-sinking Machine; this View also shows Collets for holding Tools

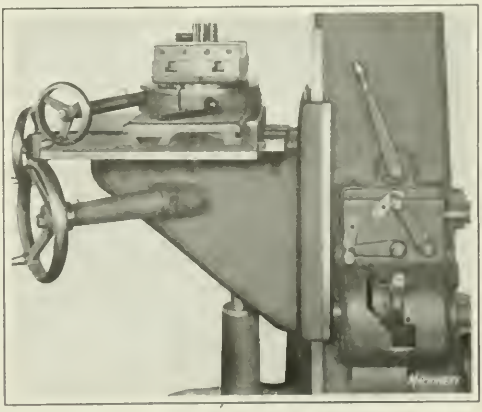


Fig 3. Side View of Machine showing Gear-box and Levers, and Narrow Guide and Square Locks of Slide

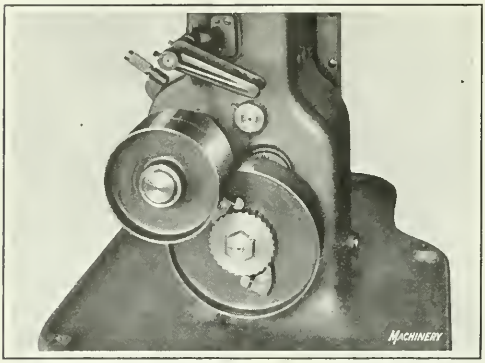


Fig. 4. Pawl and Ratchet Arrangement for transmitting Motion from Gear-box to Spindle Driving Pulley

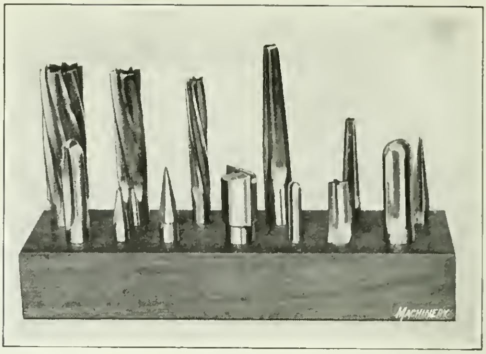


Fig. 5. Typical Collection of Tools which are used in Die-sinking Machine

pulleys and idlers continues to move the spindle. This clutch arrangement is simply a ratchet gear with two pawls. The drive from the gear-box revolves the ratchet gear, which, in turn, operates against the pawls and thereby transmits motion to the spindle driving pulley. When the main driving pulley is stopped and the gear-box and ratchet wheel also stop, the pawls can continue to slip over the ratchet. In this way speed changes by means of the gear-box may be made instantly, even though the spindle and its cutter have not been brought to a full stop.

The spindle runs in double ball bearings at the lower end, and is provided with a single ball bearing at the top. The driving pulley at the top of the spindle runs on independent ball bearings, so that the pull of the belt does not come directly on the spindle. The idlers at the rear of the column, the spindle driving pulley at the back of the machine, the main driving pulleys, and the gear-box shafts also run in ball bearings.

Chuck for Holding Cutters

One of the new features embodied in this machine is the special chuck employed for holding the cutters. The chuck is so arranged that it will hold, firmly, cutters with a straight shank not more than 1¼ inches in length. This permits of a considerable saving in cutter expense, as it eliminates the use of a long taper shank, using a large amount of high-speed steel. The chuck, as shown in Fig. 6, is provided with four jaws that bear against the straight shank along its entire length, the outside of the jaws being acted upon by the tapered surface of the spindle sleeve, which forces them inward when the chuck-actuating handle, shown on the side of the upper part of the machine, is manipulated. The chuck holds cutters with a shank diameter of 1 inch; and by the use of four hardened and ground bushings, which can be inserted in the chuck instantly, tools having shanks ⅜, ½, ⅝, and ¾ inch in diameter can be used interchangeably. The clamping and releasing of the tools and bushings is done in an instant by operating the chuck-closing handle. No wrench is required for removing or clamping tools, and taper shanks on the tools are eliminated.

Knee, Slides, and Swivel

The knee is mounted on the column by means of a square narrow guide in the center of the column of the knee and square locking strips at the sides of the column. The elevating screw for the knee is provided with a ball thrust bearing. Both the longitudinal and the cross slide are provided with a narrow dovetail guide with square locking strips at the edges. (See Fig. 3). No loose gibs are employed anywhere in the machine. The narrow guide principle, in conjunction with the square locking strips at each side of the slides, provides for a full bearing surface across the full width of the slide and prevents the binding action often found in the case of wide dovetail slides. In addition, the width of the slides has been made ample, in order to introduce the necessary rigidity.

The swivel is designed in such a way that the worm engaging with the worm-wheel attached to the swivel is adjustable for wear. Lines are provided both on the longitudinal slide and on the cross-slide, with corresponding lines on the cross-slide and on the knee, so that when these lines coincide, the center of the spindle will be exactly over the center of the swivel. In this way, micrometer readings taken on the micrometer dials provided on both the longitudinal and cross feed screws make it possible to obtain exact settings of the swivel center from the center of the spindle; and it is possible to mill grooves or contours at exactly predetermined radii.

The jaws on the vise can be placed in three different positions, square keys being provided for holding them in place. The clamping screws in the jaws are slightly inclined toward the center to provide for proper binding action. The handwheels and levers are all so placed that the operator can have the work in full view while reaching for any of them. The handles on all the handwheels are free to revolve with the hand, and the shape of the rims has been specially designed with a view to permitting a firm and comfortable grip to be obtained. All screw heads have been proportioned so that only two wrenches are required for use in connection with the machine.

The column design is noteworthy in that on the inside it is ribbed both longitudinally and crosswise to produce great rigidity without excessive weight. There are eight vertical ribs running from the bottom of the column upward and curved into the bent portion; and horizontal cross-ribs provided at intervals give stiffness in the other direction. The column and the base at the bottom are cast in one piece, and the base is cut away at the front to provide ample space for the feet of the operator as he stands in front or slightly to one side of the machine.

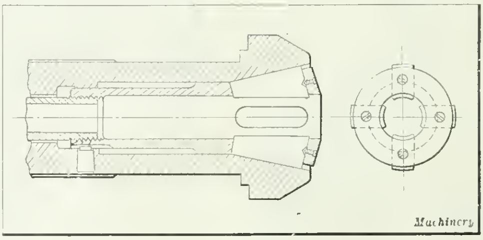


Fig. 6. Construction of Chuck for holding Cutters with Short Straight Shanks

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, April 14

AT the time of the present writing, British industrial conditions are in such a chaotic state that it is impossible to give either an accurate interpretation of present developments or to undertake to forecast the outcome of the strikes and the threats of strikes that paralyze the country. When this letter is printed, newspaper accounts will have given the readers more recent news. All that can and should be done in a letter of this kind is to review the machine tool industry up to the beginning of the present serious difficulties.

It is natural that any indication of a recovery in the machine tool industry should be considered as a herald of improvement in trade generally, and as at the present time a brighter tone than has been apparent for many months is evident in some sections of the machine tool trade, the optimism of the sanguine as regards the present year's general trade may be justified. A few makers of the larger types of machine tools are fully occupied. In the Lancashire and Yorkshire districts several firms are maintaining their plants on full time and even overtime has been mentioned. Inquiries have been received for horizontal boring, facing, and milling machines, but the heaviest demand at present is for machines for locomotive and constructional engineering shops both at home and overseas. For the first time for many months the small tool trade shows signs of weakening.

The general engineering trade is quiet, and the shipyards, although full, are not booking new orders, so that the position in twelve months' time is not expected to be so good. The machine tool industry is vitally interested in the shipbuilding position, as in this trade there are very large buyers of the best types of heavy machine tools.

The facilities for manufacturing locomotives have greatly increased, but there is still considerable difficulty in competing with American and continental makers. Recently a large order for locomotives for the British colonies was given to a German concern quoting £400,000; this represented a figure two-thirds of that at which British firms were able to quote. At the same time locomotives are being made for China, India, New Zealand, South Africa, and various of the crown colonies.

The automobile industry continues dull due to the expectation of a fall in prices; while quite a number of makers have announced price reductions, others have remained silent, which has caused a general postponement of orders. The Austin Motor Car Co., Birmingham, is putting the finishing touches to its body press shop, and will shortly be able to produce body back ends at one stroke of the press.

Overseas Trade in Machine Tools

The official returns for January of this year show that the imports of machine tools are down to about one-half and exports up to over double the tonnage of January, 1920. This proportion is no sudden condition but the result of a general improvement shown steadily during last year. A pre-war monthly average import of machine tools was 276 tons at a value of £96 per ton. At present, the monthly average is 755 tons at a value of £256 per ton. Exports before the war showed a monthly average of 1276 tons at a value of £61 per ton, and present exports average 2800 tons per month at a value of £183 per ton. The ratio of imports and exports of machine tools has now reached £100 to £206, but all value per ton figures must be considered together with the fact that after six years of improvements in design and manufacture every ton of machine tools represents a greater intrinsic value. As far as individual machines are concerned, lathes show an overwhelming preponderance of exports over imports, being about seven times as great in value or four times numerically. The only classes of machines in which imports are in excess of exports are power presses, and punching and shearing machines, the discrepancy being about three times, when values are considered.

During February both the exports and imports of machine tools showed a decided falling off, the latter amounting to little over 400 tons in weight and £125,000 in value; these figures are lower than at any time since 1914. Exports recorded were a little over £300,000 in value, the tonnage being only 2000; these figures are lower than any recorded since last June. Among foreign markets which are growing, may be mentioned Siam; out of a total import of machine tools of a value of £4600 in 1920 a little over £4000 came from Great Britain. The export of drilling machines during February showed a jump, 236 machines being sent out of the country as against 123 imported, while the value of the former was seven times that of the latter. Planing and shaping machines were imported and exported in about the same numbers although the value of the exports was seven times that of the imports. Only the machines enumerated under the title "other descriptions" show a large preponderance of imports.

If inquiries may be taken as an indication, a development of Continental trade would seem to be imminent, and there is a general feeling also that a period of greater activity is approaching so far as the Dominions and Colonies are concerned. The position has been modified, however, by the sanctions made necessary by German policy. Though the space devoted to machine tools at the fair at Leipsic has been occupied entirely by German firms, these were fully representative; the Reinecker concern was a notable absentee, however. An extensive export business was being catered for, and would apparently have been developed, but the Allied conditions of collecting 50 per cent of the purchase money to be paid to the importing countries were made public when the expectancy of business was at its height. Few, if any, exports of German machine tools will now be made, at any rate as a result of the Leipsic fair, and the threatened German retaliation is another factor that may have a depressing effect on Continental trade, even though the threat is not carried out to the full. The fair seemed to show that German machine tool design has not advanced since 1914 to the extent apparent here.

Labor Conditions

The machine tool trade has been suffering from unemployment, although perhaps not to the same extent as most other trades. No general movement with a view to the reduction of wages has taken place as yet, but isolated cases, both in the Midlands and the North of England, are known where definite propositions of this kind have been made. The reduction, stated to have been suggested in one instance is 33 1/3 per cent. Wages in the machine tool trade now bear a high ratio to other costs of production, and the question as to whether they are to be standardized at the present high rate, independent of any falling in the cost of living, has come into considerable prominence. Certain classes of labor during the war obtained an abnormal value which bears no relation to present conditions, and all workers claim a higher standard of living than in 1914. Attempts at reducing these wages are fraught with great difficulties, but cuts with the consent of the men have been made in the automobile and other trades.

In the case of the manufactured iron and steel trade, the Board of Conciliation and Arbitration has announced an immediate reduction of 25 per cent in the wages of puddlers and other forge and mill workers and Consett steel millmen's wages are to be reduced next quarter by 30 per cent. It is rather curious to note that the malleable and gray casting trade is in the unique condition of suffering from a lack of labor. This may be due in part to the molders' strike that occurred during last year, but the haphazard method of recruiting and training foundry labor for this trade is probably a more dominant factor.

Materials and Prices

In most cases the prices of raw materials have shown a strong tendency to fall of late, and the last month shows a definite reduction. For example, steel at the end of last month selling at £24 a ton is now reduced to £18 per ton. The prices of non-ferrous metals have also dropped, but not to the same extent. The prices of machine tools in general do not show a great reduction, but as an instance of what may be expected in the near future, one firm, C. H. Joyce, Ltd., is selling a novel design of thread-cutting lathe with a swing of 18 inches, which sells with all equipment for as low a figure as £100. Pig iron has been brought down by a number of step reductions to from £9 to £10 in some districts, and crown bars are now £24 to £26 per ton. Business in the iron and steel industry remains quiet. Some of the larger concerns are said to be about to put on the market large stocks, bought against orders since cancelled.

It is expected that the prices quoted will undergo a reduction within the next few weeks. As long as the price of coal is maintained at its present level, there can be little hope of steel and iron productions in this country being sold at prices that will effectively compete with the imported material. There have been cases of Belgian firms purchasing malleable pig iron over here and sending it back in the form of castings at prices lower than we ourselves can produce them. The reductions in the prices of raw materials have had little effect on the selling prices of machine tools, since the proportion of the cost of manufacture that has to be allocated to materials is low, as compared with the labor charges involved.

New Developments

The centerless method of grinding is being used in this country to a great extent. It is not only being used extensively for small pieces, such as crankpins and similar work, but some firms, notably Pratt Levick & Co., Ltd., of Chester, are grinding black bar by this method and guarantee all the bars ground by the centerless method to be, if necessary, within a limit of plus or minus one-quarter of a thousandth inch on the diameter. Ground bars of 26 feet in length are a regular production of this company. Many manufacturers are finding these ground bars of exceptional use, as by their use several manufacturing operations can be avoided. The B.S.A. plant is using the centerless method for grinding black bar for its own use. J. Holroyd & Co., Ltd., of Rochdale, are developing a centerless machine which is expected to be marketed shortly.

The A 1 Mfg. Co., of Bradford, has brought out a new method of electrically welding drum seams. This is in effect a continuous spot-welding process by which the spot-welding operation is carried out successively along the seam, the spots being close enough to form a continuous weld. The firm finds that it is possible to make perfect welds, irrespective of rust or scale, and the cost of sand blasting is avoided. A number of these machines have been supplied to an American firm making carbide drums.

WORK OF THE AMERICAN ENGINEERING STANDARDS COMMITTEE

Although the American Engineering Standards Committee has been actively at work for but slightly more than one year, and much of the time and effort of the committee has necessarily been spent in laying a basis for work the fruition of which will require at least two or three years, yet considerable progress has already been made in the unification of the more important standards and in overcoming the confusion that was being produced by the numerous organizations (more than 100) that hitherto published engineering standards without systematic cooperation among themselves. The committee itself is composed of forty-seven members representing seventeen bodies or groups of bodies, including six national engineering societies, five governmental departments and thirteen national industrial associations. Its function is merely to see that each body or group concerned in a standard shall have opportunity to participate in its formulation which is in the hands of a working committee, technically called a "sectional committee." Each sectional committee is organized by, and under the leadership of, one or more of the principal bodies interested, such bodies being known as "sponsors." Sponsorships have been arranged for the following mechanical subjects which were under way by the beginning of this year: Ball bearings, plain limit gages, gears, machine tools, nut and bolt heads, pipe flanges and fittings, screw threads, and shafting. Those who are interested in the reports that have been issued may obtain copies from the American Engineering Standards Committee, 29 West 39th Street, New York City.

* * *

FOREIGN TRADE CONVENTION

At the eighth national Foreign Trade Convention, which will be held in Cleveland, Ohio, May 4 to 7, the following subjects will be considered: Financing foreign trade, foreign and domestic credits, value of long credits to the exporting manufacturer, commercial education for foreign trade, problems of the export manager, the motion picture in foreign trade, the effect of double taxation on foreign trade, the use and value of foreign news, government service to foreign trade, reasonable policy for American foreign loans, special export problems of manufacturers, foreign trade advertising, marine insurance, banking service for foreign trade, and trade relations with the Far East. All the general sessions will be held in the Hippodrome, and group sessions, as stated in the program, will be held at the Hollenden, Statler, Cleveland, and Winton Hotels. Further information may be obtained from the secretary of the National Foreign Trade Council, 1 Hanover Square, New York City or from Henry Howard, 207 Chamber of Commerce Bldg., Cleveland. The headquarters of the convention will be at the Hollenden Hotel.

* * *

SUMMER MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS

The 1921 summer meeting of the Society of Automotive Engineers, which will be held at West Baden, Ind., May 24 to 28 inclusive, promises to be unusually successful, 150 members having forwarded reservation blanks within one week after the mailing of the first announcement. The noted British scientist, Sir Dugald Clerk, has accepted an invitation to address the society on the fundamental theories on which the internal combustion engine is based. There will be various technical sessions devoted to the topics of research, fuel, aircraft, farm power, highways, and engineering as a sales stimulus. Another subject to be discussed is the present position of commercial aviation in the United States.

Common Causes of Errors in Machine Design

Influence of Working Environment—Fifth of a Series of Articles

By R. H. McMINN

THE proper design of machines and structures is influenced by their environment during use. Certain features of design may be determined by the peculiarities of the environment in which a machine or structure is used; by frequent changes in the characteristics of a particular location; or by a change in the character of surroundings encountered, due to moving a machine from one place to another. A few variable characteristics of the surroundings of machines and structures will be given for their possible suggestive value in analyzing conditions that may affect design.

Design of Foundations

The design of foundations is affected by the soil in which the foundations are to be placed. For any foundation, the general qualities of soil should be known, to determine the size of foundation needed. For light structures and machines, a knowledge of the kind of soil encountered in preparing previous foundations in the same locality may be sufficient. Heavy structures, however, require that borings be made in the exact spot on which structures are to be erected. The kind, size, and depth of foundation will then be determined by materials encountered when boring. The depth of any foundation may also be determined by the depth of other foundations close to it so that the pressure on the soil beneath it cannot wedge the soil against walls which are on deeper foundations.

If a structure is built on the seashore or on any tributary near the sea, the height of the tide at that locality must be known. Likewise the action of the waves on the lower portion of these structures must be considered. These produce tremendous stresses and also tend to wash away foundations. The probable high water level in any locality where a structure or a machine with a foundation in the earth is to be erected should be known before designing them, and consideration should be given to the methods of drainage required or to preventing certain parts below the water level from having water contact. The depth to which the water in the ground freezes in any location must be known, to determine the minimum depth of foundation allowable, since the bottom of the foundation must be below this frost line.

Power-driven Machinery

The width of tires on vehicles or power-driven machinery is partially determined by the material upon which they run. Thus a tractor that runs on soil must have wheels with a much wider tread than a far heavier locomotive that runs on rails. Increased horsepower needed for vehicles on grades, to overcome gravity, and on curves, to overcome increased friction, must be considered. The effect of a steep grade may have to be considered in its influence on the gravity feed of a liquid from a tank by possibly making the point of delivery higher than the point of supply. Slight depressions or high points are encountered in the smoothest track or road it is possible to maintain. Their effects are partially confined to the lower portions of cars or vehicles by the use of springs. The shocks and strains produced on all parts by unevenness should be considered.

Electrolytic Action

Metal placed in the ground is subject to electrolytic corrosion from stray electric currents caused largely by the rails of electric lines being used as return circuits. Iron and lead pipes, which are frequently placed in the streets near electric lines, are especially subject to serious damage unless this tendency is known and guarded against by special protective means.

Snow Loads and Water Pressures

The weight of snow must be noted in figuring the necessary strength of roofs, and the weight of sleet in figuring the strength of wires located out-of-doors. Water may freeze and thereby exert great pressure, which is sometimes evidenced in broken automobile radiators or water-jacketed cylinders. Again, the depth to which a body is submerged in water determines the external pressure exerted on the body. This limits the depth to which a submarine can safely submerge.

Effects of Moisture

The presence of water greatly decreases the tractive resistance between a wheel and the earth or track. The rusting action of moisture in the air or ground must be recognized so that rustproof materials may be used when required. Dampness affects leather belts, making the use of rubber belts frequently advisable. Moisture tends to break down the insulation of electrical machinery, so the windings must be protected from dampness as much as possible. In fact, water has a deteriorating effect on most materials of construction unless they are suitably coated or permeated with some substance which prevents this action.

Air Resistance and Wind Pressure

The resistance of still air to the moving parts of machinery is not often considered. Yet that still air may offer considerable resistance to parts having a certain form and moving at high speed is evidenced by the airplane which is lifted by the action of the propeller and planes against air resistance. Covering large rapidly revolving flywheels on both sides with light plates has a marked effect on reduction of the air resistance of their spokes. This is rarely done, however, because of its first cost and appearance. In calculating the power necessary to move a vehicle or projectile consideration must be given to the resistance of either still air or wind against which it is forced. The wind exerts pressure on sloping roofs and the sides of all buildings, towers, bridges, or any other structure, and they must be able to resist collapsing or overturning because of this force. Even wires have considerable wind resistance, which is increased greatly when they are covered with sleet. Some machines are located in places where the air is laden with dust and sand, or the operation of the machines themselves may produce this condition. Special provision must be made to prevent the foreign particles in the air from getting into the bearings or other parts of the machine which would be injured by such material. So-called "holes" in the air, met with by aviators, which are probably due to variations in the velocity of the air movement at a certain point, require an additional factor of safety in airplanes due to the stresses produced by a sudden dropping of a plane.

Effects of Temperature

The temperature in which a machine will operate may have an effect upon its performance. The ratings of motors are based upon a certain temperature of the surrounding air, which will thus produce a known radiation from the motor. A locomotive of a certain size and design used in a mild climate has markedly less capacity when used in a frigid zone due to radiation. The required capacity of the heating system of a building depends somewhat on the severity of the winters of the locality where the building is located. Automobile radiators are sometimes scarcely large enough when working under a continuous heavy load and high surrounding temperature. The difference in horizontal expansion between the material of a structure and the foundation by which it is supported requires that special means be employed to allow for this if the structure is of considerable length. Enlarged bolt holes in the splice bars or rails of a track allow the gap in a joint to vary in width when the rails contract and expand due to changes of temperature. The earth is expanded much less than steel with certain temperature changes and this expansion is taken up by the compression of the materials of the earth. The expansion in a long roof truss or bridge is usually allowed for by sliding or rolling contact at one end or by deflection of a plate by which one end is attached to its support. The stress in wires exposed to the elements is increased when a drop in temperature contracts them and reduces the sag. This is still further increased if this occurs when there is sleet clinging to them and a high wind.

Effects of Altitude

The altitude at which a structure is placed or a machine operates may produce certain special effects. Atmospheric temperature increases about 1 degree F. for each 40 or 50 feet descent below the earth's surface after getting down far enough to be beyond the influence of the sun's heat. The temperature of the air decreases with increase of altitude above the surface of the earth. Oil at a reduced temperature congeals so that the size of pipes in airplane lubrication systems must take this into account. Likewise, water boils at a lower temperature at high altitudes which must be considered in the capacity of airplane radiators. The lifting power of the air is greatly reduced due to its rarefied conditions, involving greatly increased horsepower to sustain a plane at high altitudes. The volumetric efficiency of air compressors decreases with the altitude at which they are operated, because of the more rarefied free air which enters the compressor. The corona loss, due to the breaking down of the air insulation between high-voltage conductors increases with the altitude at which transmission lines are located, so that at high altitudes larger wires must be used for a given voltage.

Location of Machine and its Surroundings

If a machine is being designed with special reference to being located in a certain position in the purchaser's building, a drawing should be submitted to the manufacturer showing the floor space allowed, overhead clearance, and its location with reference to building walls, columns, and preferably other machines which are nearest to it. If the machine is belt-driven, the location of the lineshaft should be indicated on the purchaser's drawing, and any limitations in the location of the drive pulley on the lineshafting should be shown. Sometimes a machine may be built with a pulley on one side or the other to meet special limitations imposed by the need of belt clearance from some object already in place. The means to be used in getting material to the new machine and removing the finished product or by-products should often be known. If a foundry tumbler is to be loaded from both sides, the drive shaft in back is located especially low down so as not to interfere with placing castings in the tumbler from the back. The designer should carefully consider whether the operation of other machines near, the material used in them, or any by-products from them will have any ill effects on the new machine or its operator. It may be necessary to protect either or both from the heat, sparks, steam, or flying particles from another machine. For instance, if a traveling crane must be installed so one end passes over a large reservoir ladle for molten iron, the cage where the operator is stationed should be, if possible, on the other end of the crane to protect the crane operator from the heat radiated upward from the surface of the metal. If there is no simple or practical means to afford protection from another machine in the design of the new one, the purchaser's attention should be called to the necessity of providing some means of protection. All structures subject to special fire hazards from their contents or surroundings should be designed so that they will be suitably protected from this danger.

Ample room should be allowed around a machine for its satisfactory operation, inspection, lubrication, cleaning and repairing, and the purchaser should be advised if the space allotted does not permit these requirements. Any electrical equipment used as part of a machine must be consistent with the kind and voltage of current available, and air-driven devices must not require a pressure exceeding that of the local air distributing system. If the machine rests on foundations separate from the building and yet has some part rigidly connected to the latter, consideration should be given to the result of unequal settling of machine and building. If there is very slight clearance between some point on the building and a part on a machine, considerable settling of the building may bring pressure to bear on the machine part. A serious reduction of clearance may occur even when the weight of the machine is supported on the same foundations as the building, as with a traveling crane supported on a runway attached to building columns. If the clearance between the top point of the crane trolley and the under side of roof trusses is small under the normal load on a rather flat roof, a heavy snow load may cause such a deflection of the truss as to produce interference.

The Machine Operator

One important element in the environment of any machine is the operator. The lack of mechanical experience possessed by the class of labor which will operate the machine may demand that it be designed to reduce to the minimum the necessity for using skill or judgment in operating. The average size of operators may also determine the location of levers and pedals so the operator will have sufficient reach with hands or feet in the position (standing or sitting) that he must assume. The force which can be reasonably exerted by the feet, hands, or fingers in pushing, pulling, or gripping, either constantly or intermittently, must be considered in the design. Suitable clearance must be allowed all around the operator. Armholes and manholes should be large enough to admit the arm or body of a man with the necessary tools and materials to do any work for which these holes are provided.

The weight of any machine like an air hammer, which is designed to be lifted by hand, or even the weight of a hand hammer or the capacity of a shovel must be considered with a view to making it most easily and efficiently handled by an operator.

Any animals that may come in contact with a machine may influence the design of some feature. The National Board of Fire Underwriters' rules for acetylene gas machines state that the hood on the end of the relief pipe shall be constructed in such a manner that it cannot be obstructed by rain, snow, ice, insects, or birds.

Reaction of Machine on its Environment

The effect of a machine itself on the environment in which it will be used must be considered during design. The noise or vibration produced during operation should be kept at the minimum in any machine, but especially in those which are for use in an office or home. The heat necessary to operate or produced during the operation of a machine may bar it for use in certain environments. The operation of a machine should never require any part of the operator's body to be exposed to either such a high or such a low temperature as to be injurious. Machines should prevent as far as possible the throwing of oil, water, chips, dust, or emitting steam, smoke, gaseous fumes, or disagreeable odors in the air inside of a building. Such results can generally be prevented by the addition of suitable guards or the provision of hoods and piping which connect with an air-exhaust system.

If the machine produces sparks, as motors sometimes do, it may be dangerous to use around inflammable material, such as explosives, gases, or air heavily laden with lint or fine dust. Motors of a flame-proof type are frequently used in mines where explosive gases are encountered. Foundry cupolas are usually provided with an arrester at the top to deflect the sparks downward. Some locomotives in forest territory have special screened stacks with a downward chute attached to one side of the stack near the top to prevent sparks from scattering and starting fires. Sometimes the ill effects of a machine may be the marring of finely polished furniture. Thus, many office machines for use on desks have rubber or felt covered feet.

In starting to design a machine or structure which will be located in an environment with which the designer is not familiar, he should get all the information possible regarding the characteristics of its surroundings.

* * *

Job ticket carriers, blueprint protectors, etc., are generally used in most shops now. They have a transparent sheeting face, and the back is made of leather substitute or rubberized fabric. Experience has shown that the rubberized goods will not stand up well under contact with oil, but that the leather substitute—pyroxylin coated material is better, since oil and grease do not penetrate the coating unless literally soaked in it.

MILLING SQUARE-STEM PINIONS

The recent improvements in tools, cutters, and various kinds of auxiliary equipment has been no less marked than the improvement in machine tools. In fact, the development of cutting tools that will stand up under higher speeds and feeds may be considered directly responsible for the introduction of machine tools of heavier construction, equipped for higher speeds and feeds than were formerly believed practicable. The notable progress made in designing jigs, fixtures, and tools for use in the manufacture of interchangeable or duplicate parts is recorded in the articles on modern production methods that are published monthly in the pages of MACHINERY. While no important individual features are incorporated in the machine, tools, or fixtures shown in the present article, that have not previously been dealt with in MACHINERY, the article nevertheless deals with a combination of standard and special equipment for squaring pinion stems that is exceptionally well adapted for the work it is intended to do. In the following, a brief description will be given of the work to be machined, the machine used, and the special fixture employed to hold the work.

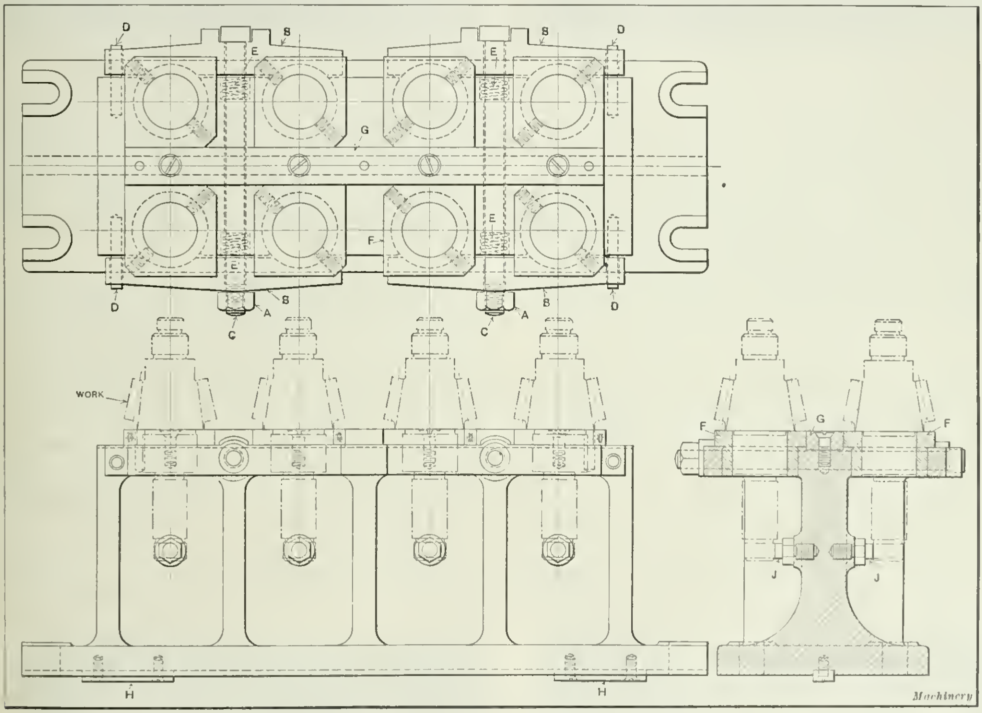


Fig. 1. Details of Indexing Fixture for milling Square-stem Pinions

Machining Operation on Pinion Stem

The work to be done is the milling of the stems of square-stem, nickel-steel bevel pinions. A short threaded stem projects from the center of the small end of the bevel pinion, while a larger stem projects from the back or larger end. There are four sections of different diameters on the larger stem; the first section back of the pinion teeth has the largest diameter and forms a shoulder for the bearing section of somewhat smaller diameter which is next to it. Between this section and the threaded end is the section on which the machining operation is performed. This part is turned concentric with the other sections of the stem previous to the squaring operation, which consists of taking

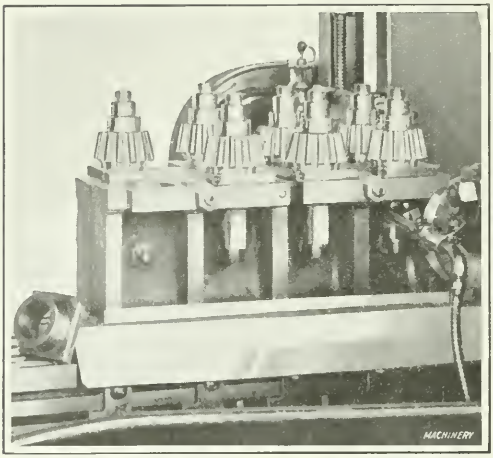


Fig. 2. Side View of Fixture for milling Square-stem Pinions

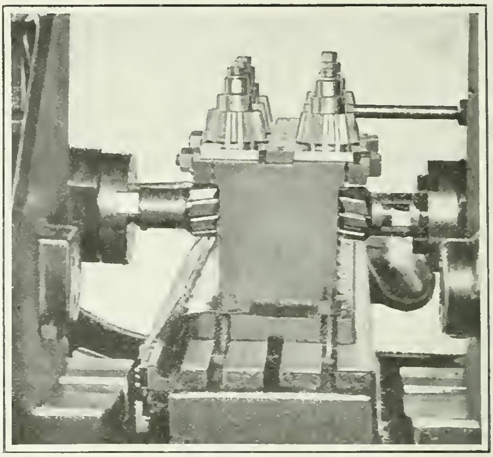


Fig. 3. End View of Fixture, showing End-milling Cutters

four slabbing cuts across the stem, indexing the work 90 degrees after each cut.

The machine employed for the milling operation is a Cincinnati duplex miller. This machine is provided with double opposed spindles mounted horizontally in belt-driven heads which are capable of vertical and longitudinal adjustment. The table on which the work, or in this instance the work-holding fixture, is mounted has a horizontal power feed at right angles to the milling machine spindles. The machine is equipped with a "jump" feed, which aids in obtaining rapid production.

Design of Work-holding Fixture

In Fig. 2 is shown a side view of the work-holding fixture. Fig. 3 is an end view of the fixture, which shows also the end-milling cutters. The design of the fixture is shown in detail in Fig. 1. Provision is made for holding eight pinions, two rows of four each being located side by side, so when the fixture is mounted on the milling machine table and fed past the end-milling cutters shown in Fig. 3, one side on each of the eight pinion stems will be milled. Thus at one pass of the table, cuts are taken on eight pinion stems, equivalent to the machine work required to complete the squaring operations on two stems. After taking the first cut, each of the pinions is indexed 90 degrees and the fixture again fed past the cutters. Indexing the work and feeding it past the cutters four times completes the eight pinions.

To unclamp the eight work-holding bushings *F*, so that they can be removed from the fixture, it is simply necessary to loosen two nuts *A* which serve to clamp all eight bushings and the pinions held in them, by means of clamps *B* held on bolts *C*. These clamps are prevented from turning on bolts *C* by pins *D*, which are screwed into the cast-iron body of the fixture and are a sliding fit in the holes at the ends of clamps *B*. Springs *E* force clamps *B* out of contact with the work-holding bushings *F* when nuts *A* are loosened, so that the clamps do not interfere with the loading or unloading of the fixture.

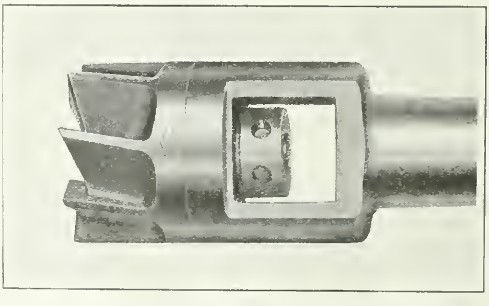


Fig. 4. Chapin & Baker End-mill used for squaring Pinion Stems

The indexing of the work is accomplished by means of bushings *F* which fit into the fixture as indicated. One of these bushings is shown removed from the fixture and pinion at the end of the fixture in Fig. 2. These bushings have a square head, one side of which, being in contact with guide bar *G*, Fig. 1, when in place in the fixture, serves as a means of obtaining accurate indexing.

To index the work, it is simply necessary to loosen nuts *A*, raise the pinions sufficiently to permit the square heads of the bushings attached to them to clear guide bar *G*, then give the pinions a quarter turn, and drop them back into position and tighten nuts *A*. By providing sixteen work-holding bushings, the operator can attach bushings to eight unmilled pinions while the machine is in operation, so that the minimum time will be required to reload the fixture. Two headless set-screws are used to hold the pinions in bushings *F*. Keys *H*, held in a slot cut in the base of the fixture, serve to locate the latter on the milling machine table. Adjustable stops or supports *J* for the ends of the pinion stems counteract the thrust imposed on the work by the cutters.

A careful consideration of the construction of this fixture will reveal the following features that are desirable in equipment of this kind: First, the heavy I-section of the casting and the webs or ribs extending from this section at right angles provide unusual rigidity; second, the method of holding the work enables the parts on which accuracy depends to be easily and inexpensively replaced in case of wear or in case slight changes are made in the size of the work; third, the locating or bearing points on the work are accurately machined previous to the milling operation; fourth, two pieces of work being located side by side and backed up by stops *J*, serve to present the metal to the cutters under a condition closely approximating that which is obtained when feeding a single solid piece of work between the cutters; fifth, the construction of the jig is such that the cutting lubricant and chips flow down away from the work, thus leaving it comparatively clean after the performance of the machining operation.

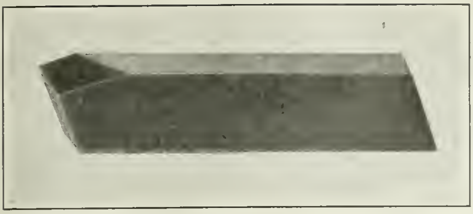


Fig. 1. Stellite Cutter Blade employed on Ingersoll Milling Cutter Heads

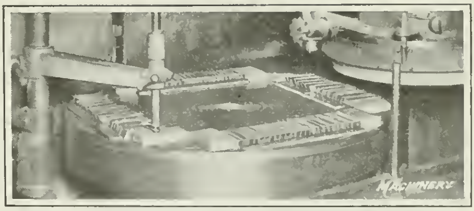


Fig. 2. Vertical Surface Grinding Machine finishing Four Sides of Stellite Blades

Cutting Tools and Speeds

One of the end-milling cutters employed, which is a regular product of the Chapin & Baker Mfg. Co., Syracuse, N. Y., is shown in Fig. 4. Referring to Fig. 3, it will be noted that the cutters are held close to the spindle noses, a feature which enables heavy feeds and high speeds to be employed without causing chatter. These end-mills are 2½ inches in diameter and their design is in a large measure responsible for the results obtained in milling the pinion stems. The cutters are run at a speed of 83 revolutions per minute, and are fed to the work at the rate of 3¼ inches per minute. The production ranges from 40 to 45 pieces per hour, as compared with from 5 to 8 pieces per hour obtained by the machine and tool equipment previously employed. The fixture described in the foregoing was designed by D. A. Lapham, mechanical engineer of the Brown-Lipe-Chapin Co., Syracuse, N. Y., where the equipment is employed.

* * *

MANUFACTURING STELLITE CUTTER BLADES

Interesting grinding methods in use in the shops of the Continental Tool Works, Detroit, Mich., for the production of stellite cutter blades are described in a recent number of *Grits and Grinds*, a publication devoted to the advancement of the grinding art, which is issued by the Norton Co., Worcester, Mass. These stellite blades are used on eleven-inch Ingersoll milling cutter heads. A completely ground blade is illustrated in Fig. 1. The material from which these blades are machined comes to the plant in the form of bars approximately 11 inches long, ¾ inch wide, and ½ inch thick. Each bar is cut into three pieces about 3½ inches in length, the operation being performed on a Racine cutting-off machine provided with a No. 30 rubber-bond alundum wheel, 12 inches in diameter, 3/32 inch thick, with a ¾-inch bore. The production obtained by this machine is about sixty-four pieces per hour and the wheels average approximately fifty-four cuts before they are worn out. Fig. 3 shows the operation being performed, the stellite bar being placed in a holder for bringing it into contact with the wheel, a stop being provided on the holder for roughly gaging the length of each blade.

The stellite pieces received from the cutting-off machine are then ground on a Blanchard vertical surface grinding machine, the blades being placed on a magnetic chuck as illustrated in Fig. 2. Each of the four sides of the blades is ground within a tolerance of 0.001 inch, the quantity of material taken off from each side ranging from 0.010 to 0.030 inch. This machine has a No. 3830-G silicate-bond alundum wheel 18 inches in diameter, with a 5- by 1½-inch rim. The production per hour on this machine averages about twenty-five pieces with the four sides ground. The silicate-bond wheels last from three to four days.

The final operation on the stellite blades consists of grinding three angular surfaces, the operation being performed on a Cincinnati cutter grinder equipped with a No. 3846-J alundum cup-wheel 5 inches in diameter, with a rim 1½ inches wide and ½ inch thick. Fig. 4 shows a blade being held in an angular position in contact with the grinding wheel on this machine. The grinding of the angular surfaces is done at an average rate of about forty-three surfaces per hour, each wheel lasting approximately 1½ hours.

* * *

During the year 1920 freight valued at $1,000,000 was transported by airplane from the United Kingdom in cargo planes to France, Belgium, Denmark, Spain, and Holland. Planes coming into England from the Continent carried $2,000,000 worth of imports.

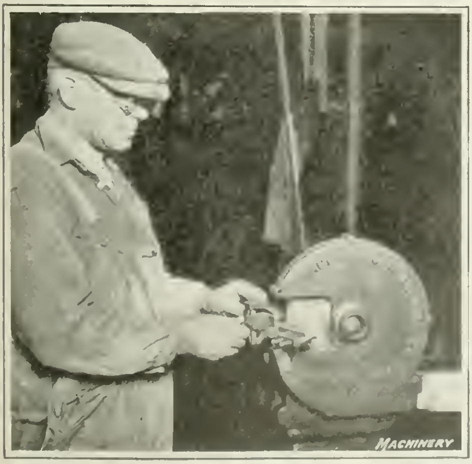


Fig. 3. Cutting the Blades to Length from Bars by Means of a Rubber-bond Alundum Wheel

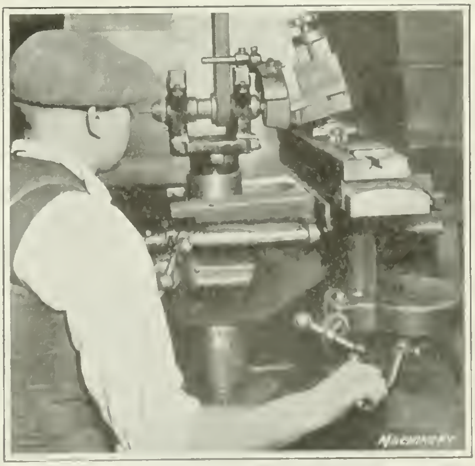


Fig. 4. Using a Cup-wheel for grinding Three Angular Surfaces on the Stellite Blades

Comparison of Formulas for Steel Columns

By N. BARNES HUNT, Engineer U. S. Reclamation Service, St. Ignatius, Montana

THE accompanying graphs of a number of the most familiar formulas for steel columns were prepared for an allowable unit stress of 12,000 pounds, in accordance with the recommendation of the special committee on steel columns and struts of the American Society of Civil Engineers, published in the Proceedings of the society, December, 1917.

The committee's recommendation was influenced by a variation of 28 per cent in the strength of the steel and by the absence of definite knowledge of column action. The grade of steel used in the committee's tests is described as having a desired ultimate tensile strength of 60,000 pounds per square inch, which is the strength assumed in preparing the diagrams. The modulus of elasticity is assumed to be 30,000,000.

Terms descriptive of end conditions are often used rather loosely. Assuming that the number may be limited to three, they may be classified as follows to include the terms variously employed:

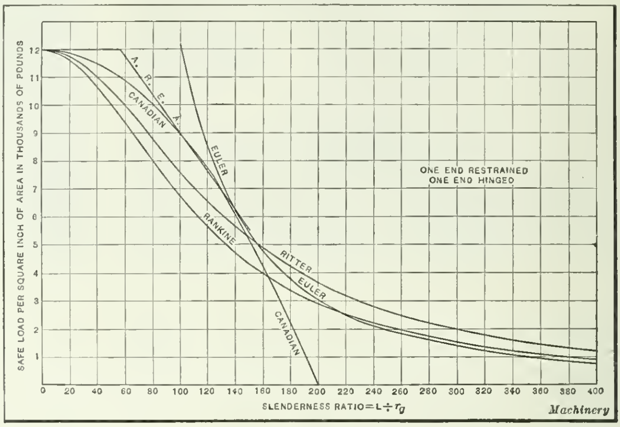


Fig. 2. Comparison of Formulas when One End of Column is Fixed and One Hinged

TYPES OF ENDS

Restrained End	Hinged End	Free End
Fixed	Pin	Unsupported
Square	Round	
Flat	Pivoted	

The types included in any one class may be said to resemble one another to a degree which justifies the grouping, but it is not implied that they are identical. A practical example of a free end is found in some types of gate frames or guides.

Nomenclature

The following nomenclature is used:

P_u = total ultimate load on column, in pounds;
P_s = total safe load on column, in pounds;
A = cross-sectional area of column, in square inches;
S_u = ultimate unit stress, in pounds;
S_s = safe unit stress, in pounds;
S_E = elastic limit;
E = modulus of elasticity;
L = length of column, in inches;
r_g = least radius of gyration, in inches;
C = constant;
C_1 = constant.

The Rankine Formula

The formula $\frac{P_s}{A} = \frac{S_s}{1 + C\left(\frac{L}{r_g}\right)^2}$ is often called Gordon's formula, but may be accredited to Rankine because he substituted the least radius of gyration for the factor of least thickness in Gordon's formula. The constant C is empirical, having been deduced from columns tested to destruction. Merriman's values of C are as follows:

Restrained	$\frac{1}{25,000}$
Restrained and hinged	$\frac{1.95}{25,000}$
Hinged	$\frac{4}{25,000}$
Restrained and free	$\frac{16}{25,000}$

The Ritter Formula

The Ritter formula $\frac{P_s}{A} = \frac{S_s}{1 + C_1\left(\frac{L}{r_g}\right)^2}$ is identical with Rankine's formula with the exception of C_1, which is theoretic and equal to $\frac{S_E}{C\pi^2 E}$. The values of C are as follows:

Restrained	4
Restrained and hinged	2.05
Hinged	1
Restrained and free	0.25

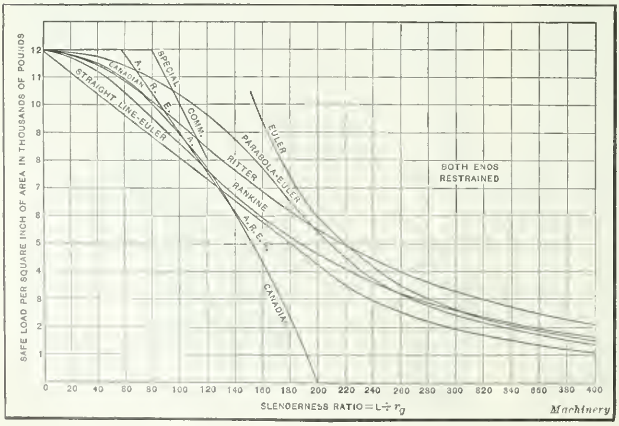


Fig. 1. Graph of Formulas for Columns when Both Ends are Fixed

When $S_E = 35{,}000$ the values of C_1 are:

Restrained	$\frac{1}{34{,}000}$
Restrained and hinged	$\frac{1.95}{34{,}000}$
Hinged	$\frac{4}{34{,}000}$
Restrained and free	$\frac{16}{34{,}000}$

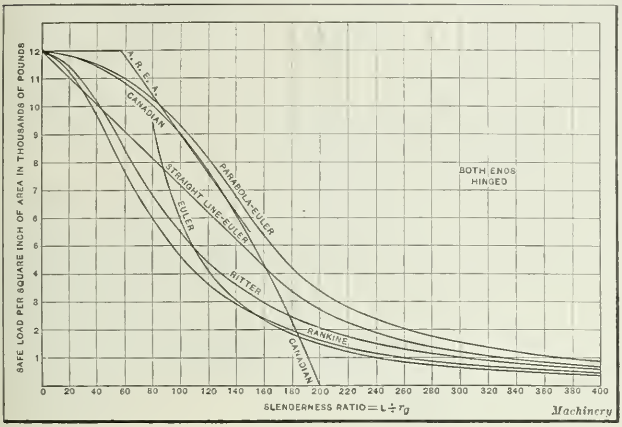


Fig. 3. Plotted Curves for Comparison of Column Formulas—Both Ends Hinged

The Euler Formula

The Euler formula $\frac{P_u}{A} = \frac{C\pi^2E}{\left(\frac{L}{r_g}\right)^2}$ for ultimate loads, may be transformed to

$$\frac{P_s}{A} = \frac{C}{5}\left(\frac{\pi^2E}{\left(\frac{L}{r_g}\right)^2}\right)$$

for safe loads. Merriman's values of C in this case are:

Restrained	4
Restrained and hinged	2.05
Hinged	1
Restrained and free	0.25

The Parabola-Euler Formula

J. B. Johnson's parabola formula for ultimate loads is:

$$\frac{P_u}{A} = S_u - C_1\left(\frac{L}{r_g}\right)^2$$

He used $S_u = 42{,}000$ from which

$$\frac{P_s}{A} = \frac{S_u - C_1\left(\frac{L}{r_g}\right)^2}{3.5} = 12{,}000 - \frac{C_1}{3.5}\left(\frac{L}{r_g}\right)^2$$

for safe loads.

Dividing the constant in Euler's formula for ultimate loads by the same number (3.5) the formula becomes

$$\frac{P_s}{A} = \frac{C}{3.5}\left(\frac{\pi^2E}{\left(\frac{L}{r_g}\right)^2}\right)$$

for safe loads.

Johnson's values of C are:

Restrained	$\frac{25}{\pi^2}$
Restrained and hinged	not given
Hinged	$\frac{16}{\pi^2}$
Restrained and free	not given

The value of C_1 and the value of $\frac{L}{r_g}$ at the point of tangency are given by

$$C_1 = \frac{S_u^2}{4C\pi^2E} \text{ and } \frac{L}{r_g} = \sqrt{\frac{2C\pi^2E}{S_u}}$$

Values calculated for the diagrams are:

Restrained	$\frac{C_1}{3.5} = 0.168$	$\frac{L}{r_g} = 189$
Hinged	$\frac{C_1}{3.5} = 0.263$	$\frac{L}{r_g} = 151$

The value of E used by J. B. Johnson was 28,500,000.

The Straight-line-Euler Formula

T. H. Johnson's straight-line formula for ultimate loads is:

$$\frac{P_u}{A} = S_u - C_1\left(\frac{L}{r_g}\right)$$

He used $S_u = 52{,}500$ from which

$$\frac{P_s}{A} = \frac{S_u - C_1\left(\frac{L}{r_g}\right)}{4.375} = 12{,}000 - \frac{C_1}{4.375}\left(\frac{L}{r_g}\right)$$

for safe loads.

Dividing the constant in Euler's formula by the same number (4.375) the formula becomes

$$\frac{P_s}{A} = \frac{C}{4.375}\left(\frac{\pi^2E}{\left(\frac{L}{r_g}\right)^2}\right)$$

for safe loads.

Johnson's values of C are:

Restrained	$\frac{25}{\pi^2}$
Restrained and hinged	not given
Hinged	$\frac{16}{\pi^2}$
Restrained and free	not given

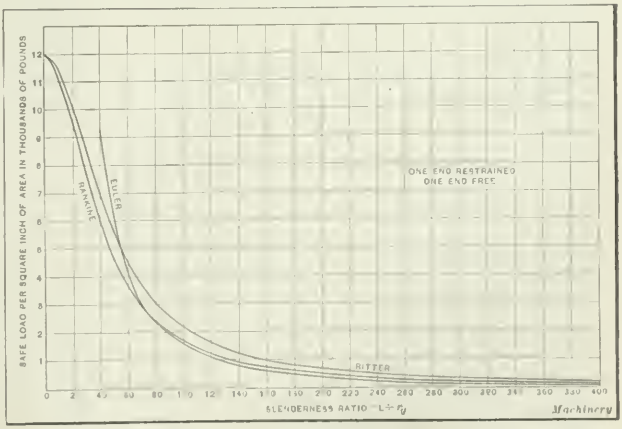


Fig. 4. Column Formulas graphically compared when One End is Fixed and One End Free

The value of C_1, and the value of $\frac{L}{r_g}$ at the point of tangency are given by

$$C_1 = \frac{2}{3} S_u \sqrt{\frac{S_u}{3C\pi^2 E}} \quad \text{and} \quad \frac{L}{r_g} = \sqrt{\frac{3C\pi^2 E}{S_u}}$$

The expression for C_1 is for any point, not only the point of tangency.

The values calculated for the diagrams are

$$\text{Restrained} \quad \frac{C_1}{4.375} = 38.649 \qquad \frac{L}{r_g} = 207$$

$$\text{Hinged} \quad \frac{C_1}{4.375} = 48.305 \qquad \frac{L}{r_g} = 166$$

The values of C_1 and $\frac{L}{r_g}$ given by T. H. Johnson indicate that he used $E = 27{,}000{,}000$, approximately.

American Railway Engineering Association Formula

The A. R. E. A. formula $\frac{P_s}{A} = S_s - C\left(\frac{L}{r_g}\right)$ is often used for both restrained and hinged ends when $S_s = 16{,}000$ and $C = 70$. The curve is ordinarily truncated at $\frac{P_s}{A} = 14{,}000$, but in the diagrams it is truncated at $\frac{P_s}{A} = 12{,}000$. No provision is made for different end conditions, and the graphs in Figs. 1, 2, and 3 are identical.

Special Committee of the American Society of Civil Engineers

The formula adopted by the Special Committee of the American Society of Civil Engineers $\frac{P_s}{A} = S_s - C\left(\frac{L}{r_g}\right)$ applies only to restrained ends and values of $\frac{L}{r_g}$ not greater than 120. The values of S_s and C are 20,000 and 100, respectively, and the curve is truncated at $\frac{P_s}{A} = 12{,}000$.

Engineering Institute of Canada

The formula adopted by the Engineering Institute of Canada $\frac{P_s}{A} = 12{,}000 - 0.3\left(\frac{L}{r_g}\right)^2$ is primarily for use in bridge design, and was derived mainly from the record of the tests made by the Special Committee of the American Society of Civil Engineers. The graphs in Figs. 1, 2 and 3 are identical.

Remarks

In preparing the curves, the variables employed were the slenderness ratio $\frac{L}{r_g}$ and the safe load per square inch of area $\frac{P_s}{A}$. The designation "allowable unit stress" is sometimes given to $\frac{P_s}{A}$, although the former is a constant and the latter a variable. The fact that limiting the working stress to 12,000 pounds also limits the safe load per square inch of area to 12,000 pounds is explained by the equality of S_s and $\frac{P_s}{A}$ when $\frac{L}{r_g} = 0$.

The value of $\frac{L}{r_g}$ at the point of tangency in the Parabola-Euler and Straight-line-Euler formulas is the same for graphs representing ultimate and safe loads.

It is often stated that Rankine's formula is not applicable to high values of $\frac{L}{r_g}$, and Euler's formula is recommended. An examination of the curves, however, does not reveal an appreciable discrepancy between them.

In investigations to determine the actual stresses resulting from a combination of compressive and other forces, it is essential that the actual stress due to each of the forces can be calculated. Of the formulas discussed herein only those of Rankine and Ritter are suitable for calculating the actual unit stress due to a given load and one or the other must be used in combined stress calculations when one of the stresses is compression. In a previous article the writer used Rankine's formula in discussing combined torsion and compression. Rankine's formula covers all types of ends, and it is quite generally conceded that no formula agrees more closely with the results of tests.

The diagrams were prepared primarily for the purpose of comparison, but their usefulness may be extended to problems of design and investigation. A table of coefficients is given below for working stresses greater than 12,000 pounds. The coefficients should not be applied to the A.R.E.A. and Special Committee formulas. The former was truncated at $\frac{P_s}{A} = 12{,}000$, as previously stated, and higher working stresses may be provided for when $\frac{L}{r_g}$ is less than 57.14 by disregarding the horizontal portion of the graph. This procedure in the case of the Special Committee formula would lead to very high unit stresses for low values of $\frac{L}{r_g}$, and moreover the propriety of any change whatever would be doubtful in view of the committee's recommendations. Likewise the Canadian formula does not contemplate working stresses greater than 12,000 pounds per square inch.

The Rankine and Ritter formulas may be used with any desired working stress, and the Euler, J. B. Johnson and T. H. Johnson formulas are in terms of ultimate loads; hence, the working stress depends upon the factor of safety. The coefficients may be applied to these five formulas.

COEFFICIENTS FOR VARIOUS WORKING STRESSES

Working Unit Stress, Pounds	13,000	14,000	15,000	16,000	17,000	18,000
Coefficient	1.08	1.17	1.25	1.33	1.42	1.50

Machinery

Example 1—The diameter D of a round steel column is 3 inches; the unsupported length is 10 feet, and one end is restrained and the other hinged. What would be the maximum safe load on the column using Rankine's formula with a working stress of 12,000 pounds per square inch?

Expressing the length in inches

$$\frac{L}{r_g} = \frac{10 \times 12}{\frac{D}{4}} = \frac{10 \times 12 \times 4}{3} = 160$$

Referring to Fig. 2, the safe load per square inch $\frac{P_s}{A}$ is 4000 when $\frac{L}{r_g} = 160$. The area of a 3-inch circle is 7.07 square inches, and the total safe load on the column is $7.07 \times 4000 = 28{,}280$ pounds.

Example 2—What would be the total safe load on the column in the preceding example for a working stress of 16,000 pounds per square inch?

Using the table of coefficients

$$1.33 \times 28{,}280 = 37{,}610 \text{ pounds.}$$

Railway Machine Shop Practice

By EDWARD K. HAMMOND

Methods of Machining Parts of Locomotive Valve Gears, Valves, and Pistons—Second of a Series of Articles

ON locomotives which are equipped with the Stephenson type of valve gear, the admission of steam to the engine cylinders is controlled by eccentrics which are mounted on the driving axle at points just inside the journals. Fig. 1 illustrates a heavy-duty lathe built in the Pond Works of the Niles-Bement-Pond Co., at Plainfield, N. J., which has been especially equipped for turning the outside diameter of six Stephenson valve gear eccentrics at one time. Obviously this is quite a simple operation in so far as the actual turning is concerned. Before the pieces are set up in the lathe, they are bored, keyseated, and faced on the hubs so that these finished surfaces may be utilized in setting up the work.

Secured to the lathe faceplate, it will be seen that there is a mandrel *A* of such size that it will just enter the bore of the eccentrics. This mandrel is furnished with a flange *B* by means of which it is secured to the lathe faceplate with bolts and straps; and extending from the center of the opposite side of the flange there is a turned pilot that enters a hole carefully bored in the faceplate at a distance from the center of rotation exactly equal to one-half the throw of the eccentrics to be turned. At the right-hand end, it will be seen that the tail-center enters a hole located in the mandrel at the center of rotation. Location of the work is accomplished by means of a key on the mandrel that enters the finished keyway in the eccentric. The actual work of turning is accomplished in accordance with standard lathe practice. This illustration and the two following ones, refer to the practice of the Chicago & Northwestern Railway Co.

When an engine comes to a railroad machine shop to be overhauled for the making of repairs, it is often found that there are some parts which must be replaced. As the manufacture of locomotives has not been reduced to a quantity production basis, it is evident that a railroad might be able to handle work of this kind more economically in its own shops than by sending orders for replacement parts to the builder of the locomotive. Therefore, this procedure is followed in many instances, and this article describes methods used in machining valve gears and piston-rings in railway repair shops.

A practice was formerly made at the shops of the railroad mentioned, of facing the yoke bosses of the Baker valve gear eccentric rod on a slotter. A good job could be obtained in this way, but too much time was required, and a substantial economy has since been effected through the substitution of a method of milling these parts, as shown in Fig. 2. The work is handled on a milling machine built by the R. K. LeBlond Machine Tool Co. of Cincinnati, Ohio, which is equipped with a double-sided inserted-tooth milling cutter. Attention is called to the fact that in addition to the performance of the operation which is here illustrated, this milling machine equipment is employed for handling a variety of other jobs which are of the same general type as that shown.

Milling the Yoke Bosses on Baker Valve Gear Eccentric Rods

Secured to the table of the milling machine it will be seen that there are two short pieces of I-beam *A*, the flanges of which are drilled at the bottom to provide for bolting them down to the table, and at the top to receive bolts which are used with U-straps *B* to clamp the work to the I-beam supports. As the forging to be milled is made from a tough grade of steel, it is desirable to provide for the efficient cooling and lubrication of the cutter, and this is accomplished by placing a pan *C* filled with mineral lard oil under the cutter, so that the teeth are immersed as the cutter rotates. In setting up this job, the valve gear eccentric rod is laid across the tops of the I-beams and lined up with the line of travel of the milling machine table. Then it is merely necessary to feed the work up to the cutter four successive times to provide for facing the four surfaces of the yoke bearing bosses. If this machine were used continuously for the performance of a specified manufacturing operation, it is obvious that a gang of cutters could be utilized to simultaneously finish all four surfaces, but as previously mentioned the same equipment is used for various milling operations, and so the yokes are not straddle-milled.

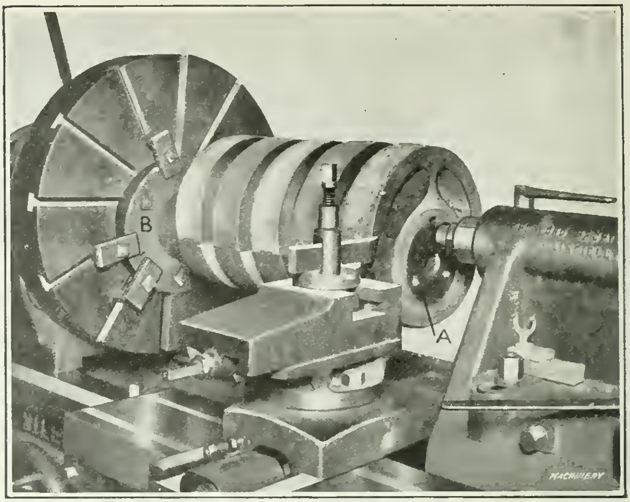


Fig. 1. Lathe equipped with a Special Work-holding Mandrel for carrying Six Stephenson Eccentrics

Boring and Turning Operations on Reverse Yoke for Baker Valve Gear

In machining the reverse yoke of the Baker valve gear, it is necessary to turn two trunnions *A*, Fig. 3, and to face the surfaces at the base of these trunnions; also, it is required to bore two bearing holes at *B*. To fulfill requirements, the two trunnions and the two bearings must be held in accurate alignment with each other, and the center lines of each must also be parallel and exactly spaced. This job is handled on a vertical boring machine built by the Gisholt Machine Co., Madison, Wis., which is equipped as shown. It will be seen that the fixture *C* is made in the form of an angle-plate with bolts set in the vertical leg, against which the work is clamped. No machining has been done on the work before it comes to this boring machine, and the first step is to strap the casting against the vertical plate of the fixture, and bore a hole in one of the bearings *B*. After this has been done, a pilot of exactly the required size to fit the finish-bored bearing hole, is set up on the base of the fixture, this pilot being located on the center of rotation of the table by means of a stem that fits a hole in the fixture. For boring the hole in the second bearing *B*, the work is located by the pilot entering the previously bored bearing hole; and it is then strapped against the vertical plate of the fixture. Held in this manner the boring operation in the second bearing can be performed with the assurance that the two bearings will accurately align.

It is necessary to reset the work for turning the first trunnion *A*, and the yoke is located during this operation by means of pilot *D*, over which the work is dropped to allow the pilot to enter one of the finish-bored bearings *B*. There are two of these pilots, one at each end of the fixture, and it will be evident that the work is shown set up with the pilot at the right-hand end of the fixture in position in the bearing. The method of strapping the work back against the vertical plate of the fixture and down on the pilot is made fairly evident from the illustration, but it may be mentioned in this connection that for use with each pilot there is a bolt and slotted strap that provide for holding the work down, the action of this holding medium being supplemented by a large clamp secured directly to the table of the machine. The illustration shows the work of turning the second trunnion, and it will be seen that the tool, in the position illustrated, has finished its downward feed and is engaged in facing the horizontal surface which surrounds the trunnion.

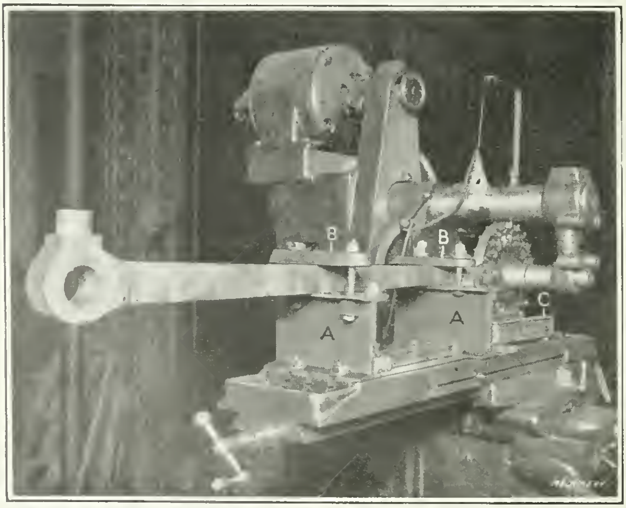


Fig. 2. Milling Machine equipped for facing Bosses on Eccentric Rod of Baker Valve Gears

Expanding Chuck for Turning Piston Valve Rings

For use in turning and facing operations on piston valve rings in the Silvis shops of the Chicago, Rock Island & Pacific Railway, an interesting special chuck has been developed to meet the requirements of the job. Reference to Fig. 4 will show that the piston-ring *A* on which the turning and facing operations are to be performed is placed over a chucking ring *B*, which is slotted radially at a number of places, these slots starting alternately from the inner and outer surfaces of the chucking ring and running almost through it. The inside of ring *B* is engaged by pins *C* which, when operated, apply sufficient pressure to expand the outside diameter of the slotted ring *B*. This is accomplished by means of a screw *D* which actuates a tapered plug against which the inner ends of pins *C* bear. At the time the piston-rings arrive at this lathe, they have been bored, so that the finished bore may be utilized as a locating surface. Very little time is required to set the work up on a chuck of this kind. In so far as the turning and facing operations are concerned, there is nothing of especial interest, but it may be mentioned that the rings are required to pass inspection with "Go" and "Not Go" gages for both width and thickness.

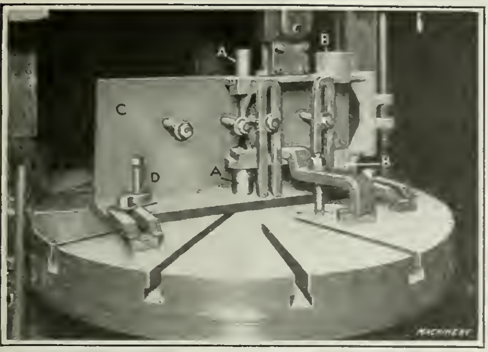


Fig. 3. Vertical Boring Machine and Fixture for holding Reverse Yoke of Baker Valve Gear while boring and turning

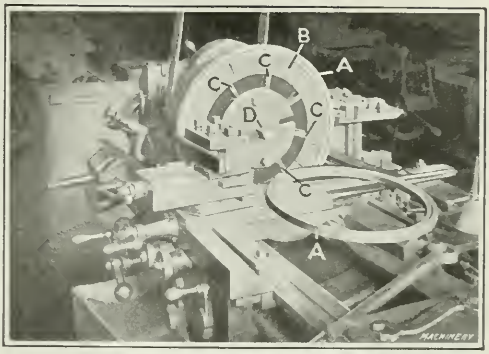


Fig. 4. Special Expanding Chuck for holding Piston-rings during the Performance of Turning and Facing Operations

Quick Method of Cutting Piston-rings

After a piston-ring has been machined, it must be severed and enough metal removed to allow the ring to be compressed sufficiently to enter the cylinder. Through the tendency of the compressed ring to return to normal shape, there is obtained an effective seal to prevent leakage between the piston and the cylinder. In Fig. 5 there is illustrated a simple machine developed in the Silvis shops of the Chicago, Rock Island & Pacific Railway, which provides an economical method of handling this operation. The machine consists of a pedestal, at the top of which is supported a hardened steel anvil *A* on which the ring rests while being cut. Above the ring there is a second anvil *B* that is carried by a spring-supported block so that it is normally held with sufficient space between the upper and lower anvils for the admission of a piston-ring *C*. The cut is made by simply striking the top of head *D* with a sledge hammer, and after one cut has been made the ring is moved slightly, as shown, ready for making the second cut to remove the necessary amount of metal. Formerly, a practice was made of handling this job on a power hacksaw, but much more time was required to do the work in this way and although a somewhat smoother cut is produced, this is really of no especial advantage because the shearing machine now employed for performing this operation fulfills all requirements.

Cutting Piston-rings on the Slotter

Fig. 6 shows another method of removing a segment of metal from a piston-ring, the job shown in this illustration being handled on a slotting machine built by the Newton Machine Tool Works, Inc., of Philadelphia, Pa. It will be seen that where this method is employed, a stack of fifteen rings is placed on the slotter table and that these rings are held on parallels *A* so that they are raised sufficiently to afford clearance for the tool beneath the lowest ring. The rings are held down by means of the familiar arrangement of straps and clamping bolts, care being taken to place one clamp on each side of the segment which is to be removed. After the slotting tool has taken one cut on fifteen rings, the operation is repeated at the section of ring near the second clamp, to permit removing the segment of metal from each ring.

Turning, Boring, and Facing Piston-rings

In the manufacture of piston-rings for use in air pumps, the Chicago & Northwestern Railway Co., has adopted the

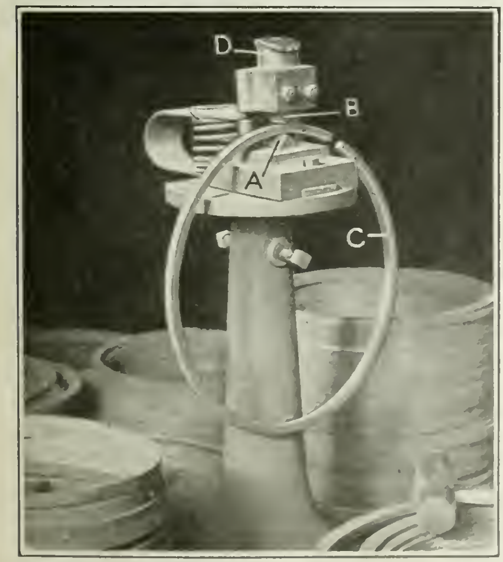


Fig. 5. Special Machine developed to provide a Rapid Means of cutting Segment from Piston-rings

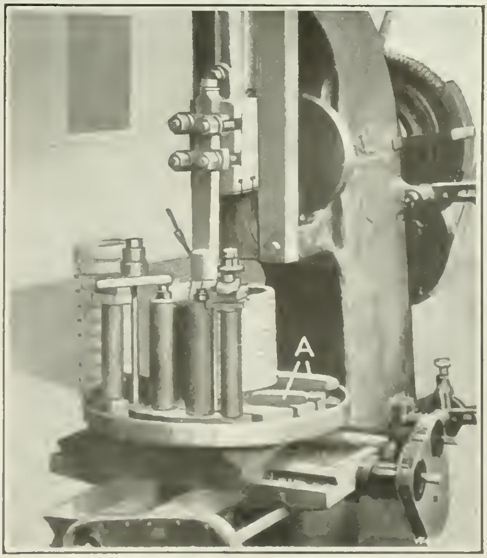


Fig. 6. Slotter equipped for splitting Fifteen Piston-rings at a Single Setting

following procedure. To expedite the performance of turning and boring operations, both castings are delivered to the lathe on which this work is handled. Reference to Fig. 7, which shows the work set up for the preliminary operation, will make it apparent that there are lugs provided on the pot casting with bolt holes to facilitate attaching to the faceplate. On the tail-spindle there is a center *A* of sufficient size to enter the open end of the pot casting and afford the necessary outboard support. Three successive operations are required to complete the preliminary machine work: First, the outside of the pot casting is rough- and finish-turned to the required diameter, after which the casting is slotted with multiple parting tools, carried in a block of the type shown at *B*, this tool-block having the parting tools properly spaced for cutting the grooves which establish the unfinished width of the piston-rings. After this operation has been completed, the tail-center *A* is withdrawn and a boring tool is utilized to machine the inside of the casting to the required diameter. The grooves cut in the previous operation were sunk to such a depth that as the boring tool removes the surplus metal by means of which the casting is held together, the rings drop off successively while the boring tool is progressing through the work.

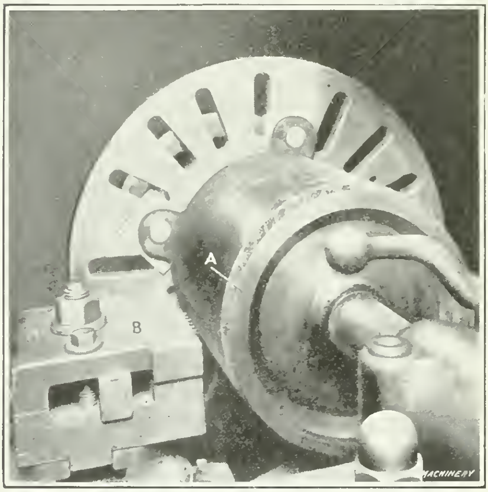


Fig. 7. Method of chucking a Pot Casting for turning Air Pump Piston-rings, and Multiple Parting Tool used

The rings produced by the method just described still have to be faced on the sides to reduce them to exactly the required width and to give the desired finish. For this purpose the work is transferred to a lathe which is equipped, as shown in Fig. 8, with a special magnetic chuck *A*. Magnetic force is depended upon to hold the work in place on the chuck, but to facilitate the labor of centering each ring in anticipation of the facing operation, there is a set of mechanically operated jaws *B* that engage the inside of the ring. At their inner ends these jaws engage a taper plug which is pushed inward by tightening a knurled nut *C*, and this causes the jaws to be expanded sufficiently to bring the ring approximately concentric with the center of the chuck. The facing operation is a simple lathe operation, but it may be mentioned that after one side of a ring has been rough- and finish-faced, it is turned over and relocated on the magnetic chuck from this finished surface, so that both sides are finished exactly parallel. Each ring is required to test up properly in a "Go" and "Not Go" gage *D*, in which two piston-rings *E* are shown. One of these rings is under size as regards width; otherwise it would not enter the "Not Go" opening of the gage.

MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The 1921 spring meeting of the American Society of Mechanical Engineers will have many noteworthy events. It will open at McCook Field, Dayton, Ohio, on May 21, where the Society of Automotive Engineers and the Aeronautic Section of the American Society of Mechanical Engineers will meet jointly to inspect the field. Following the main meeting at Chicago an excursion will be made to Rock Island Arsenal with the Ordnance Section.

Friday morning will be devoted to a trip through the arsenal, with a technical meeting in the afternoon. The Ordnance Department is cooperating fully in the Rock Island program. The local Tri-Cities Section of the society will have charge of the arrangements during the sojourn at the arsenal.

The meeting proper will be held at Chicago, May 23 to 26. The plans for the sessions, under the auspices of the various professional sections, are well under way and a program of value is assured. The Forest Products group promises an interesting program of miscellaneous papers on the subjects in their field which were not covered at the annual meeting in New York. The Fuel Section will consider as its main subject the burning of mid-western fuels. An excursion is planned to Milwaukee to visit the new installation of the powdered-coal plant of the Milwaukee Electric Railway & Light Co. The Machine Shop Section is devoting its program to the consideration of the effect of the automotive industry upon machine tool design and machine shop practice. Papers are in process of preparation to cover this subject.

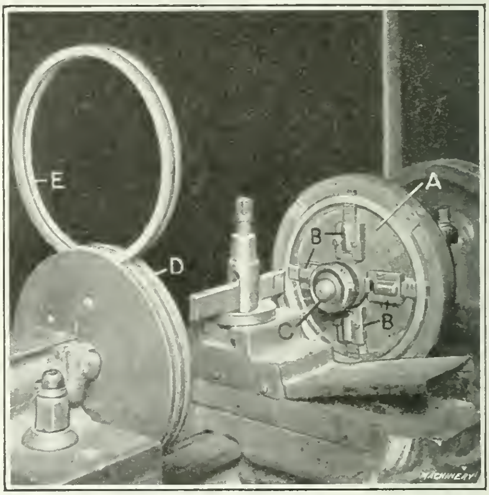
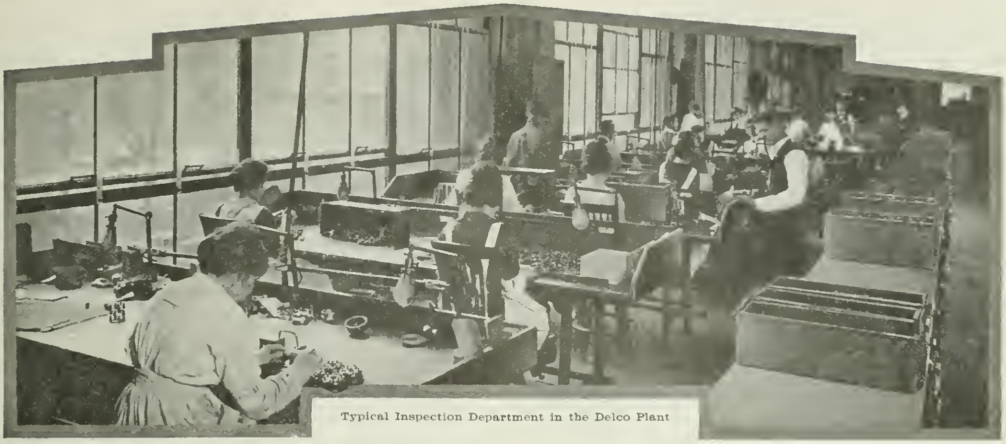


Fig. 8. Special Magnetic Chuck used in Facing Operations on Rings cut from Pot Casting shown in Fig. 7

The Management Section will have a program made up of three papers and a report of the joint committee on Management Terminology. The Materials Handling Section will devote its time to the treatment of the problem of design and construction of machinery for road building. Four papers are planned which will treat the problem from the point of view of the contractor, the road builder and possible future development of mechanical equipment in road building. Instead of excursions a number of very interesting films are being arranged for. The Power Section has made tentative plans to discuss power resources and development in the Middle West. The subject to be discussed by the Railroad Session will be the design of large freight locomotives.



Typical Inspection Department in the Delco Plant

Principles of Inspection

A Detailed Review of the Principles upon which Rational Inspection Methods are Based, with Special Application to Interchangeable Manufacture*

By LOUIS RUTHENBURG, Superintendent, and R. A. CRIST, Assistant to the Superintendent of the
Dayton Engineering Laboratories Co., Dayton, Ohio

INSPECTION should be considered in a broader sense than is ordinarily the case. Generally, inspection is thought of as the mere verification of the dimensions of parts. This is too narrow a view of the scope of this branch of manufacture. The inspection department is that part of a manufacturing organization which is charged with the full responsibility for safeguarding the quality of the product. The function of the inspection department in manufacture may be likened to that of the judiciary system in civil life, namely, to interpret and enforce the laws. In the case of the inspection department the laws which it must interpret and enforce are those governing the quality of the product. The judiciary could not function without laws upon which to base judgment; neither could the inspection department function without laws upon which to base its operations and govern its decisions. The laws that are interpreted and enforced by the inspection department are the specifications originated and approved by the engineering department.

The Scope of Inspection

Inspection as applied in large modern manufacturing plants covers a wide range of activities. It includes the inspection of the materials received from outside manufacturers either in the form of raw materials or finished products. It further covers the inspection of the parts manufactured in the plant, and the inspection and testing of the assembled and completed machines or devices manufactured. It also includes the verification and testing of gages, and inspection and testing of all special tools, jigs, and fixtures to be used by the manufacturing departments, as well as the inspection of all machine tools and devices bought from outside manufacturers for use in the plant. Briefly, therefore, it covers the inspection and testing of everything that enters the plant, as well as of everything that leaves the plant. It assures that the manufacturing departments are provided with the proper materials, tools and machines with which to work, and it is responsible for the quality of the product.

Inspection Specifications for Materials

The laws or specifications that govern the work of the inspector cover the whole range of inspection as outlined in the previous paragraph. Dealing first with the inspection of materials, it will be found that a large part of the work of the inspection department consists in comparing materials with established specifications, and in passing or rejecting those that conform or fail to conform with these specifications. The specifications should cover any property of the material that will affect its ability to give the proper service for which it is intended.

The more usual specifications covering materials used in the manufacture of mechanical or electrical machines and devices are as follows: (1) Dimensional specifications; (2) chemical specifications; (3) physical specifications; (4) electrical specifications; (5) treatment and finish specifications; and (6) performance specifications. In preparing specifications, it must be remembered that exact duplication is not possible in any mechanical process. Two pieces of steel cannot be finished to exactly the same dimensions. One of them may vary from the other by only an infinitesimal part of an inch, but they cannot be identical. As a result of the recognition of this

The present article on the principles of inspection methods is based on a paper prepared for a training course for executives by the executive training course committee of the Dayton Engineering Laboratories Co. This committee consists of Louis Ruthenburg, superintendent, R. A. Crist, assistant to the superintendent, W. E. Baker, employment manager, and O. T. Kreusser, educational head, working in cooperation with other executives of the Delco organization. The principles laid down, therefore, constitute the authoritative record of the best practice in inspection, as the highly developed and systematic methods of the Delco organization are well known throughout the whole engineering world.

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fact, specifications must provide limits—maximum and minimum limits—and the difference between the limits is known as tolerance.

In the same way as limits are provided for dimensions, so chemical limits and tolerances are specified for the composition of material. Instead of specifying 0.20 per cent carbon steel, the specifications would call for a carbon content within the limits of 0.15 and 0.25 per cent carbon. This provides for a tolerance of 0.10 per cent, or "ten points."

In physical specifications, tolerances and limits are seldom given, because they are of no importance. Specifications of this kind may be called "single-limit" specifications. For example, the strength of a certain class of steel may be specified by saying that the elastic limit must be 90,000 pounds per square inch. This is the minimum limit. The maximum limit is of no importance. It makes no difference how much stronger the steel is, so long as the minimum limit is equalled or exceeded.

Specifications for the Work in the Manufacturing Departments

The modern tendency is to place on the engineer or designer the full responsibility for definite specifications. Instead of using such expressions as "running fit," "force fit," "screw stock," "cold-drawn steel," "carburized," "oil-hardened," "file-hard," etc., modern manufacturing practice requires that the engineering department shall provide specifications giving definite limits or directions.

This does not mean that proper specifications can be established arbitrarily from the limited point of view obtainable from the drafting table or the laboratory. On the contrary, satisfactory specifications are only obtainable through the closest cooperation between all the departments of an organization. Correct specifications can best be provided as follows:

First of all, the records of the product in service must be studied. If the machine or apparatus built, or any parts of it, are giving trouble, the reports of these troubles should be closely studied by the engineering department with a view to so changing the specifications as to avoid similar difficulties in the future. If new machines or apparatus are being designed, the service records of previously designed similar apparatus must be carefully studied before specifications for the new apparatus are adopted.

Satisfactory limits and specifications for manufactured products cannot be established arbitrarily from the limited point of view obtainable from the engineer's desk, the drafting table, or the laboratory. On the contrary, satisfactory specifications are only obtainable through the closest cooperation between all the departments of an organization. The records of the product in service must be studied; the customer's requirements must be considered; and existing standards must be taken into account.

Next in importance to service records are the customer's requirements. These requirements are, of course, based primarily upon his own service records, but often the customer has some individual requirements which must be carefully considered in order that the specifications established may properly meet his needs.

The third thing to be considered in establishing specifications is existing standards. There are certain analyses of steel that are generally accepted as standard among steel makers. It would be short-sighted and expensive to specify a steel differing but slightly from an accepted standard, if no benefit resulted from the use of the steel with the odd specifications. If screw threads of certain dimensions are an accepted standard among automobile makers, for example, it would be unwise for makers of automobile accessories to specify other thread dimensions, except under very unusual conditions that might justify the use of a thread not accepted as standard.

Shop standards must also be given careful consideration, as well as the limits imposed upon the engineer by the mechanical processes and equipment by means of which the work is to be done. In specifications covering shafts and holes, for example, it is good practice to provide a larger tolerance for the hole than for the shaft, because it is less expensive to maintain close limits on external dimensions than on internal dimensions. Furthermore, dimensions should be so given, whenever possible, that tools of accepted standard may be utilized, and treatment and finish specifications should only be adopted after a careful study of existing shop practice and the available equipment.

A careful study of the specifications is a very important part of the whole inspection system. Just as unreasonable laws can be enforced only with difficulty or not at all, so unreasonable specifications cannot be lived up to except at great expense and loss of efficiency. Specifications and inspection are tied together as closely as the law in civil life and its enforcement. It is impossible to arrive at a correct understanding of the functions of the inspection system without first having a clear understanding of specifications and the methods by which they are decided upon.

Interchangeable Manufacturing and Inspection

The most highly developed inspection systems are those found in plants having a highly developed system of interchangeable manufacture. In fact, interchangeable manufacture may be said to be the basis of modern inspection specifications and methods. The subject of interchangeable manufacture was dealt with completely in the series of articles by Major Earle Buckingham, published in MACHINERY during the last two years, and it is therefore unnecessary at this time to treat in detail of the advantages of interchangeable manufacturing methods. It may be enough merely to summarize these advantages by saying that the main object of interchangeable manufacturing is to reduce costs.

One of the main reasons that costs can be reduced is that where the interchangeable system is properly applied, a less skilled grade of labor can be employed. A skilled mechanic is required to make a number of parts alike within the required limits without a gaging system; but a semi-skilled mechanic can make a much larger number of parts in the same time alike within the required limits when the proper tool equipment, and gaging and inspection methods are used. Furthermore, when the parts are made interchangeable, a great deal is saved in the assembling department. Thus the advantage gained by interchangeable manufacture is not only that all parts are made alike, but that production costs are greatly reduced.

The Limit System

The limit system, which forms the basis of interchangeable manufacturing, is applied in a number of ways in manufacturing plants. In some cases the system, as generally understood, is only partially applied. The importance of and the principles involved in the limit system have also been covered in the articles by Major Buckingham on interchangeable manufacturing, previously referred to. It may be sufficient to summarize the advantages gained by its use. It makes an interchangeable product possible, eliminates the necessity of depending upon the judgment of the workmen and the inspector, and reduces the amount of spoiled work to a minimum.

In some cases the initial cost of installing a limit system is heavy, but when it is considered that a properly organized limit system greatly reduces inspection and manufacturing costs, it will be found that the advantages to be gained will generally more than offset the initial expense. The experience of every large plant working on the interchangeable basis verifies this.

Setting Manufacturing Limits

The setting of limits on work which is to be made on the interchangeable basis is one of the most vital parts of the work of a manufacturing organization; and upon the knowledge, care, and common sense used in doing this work may often depend the success or failure of the manufacturing enterprise. The practice of specifying proper limits saves much needless expense. Suppose a tool drawing specifies the length of a part in fractions of an inch, and does not give any limits. It may be that it would be of no practical importance if the part was one-sixty-fourth inch more or less than the size designated. Yet the toolmaker would be very likely to spend a considerable amount of time in making the part as nearly to the size specified as possible with ordinary machining means at his disposal, thereby greatly increasing the cost.

Both manufacturers and workmen frequently make use of the expressions, "exactly one inch," "right up to dimensions," "without any tolerance," etc. Such expressions indicate a lack of understanding of the conditions present in manufacturing. To a toolmaker such an expression may mean an accuracy within a tolerance of one ten-thousandth inch; to a machinist it may mean an accuracy within a thousandth inch; and to a woodworker it probably would mean an accuracy to a tolerance of one-sixteenth inch. No matter how skillful the workman nor how accurate the machines and measuring instruments at his disposal, the work produced must always vary to some extent from the established dimensions. Hence the necessity for establishing a limit system.

A careful study of the specifications is one of the most important functions of the whole inspection system. Just as unreasonable laws can be enforced only with difficulty, or not at all, so unreasonable specifications cannot be lived up to except at great expense and loss of efficiency. Specifications and inspection are tied together as closely as the law of civil life and its enforcement. It is impossible to arrive at a correct understanding of the functions of inspection without first having a clear understanding of the method by which the specifications have been determined upon.

The object of the limit system is often misunderstood. Except in isolated cases, the limit system is not intended to attain the highest possible degree of accuracy, and the best limit system is not that which does attain this accuracy. The best limit system is that which insures that each part will be made as accurately as is required in order that it should give the kind of service expected from it. Too small tolerances are often wasteful and extravagant; too great tolerances may mean failure to provide a machine or device of the quality required. It is only by a close study of the hundred and one conditions that enter into the manufacture and the service of a given part that the best tolerances in any given instance can be determined upon, but when the tolerance has been established, whether it be a ten-thousandth or a sixteenth part of an inch, it should be maintained by the manufacturing and the inspection departments until changed conditions or a more complete study of the problem renders it advisable to make a revision.

A great many methods have been evolved for establishing a system of limits, but practically no two manufacturers use the same system for setting limits or give the same permissible amount of error in manufacture. No general rule can be laid down, as the tolerance depends entirely upon the character of the work and the conditions under which the parts are to operate. Set rules cannot be established. Judgment and experience may be said to be the only basis for the establishment of manufacturing limits. A review of the tolerances within which work may be kept when using different machining methods in regular manufacturing practice is given in the article "Developing a Gaging System," published in MACHINERY, October, 1918.

Organization and Functions of an Inspection Department

Successful organizations are usually shaped about the personalities involved, rather than built to conform with some ideal paper plan. For this reason it is impractical to lay down a definite rule as to the final responsibility for inspection in all organizations. It is fairly obvious, however, that such final responsibility should rest with the person possessing, or who is in a position to obtain, the clearest conception of quality requirements as balanced against that which is commercially desirable or practicable. These qualifications are usually held by the man broadly responsible for the management of the business, and he should therefore be closely in touch with the inspection department.

Under such conditions it may be fairly stated that a chief inspector who is independent of the manufacturing departments and whose opinions of quality will not be influenced by a desire to obtain increased production, will naturally be able to maintain a higher standard of quality than would otherwise be the case. On the other hand, the inspection department must not become so technical and academic in its judgment that the product is needlessly rejected. The influence of the general manager will make itself felt in this direction.

While the inspection is a separate unit in the organization, it should be clearly understood that the work of the inspection department must at all times be in full harmony with the manufacturing work, and that there must be the fullest cooperation between the inspection and the manufacturing departments, so that all questions arising may be speedily disposed of and all controversy settled in a friendly and harmonious manner.

The methods of inspection must be decided upon and the scope of the inspection department's work must be worked out differently in different plants. In following articles to be published in MACHINERY the methods employed in the actual organization of the inspection department and in the carrying out of the duties of inspection at the Dayton Engineering Laboratories Co. will be dealt with in detail. These methods have been worked out over a considerable period of time, have been checked from time to time to conform with the requirements, and have been developed to a point where they meet the needs of this plant in an unusually satisfactory manner. The principles involved in these methods will doubtless be found applicable to a great number of plants manufacturing a variety of products in quantities.

The Gaging System

Having determined upon the method of conducting the inspection during the manufacture, the next consideration is the gaging system, since the gaging system provides the means by which the requirements of the limit system are carried out. It is not necessary here to review the types and classifications of gages, as these have been thoroughly dealt with in past articles published in MACHINERY, in the October, November, and December, 1918, January and February, 1919, and July and August, 1920, numbers; the following books published by THE INDUSTRIAL PRESS also cover this subject: "Gages, Gaging and Inspection," by Douglas T. Hamilton; "Gage Design and Gage Making," by Erik Oberg and Franklin D. Jones; and a forthcoming book on "Principles of Interchangeable Manufacturing," by Earle Buckingham.

Special methods in the designing and use of gages and special gaging fixtures used by the Dayton Engineering Laboratories Co. will be described in articles to be published in coming numbers of MACHINERY. While, therefore, it is not necessary in this review of the principles of inspection to deal with the different classes of gages used, it is, however, of great importance to point out in detail the application of the gaging system and its relation to the inspection system.

Application of the Gaging System in Inspection

In the application of a practical gaging system as part of the inspection system of a modern manufacturing plant, certain considerations are fundamental. The basic requirements of modern manufacturing practice may be set forth in the form of a table. On the one hand, the fundamental ideals toward which the manufacturer may direct his efforts are indicated. On the other hand, we have the essential practical equipment with which he must be supplied, and the equally practical conditions under which the work must be conducted in order to attain approximately the ideals aimed at.

Things Desired	Means Required
1. Maintenance of limits	1A. Tools, jigs and fixtures of maintained accuracy under conditions of high-speed operation
2. Reduction of time factor	2A. Working gages of maintained accuracy under conditions of high-speed operation
	3A. Elimination of personal element in mechanical operations

It may be of interest to consider briefly the points indicated in the accompanying table. The maintenance of limits has already been considered in this article in connection with the setting of manufacturing limits for interchangeable parts.

The object of the limit system is often misunderstood. Except in a few isolated cases, the limit system is not intended for attaining the highest possible degree of accuracy, and the best limit system is not that which does attain this accuracy. On the other hand, the best system is that which insures that each part will be made only as accurately as is required to give the kind of service expected from it. Too small tolerances are wasteful and extravagant; but, on the other hand, too great tolerances may result in utter failure to provide a machine or device of the quality required.

Reduction of Time Factor

The subject of reducing the time factor is so comprehensive that every effort toward efficiency may be said to hinge upon it. Volumes have been written on this subject without accomplishing more than scratching the surface. To do more than mention its broader phases here would be impossible. Material, overhead, and labor are the three items of expense entering into every manufacturing operation. Of these items labor is the greatest, not only directly, but also indirectly, because of its control of the others. When we save labor we also save time, and it would be just as accurate to speak of time-saving devices as of labor-saving devices. When time is conserved, labor may accomplish more and greater things. What we really mean by a labor-saving device is not that it saves labor, but that it saves the time of labor, so that labor may be used for other purposes to best advantage.

Tools, Jigs, and Fixtures of Maintained Accuracy

A prominent manufacturer of special tools recently said: "I find it much easier to satisfy Brown's requirements than those of Smith." It happens that Brown is the maker of an unusually high-grade expensive automobile, while Smith builds cheap cars in great quantities. Hence, it seemed peculiar at first that it should be easier to satisfy the requirements of Brown. The explanation, however, was as follows: The manufacturer of the high-grade automobile takes a great deal of time to produce his car. In his plant they can give more attention to the tools, and they do not use them as severely; they do not wear away from the original dimensions as rapidly. The manufacturer building cheaper cars in large quantities has his whole plant keyed up to produce work at the greatest possible speed. The average tolerances in his manufacturing processes are fairly large, but these tolerances must be accurately maintained or the high speed of the assembly work would suffer. The tools wear away from the original dimensions much more rapidly because they are subjected to more severe usage; hence the original requirements in the making of jigs, tools, and fixtures of all classes for the cheaper car are by necessity more exacting than in the other case.

The idea brought out furnishes much food for thought. It seems at first to be a paradox that the cheapest products should be produced by the most expensive tools, but when carefully considered it will be found that where the profit margins are the closest, the manufacturing efficiency must reach the highest mark. The limits must be maintained; the time factor must be reduced; and the accuracy of the tools must therefore be maintained. Frequent inspection and repair of tools, jigs, and fixtures become necessary, and the time involved in these operations becomes a profitable investment.

Maintaining the Accuracy of the Working Gages

In the accompanying table it may be thought that the maintenance of the accuracy of working gages has been too strongly emphasized. It may also be thought that the working gages could be grouped with the tools. Here again we come back to our analogy between a manufacturing organization and civil life. Working gages may be regarded as bearing the same relation to tools, jigs, and fixtures that a police force bears to the commercial interests of a city. The gages are the veritable guardians of the peace in the factory. Just as long as the tendency to err keeps within the law, these safeguards may seem of little importance. They may even be scorned as representing a useless expense. But consider what happens in a factory equipped with unsatisfactory working gages when it encounters one of those unavoidable "crime waves" of defective workmanship. Just as soon as this happens, complaints from customers make it clear that a dangerous condition exists, and an effort is immediately made to organize an efficient system of gaging—to create a police force—equipped to prevent defective workmanship.

Too often in manufacturing plants, tools and gages are lumped together as one item, and because of the urgent need of starting production, the gages are neglected until a disregard of the working limits and the succeeding confusion and expense emphasize their necessity.

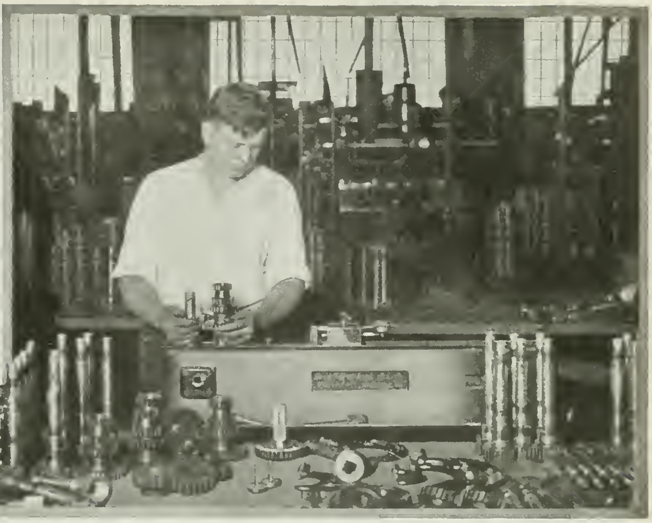
Elimination of Personal Element in Mechanical Operations

With a certain fixture an experienced operator produces parts within the prescribed limits. With the same tool an unskilled workman is unable to produce work that will pass inspection. This indicates that the fixture should be redesigned so that a less experienced workman may produce more parts with an equal degree of accuracy in the same length of time as the experienced operator. In this way the influence of the personal element has been reduced.

With a pair of micrometers a skillful inspector can gage parts accurately for diameter. With a limit snap gage an untrained girl more accurately inspects the same number of parts in less time, and the tendency toward errors has been minimized. The personal element has been eliminated.

In any industry a definite function of inspection is the matter of service to the manufacturing or producing departments. The inspection system should be a bulwark against the lowering of quality in order to obtain quantity, but due consideration must be given all factors involved, with the idea of rendering the greatest possible service to the factory in the production of quality apparatus.

Quantity Production in a Gear Shop



Practice of the Dittmer Gear & Mfg. Corporation, Lockport, N. Y., in the Manufacture of Gears for Tractors, Trucks, and Automobiles—Second of Two Articles

By FRED R. DANIELS

THE first installment of this article, published in the April number of MACHINERY, described the preliminary steps in preparing the stock for the machining operations, and dealt in detail with the machining operations previous to cutting the teeth of various types of automobile gears. The present installment will deal with the cutting of the teeth, the heat-treatment, the grinding operations, and the inspection.

Cutting the Teeth

After the roughing operations on the gears are completed, they are given a preliminary inspection and are then passed on to the gear-cutting department, where the teeth are roughed on Cincinnati hobbing machines and finished on Fellows gear shapers, a battery of which may be seen in Fig. 11. This statement is, of course, a general one, as it will be evident that for hobbing the teeth in gear *E*, for example, of the cluster gear shown in Fig. 8 in the first installment, sufficient clearance space is not available between gears *D* and *E* to permit the use of a hob, and in such a case both the roughing and finishing cuts are performed on a Fellows gear shaper. Fig. 11 also shows the method of transporting stem gears about the factory during the course of manufacture, the work being held in suitable carriers, one of which is shown in the foreground of the illustration.

In the case of stem gears having a splined shaft, like gear *B*, Fig. 5 in the April number, the splines are machined by the hobbing process on a Barber-Colman gear-hobbing machine equipped the same as the job shown in Fig. 12, with a hob that provides for under-cutting the sides of the spline, as at *R*, Fig. 5. This is done to facilitate the subsequent finishing of these spline-ways. Fig. 12 shows a similar operation on a splined shaft, the set-up for the gear being identical with the set-up shown. The operator of this machine also runs a similar machine for rough-cutting the teeth in the stem gears. Production time on the splining operation is thirty stem gears per hour, this also being the production rate for the roughing operation on the gear teeth.

Fig. 13 is a close-up view of a Cincinnati hobbing machine engaged in roughing the teeth in gear *B*, Fig. 8, while Fig. 14 is the finishing operation on this gear as set up on the Fellows gear shaper. The production time for rough-cutting the twenty-nine teeth in gear *B* is 16 gears per hour; for gear *D*, 22 per hour; for gear *E*, 8 per hour; and for gear *F*, 28 per hour. As previously explained, gear *E* is both roughed and finished on a Fellows gear shaper, which accounts for the proportionately long machining time. The finishing operations on the four gears of the cluster are performed at the rate of 4.7, 6, 7, and 8 gears per hour, respectively.

Before the teeth are finish-cut, the ends of the teeth in gears *D* and *E* are pointed on a tooth-rounding machine manufactured by the Cross Gear & Engine Co., Detroit, Mich., and this machine is shown in Fig. 15, engaged in rounding the teeth of gear *E* of the cluster gear. The tool is clearly shown at *A*. This rounding of the teeth facilitates the sliding engagement of the gears when they are in operation. The production time is twenty-eight forgings per hour for each of the gears *E* and *D*. After finish-cutting, the rough edges are next removed and the burrs cleaned off on a speed lathe; this completes the machining operations prior to heat-treatment. Before heat-treating, all work is subjected to another inspection, after which the work is delivered to the heat-treating department, a corner of which is shown in Fig. 16.

Heat-treatment

The heat-treating department is equipped with two Rockwell under-fired carburizing furnaces in which platinum hot-end pyrometers are installed. The gears are packed in semi-steel cast pots, using "Bohnite" carburizing material, manufactured by the Case Hardening Service Co., Cleveland, Ohio. The pots are covered and sealed with fireclay, and in about every fifth one, the cover has a hole through which a test piece extends into the pot so that the depth or case may be tested from time to time. This, of course, is merely an approximate method of ascertaining the condition of the work, and is not relied upon solely to determine when the proper depth of case has been reached. There is included in each lot of work to be carburized a scrap gear; this gear is fractured and the case examined as a further means of checking up the degree of carburization

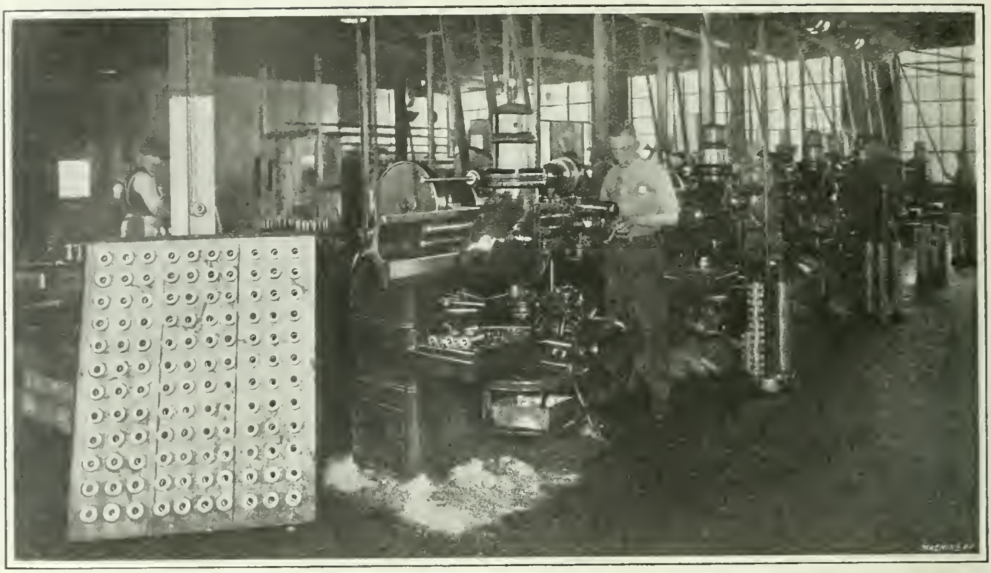


Fig. 11. Section of the Gear-cutting Department, showing a Row of Gear Shapers

that is indicated by the pyrometer. A temperature of from 1650 to 1700 degrees F. is maintained, and the work is permitted to cool in the pots after carburizing.

To prevent the formation of scale during the hardening process, the gears are immersed in molten lead. This is done by stringing them on a poker, which is inverted when the gears are immersed; otherwise, due to the greater specific gravity of the lead bath, the gears would not remain on the poker but would rise to the top of the lead bath. In hardening, a number of Gilbert & Barker lead pot furnaces are employed, and these are equipped with nichrome pots in place of the regular pot furnished with the furnace. The hardening consists of first refining the core at a temperature of 1500 degrees F. and then quenching in oil. This leaves the core in proper condition to give the highest gear service, but the case remains very brittle. In reheating to a temperature of 1325 to 1350 degrees F., the case is refined and the core unaffected. Temperature figures for hardening are, however, more or less flexible, since the greater the carbon contained in the case, the less the temperature required to harden it, and vice versa. From the reheating furnace, the gears are quenched in an oil bath.

In order to realize the most uniform results, the temperature of the oil bath must be kept uniform, and to that end, the oil is circulated by being delivered to the tank from the bottom, and returned to the supply tank by a pipe connection at the top of the quenching tank. The supply tank is located underground and is equipped with water-cooling coils. After casehardening, the gears are tempered in oil at a temperature of 325 to 350 degrees F., thus relieving the hardening strains set up in the case. The tempering furnaces are of the Gilbert & Barker type. These, as well as a wire-mesh basket in which the parts are contained during tempering and rinsing, may be clearly seen in Fig. 16. This illustration also shows some of the other heat-treating appurtenances, including cleaning tanks and hardness testing equipment. The hardening room is equipped with an overhead trolley system by means of which the work is transported from one section of the room to the other. After tempering, the coating of oil left on

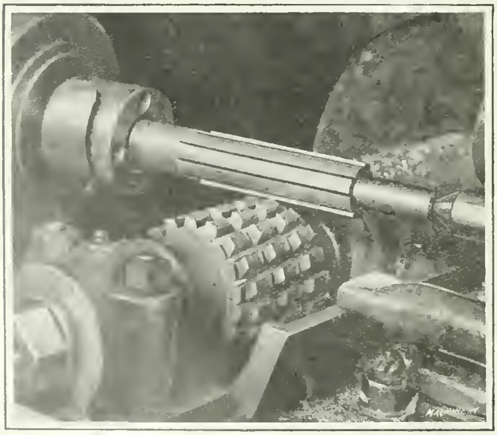


Fig. 12. Hobbing Machine employed in cutting Splines in Shafts and Stem Gears

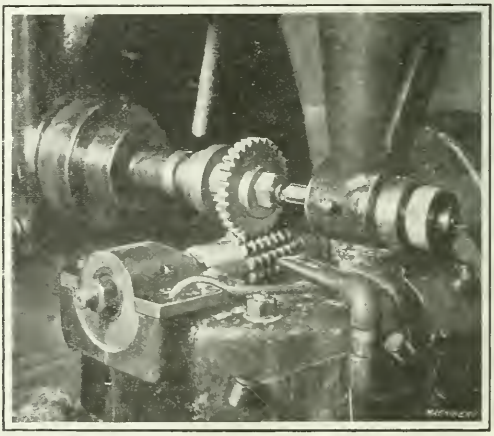


Fig. 13. Roughing Operation on a Spur Gear, performed by the Hobbing Process

the gears is removed by immersing in a tank of mineral cleaner, from which they are quickly withdrawn and then wire-brushed. The oil used for the quenching bath is Houghton's No. 2 soluble quenching oil.

Testing Hardness and Straightening

Every gear that passes through the heat-treating department is subjected to a hardness test by the scleroscope method, a reading being taken on two diametrically opposite teeth. In the case of gear *A*, Fig. 5, it will be seen that the stem end of the gear is drawn to a scleroscope reading of from 50 to 60, but, in general, a reading of from 70 to 85 is required. Long gears of the type shown in Fig. 5 and splined shafts which are likely to warp during heat-treatment are straightened on a 30-ton Lucas power press before being delivered to the grinding department, where the final machining operations are performed. Other auxiliary equipment found in the heat-treating department includes an ordinary lathe with a dial indicator for inspecting the straightness of these long slender parts.

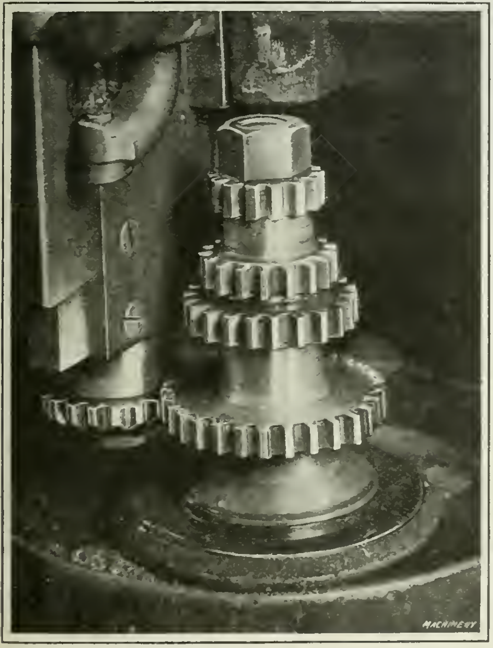


Fig. 14. Finish-cutting the Teeth on a Gear Shaper

Before leaving the heat-treating department, it may be of interest to call attention to the power installation by means of which the oil is pumped to the furnaces and tanks, and the air pressure supplied to the oil burners. A 20,000 gallon capacity storage oil tank is used, from which a rotary oil-pump delivers the fuel to the furnaces. The air pressure is supplied by a Root positive pressure blower, and the quenching oil supply, fuel oil-pumps, and the blower for atomizing the oil, are all driven from one lineshaft, so that in case there is trouble and any one unit is inoperative, the results will not be serious. By this arrangement, when either the quenching oil supply, the fuel oil supply, or the blower is stopped, there remains no possibility of the oil being supplied to the furnace in a stream, rather than in a spray, which might be the case if the blower and fuel supply were operated independently. An additional advantage of this arrangement is that a considerable saving of power and auxiliary equipment for pumping the oil supply is realized.

Grinding Methods

The first grinding operation performed on the stem gears, Fig. 5, after being delivered from the heat-treating department, consists of grinding a 60-degree center, as at *S*. The work is chucked from the pitch circumference in a Johnson gear chuck, made by the Garrison Machine Works, Dayton, Ohio, and is supported at the small end by a regular 60-degree center. In the performance of this operation, any available grinding machine or any lathe equipped with a grinding attachment may be used. The stem gears of the type shown at *A*, Fig. 5, are then ground on surfaces *T*, *D*, and *E*, and the gears of the type shown at *B*, on surfaces *T*, *Q*, and *U*, the operations being performed either on a Landis or a Cincinnati cylindrical grinder, with the work supported between centers as shown in Fig. 17. This illustration shows a Cincinnati grinder engaged in grinding surface *E* of gear *A*, Fig. 5. The grinding wheel used on this operation is a Norton, grade 6660CM, 18 inches in diameter and 2¼ inches face width, and the production time is fifty ground gears per hour.

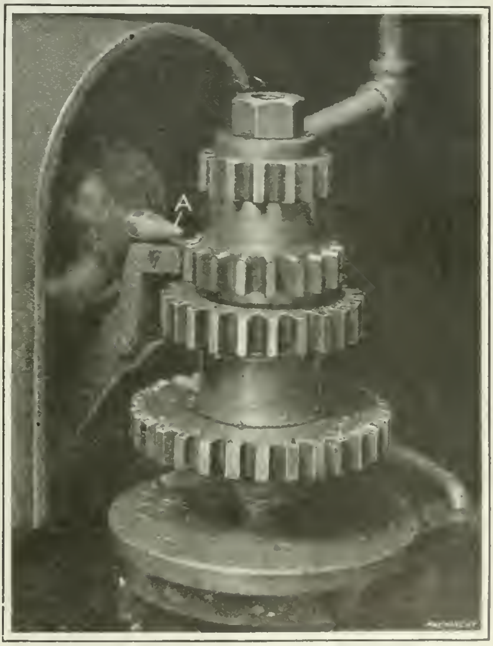


Fig. 15. Gear Rounder machining the Ends of the Teeth

These ground surfaces, being located from the center line of the gears, are used as the registry surfaces during the grinding operations which follow. The central hole *I* of the stem gears may be finished either by grinding or by reaming. In the case of gear *B*, the work is ground in an internal grinding machine. In the gear shown at *A*, this hole is finished by reaming, but the work is chucked from the bearing surface, as in the case of grinding the hole of gear *B*, so that the same relationship is established.

The only grinding operation required in finishing the cluster gear, Fig. 8, is that of grinding the central hole and this operation is illustrated in Fig. 18, which shows a Worcester bore grinder, equipped with a special Garrison gear chuck having provision for clamping the work by the large and also by the small gear. Aside from the fact that the chuck is of duplex construction, it is not different from the regular gear chucks of this type. By this special provision, the concentricity limit of 0.003 inch between the central hole and the pitch line may be readily maintained. The

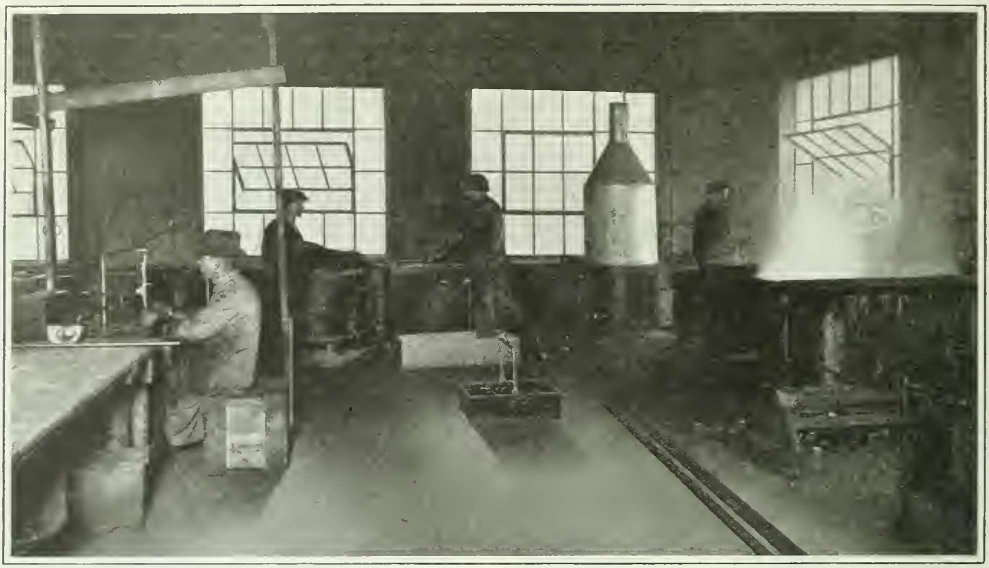


Fig. 16. Heat-treating Department, showing Furnaces, Quenching Tanks, and Hardness Testing Bench

production time on this operation is four gears per hour, and a Norton grinding wheel (grade 6660 L) 1⅛ inches in diameter and ⅝ inch wide is used.

Inspection

The inspection of all gears manufactured in this plant is one of the most painstaking and carefully conducted operations to which the work is subjected. The gears are inspected, as has been explained, in the rough, before the teeth are cut, after they are cut, just before being heat-treated, and finally after grinding. At the beginning of any operation, one gear is always inspected before the operator is permitted to proceed. After the inspection has been concluded, if the work is satisfactory, it is then necessary for the operator to submit a piece to be inspected every hour during the day. This practice is insisted upon, and the results of this hourly inspection are indicated by a card such as shown in the lower part of Fig. 19. This card is self-explanatory, and shows the punch marks which indicate that the gear has received the inspector's attention. Each gear that is inspected, is stamped at the time of inspection, and this prevents the workmen from submitting the same piece from hour to hour.

The inspection is divided into two sections, one for the intermediate stage of manufacture and one for the final inspection, but the same general scheme is followed in both, in maintaining the desired quality of output. The inspector is required to fill out a daily report, which is shown in the upper part of Fig. 19, so that the chief inspector may be advised as to the amount of work going through and the quality of the work. A reason is also given for the cause of rejected work so that a cue is furnished for correcting any factor which may need such attention. In addition to the stationary inspectors, there is a roving inspector whose duty it is to pass around through the shop frequently during the day.

Before any gears are passed to the gear-cutting department, they are given a final 100 per cent inspection. Gears

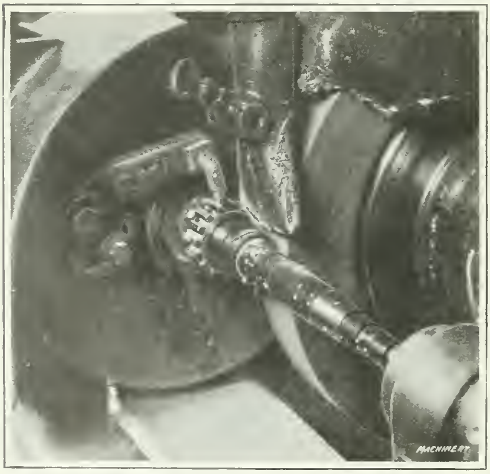


Fig. 17. Grinding Bearing Surface of Stem Gears

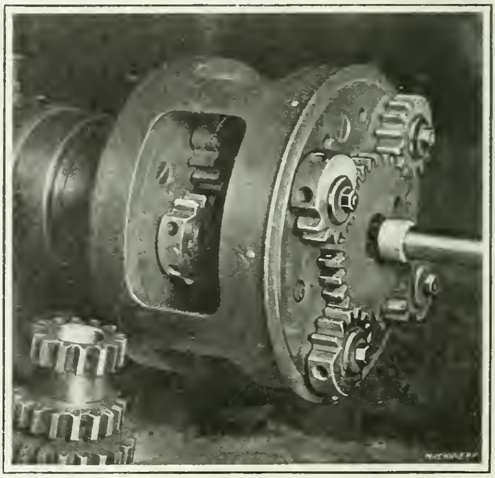
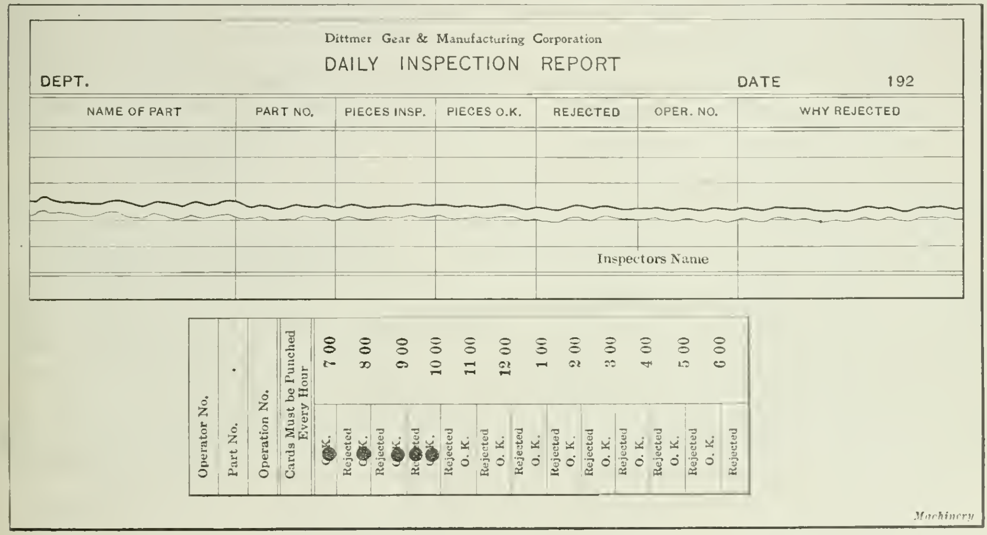


Fig. 18. Grinding the Bore of an Automobile Cluster Gear

that do not meet the requirements are suitably tagged, and are not permitted to go on. Work which is tagged in this way is brought to the attention of the chief inspector, who uses his judgment to determine whether or not the gear can be salvaged, and if so, means are taken in the salvaging department to correct the faults so that the gear may pass inspection. If the gear cannot be salvaged, it is mutilated so badly that it will not be possible to use it, thus preventing the possibility of its getting into the work which has been already passed. It will thus be seen that those gears which pass to the gear-cutting machines are in such a condition that no distortion, or any error in cutting teeth, can be traced back to the roughing-out operations. This simplifies the final inspection and confines it principally to the gear teeth and the concentricity of the pitch line with the bearing surfaces.

The heading illustration is a view of the final inspection bench and shows the Brown & Sharpe vernier testing machine, and a collection of gears of various types. This illustration gives an idea of the variety of gears manufactured in connection with automobile work. There are a great number of micrometers used in inspecting, and these are regularly checked by means of gage-blocks, so that errors will not be permitted to creep into the inspection work due to inaccuracies in measuring. For testing the concentricity of the gears and the perpendicularity of the face with the bore, Brown & Sharpe bench centers are used. The inspectors are rewarded for perfect shipments, so that each gear receives conscientious attention, which tends to eliminate the possibility of passing gears that do not quite come within the specified requirements.

Although only a few typical examples of automobile gears have been dealt with in this article, these illustrate the general practice as applied to all gears that pass through this factory. Any further description of other gears would serve no particular purpose, for it would only be a repetition of the machining methods described in connection with the stem, cluster, and camshaft gears which have already been mentioned. Nothing has been said specifically relative to the machining of gears cut from alloy bar stock, but since these represent a type that is different from others only in its first stages of manufacture, it will be apparent that the machining operations required are not of a special nature and are along the same general lines as previously described.



Dittmer Gear & Manufacturing Corporation

DAILY INSPECTION REPORT

DEPT. DATE 192

NAME OF PART	PART NO.	PIECES INSP.	PIECES O.K.	REJECTED	OPER. NO.	WHY REJECTED
				Inspectors Name		

Operator No.	Part No.	Operation No.	Cards Must be Punched Every Hour	7 00	8 00	9 00	10 00	11 00	12 00	1 00	2 00	3 00	4 00	5 00	6 00
				O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected	O. K. Rejected

Fig. 19. Inspector's Daily Report Slip and Workman's Operation Card

GERMAN MACHINERY IN HOLLAND

Of all the machinery exported to Holland in 1920, including labor-saving machinery and machine tools, textile machinery, engines, motors, etc., amounting in all to about $35,000,000 at an average rate of exchange, Germany has furnished according to a recent *Commerce Report*, at least two-thirds. Of the machine tools, amounting to about $17,000,000 in value, the proportion from Germany was almost three-fourths. Germany sent six-tenths of the $3,500,000 worth of textile machinery imported, almost half of the $3,000,000 worth of internal-combustion engines, about 55 per cent of the $5,500,000 worth of electrical installations imported, and about 80 per cent of the $6,000,000 worth of electric motors, transformers, and the like. In machine tools, in which the United States at one time had all but a dominant share of the trade, the year's business has been very largely German. These tools have been imported at such prices as to cause a rush to equip all factories, with the result that American and other business for the future in this line is all but destroyed.

The chief reason for the large German export lies in the low value of the mark and the consequent low cost of machines in Dutch gold. There has also been a good deal of change in the nature of the business, since a considerable number of small Netherlands firms have gone into the machine import business. Proximity of the producing factories and favorable exchange has enabled these small firms to handle business formerly confined largely to old established and larger firms that had American and British connections. German manufacturers and dealers in nearly all such lines of goods have opened branch houses in Rotterdam, Amsterdam, the Hague, and other centers, and have gone after the trade themselves. The high exchange value of the dollar, or rather the comparatively low buying power of the Dutch guilder, has had a material influence in shaping the course of trade in machinery lines. Aside from the German supplies, most of the machinery imports come from Great Britain, whose trade is aided by the fact that the pound sterling and the guilder are more nearly at a par value. These results of the general exchange situation have been materially increased by the fact that many Dutch importers had considerable funds in German marks when the latter fell in value, and it was necessary to take goods from Germany to prevent increased losses.

Manufacture of Socket Wrenches

By P. BALDUS

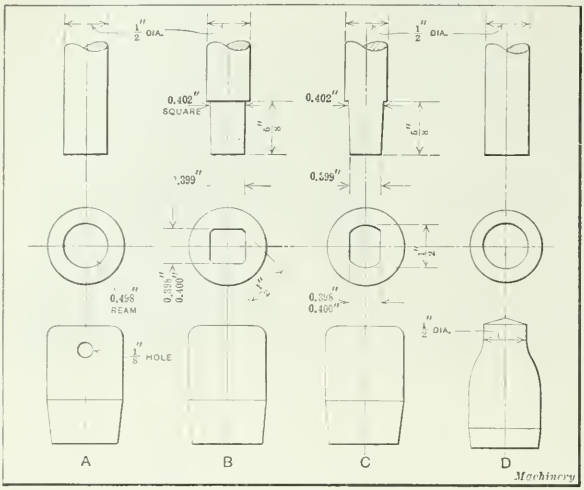


Fig. 1. Various Types of Wrench Handle Ends and Corresponding Sockets

SOCKET wrenches are manufactured by a large number of concerns, but their design, the dimensions of the various sizes, and the material from which they are made are practically the same for all makes. There is quite a variety of styles, including long tee, short tee, offset, bit-brace, L-handle, Z-handle, etc., the principal differences being in the design of the handle. Diverse methods are also employed in attaching the handles to the sockets. In this article, information concerning the manufacture of hexagonal socket wrenches will be presented, which will include the dimensions of sockets, the manner in which the latter are attached to the handles, and the machining methods employed in producing the sockets.

Handles for the smaller sizes of socket wrenches are usually made from 7/16-inch diameter steel, while ½-inch stock is used for the larger sizes. The material chiefly used is commercially known as "bright soft basic wire." Both the sockets and handles of Ford wrenches are made from a steel having the following analysis: Carbon, 0.15 to 0.20 per cent; manganese, 0.30 to 0.40 per cent; sulphur, 0.045 per cent and less; phosphorus, 0.040 per cent and less; and silicon, 0.07 to 0.14 per cent.

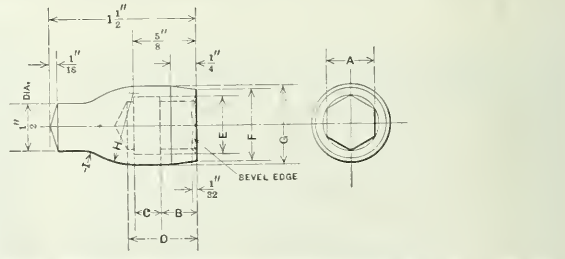
Methods of Attaching Handles to Sockets

Various methods are employed for attaching the wrench handles to the sockets, the most popular being to pin, rivet, or weld them together. Fig. 1 shows the way in which the handle ends and the corresponding socket holes are machined when the parts are assembled by any of these methods. The handle ends are shown in the row at the top of the illustration, and the sockets in the two rows at the bottom. In the style shown at *A*, the end of the handle is forced into the reamed hole of the socket and then pinned to it. In the styles shown at *B* and *C*, the handle ends are pressed into the sockets and then riveted through the inside of the sockets. The style shown at *C* is somewhat stronger than that illustrated at *B*. In both cases, the torsional strain is transmitted through the flat faces of the parts. The handle and socket shown at *D* are secured to each other by a butt-welding operation. This is the strongest connection of the four illustrated, provided the welding operation is done well. After the parts are welded together, the joint is ground smooth.

Screw Machine and Punch Press Operations on Sockets

Dimensions of different sizes of butt-welded wrench sockets for attachment to ½-inch diameter handles are given in the accompanying table. These sockets are turned and drilled in a four-spindle Gridley screw machine, and then recessed on a machine especially designed for the purpose. By supplying suitable fixtures, the recessing operation could, no doubt, also be accomplished in the screw machine. The sockets are then transported to the punch press department, where the hexagonal opening is punched in one operation on a back-geared Toledo press, the sockets being held securely in a locating fixture bolted to the machine. Centering bushings are provided for each size, these bushings being made of machine steel and casehardened and ground. They are

DIMENSIONS OF BUTT-WELDED WRENCH SOCKETS, IN INCHES



Size	7/16	½	9/16	19/32	⅝	11/16	¾	25/32	13/16	⅞
A	29/64	33/64	37/64	39/64	41/64	45/64	49/64	51/64	53/64	57/64
B	⅜	⅜	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16
C	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
D	11/16	11/16	¾	¾	¾	¾	¾	¾	¾	¾
E	0.533 0.543	0.605 0.615	0.676 0.686	0.712 0.722	0.748 0.758	0.820 0.830	0.892 0.902	0.930 0.940	0.966 0.976	1.040 1.050
F	11/16	¾	25/32	⅞	⅞	1	1 1/16	1⅛	1⅛	1 3/16
G	¾	13/16	⅞	15/16	1	1 1/16	1⅛	1 3/16	1 3/16	1¼
H	¾	¾	¾	¾	¾	⅝	⅝	⅝	⅝	½
I	⅜	⅜	⅜	¼	¼	¼	¼	3/16	3/16	¼

Machinery

attached to the fixture by fillister-head machine screws, and are readily interchangeable.

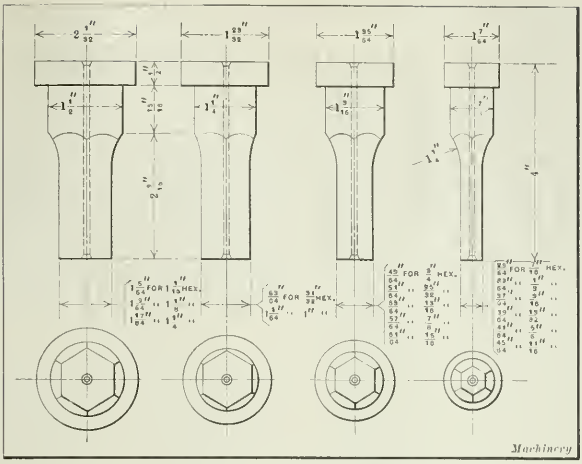


Fig. 2. Dimensions of Punches for Hexagonal Holes in Wrench Sockets

The design and dimensions of the punches used in producing the hexagonal openings in the sockets are shown in Fig. 2. The various lengths of these punches are identical, the only dimensions varying being the diameters and the distance across the flats on the punching end. These punches are made from a special tool steel, and are hardened and ground. Considerable trouble was experienced at first, due to the sockets adhering to the punches, which were first made of an ordinary tool steel. By employing a special tool steel for the punch and using certain lubricants, the stripping of the sockets was successfully effected. Buttermilk was found to be a very satisfactory lubricant for the operation. The stripper was made from a tool-steel plate, 1 inch thick, and fastened in an ordinary manner to the punch, being operated by the knock-out mechanism on the machine. When the drilled hole in the socket is equal to, or a few thousandths inch smaller than, the distance across the flats of the hexagonal opening, it is necessary to have a 1/8-inch hole through the center of the punch (see Fig. 2) to permit the escape of air and prevent bursting of the socket walls.

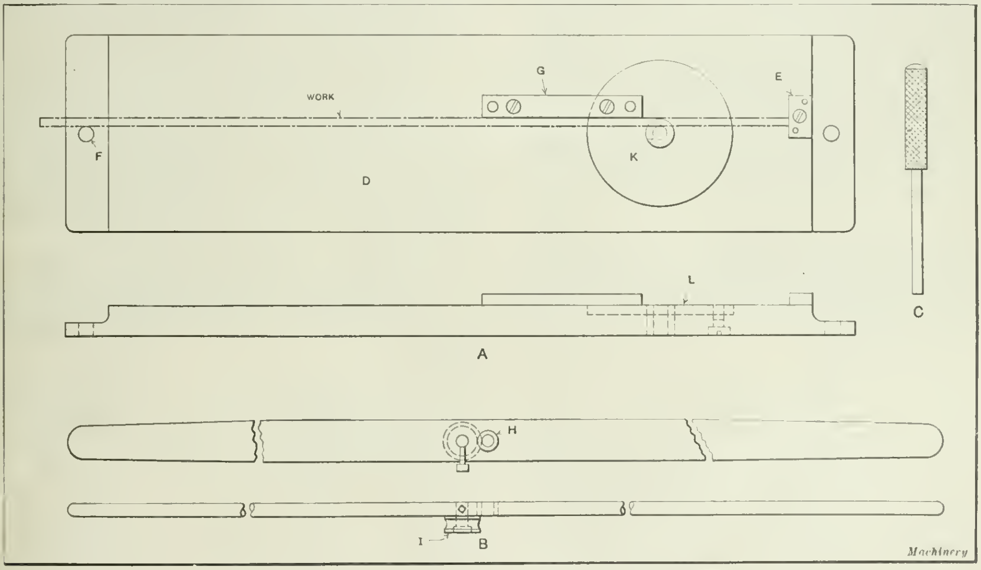


Fig. 3. Fixture used in bending T-handle to Shape shown at A, Fig. 4

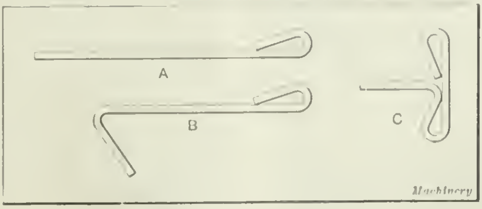


Fig. 4. Different Steps in the Making of a T-handle

Bending the Wrench Handles

T and offset handles are generally bent by hand in three operations, as indicated in Fig. 4. Fixtures of the general type illustrated at *A* in Fig. 3 are employed for the bending operations, this particular fixture being used in making the first bend. In operation, the work is placed on base *D*, as indicated by the heavy dot-and-dash lines, being properly located by stops *E* and *F*, and block *G*. Handle *B*, which is about 5 feet long, and provided with a steel bushing *H* and a hardened roller *I* near the center, is then attached to the fixture by inserting pin *C* through bushing *H* and into bushing *K*, the roller *I* on the handle being in contact with the hardened steel plate *L* in the base. Roller *I* is on the opposite side of the work in relation to the position of pin *C*, and so, when the handle is gripped at each end and turned about pin *C*, the work is bent to the shape shown at *A*, Fig. 4. Some manufacturers produce handles for "speeder" wrenches in two operations on a punch press, while others prefer to bend them by hand on similar fixtures to that described. After the sockets have been welded to the handles, the wrenches are ground, and then sent to the finishing department, from which they go to the shipping department.

Manufacture of Heavy-duty Helical Springs

An investigation of the general practice of spring-makers in an endeavor to find a way of manufacturing helical springs for transmitting the driving power of a motor to the wheels of an electric locomotive, was discussed in a paper read before the American Society for Steel Treating by T. D. Lynch, research engineer, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. The arrangement of the springs was such as to permit free vertical and lateral wheel play. In this application, tensile, compressive, torsional, and shearing stresses are produced, separately or in combination, and these stresses are augmented from time to time by shock, producing a condition that makes necessary a material having great elastic strength and a high degree of toughness. The investigation disclosed the fact that the general process in use for the manufacture of springs from bars larger than 3/8 inch in diameter is to obtain bars produced in large open-hearth furnaces and rolled in a commercial manner. Bars thus made are heated until the color ranges from a bright to a dull red, are coiled into springs, and quenched from this irregular coiling temperature. It is needless to say that springs made by such a process cannot be depended upon in severe service.

Spring steel, and especially an alloy spring steel, cannot be too carefully made, nor too carefully coiled and treated in order to produce a strictly reliable finished product. The author of the paper proposed a process for manufacturing heavy-duty springs made from silico-manganese steel 1 inch in diameter although many other alloy steels could be used. The process includes the making and rolling of the steel, and the coiling, treating, testing, and inspection of the spring. The important parts of this method are outlined in the following:

The silico-manganese steel used should be of the following chemical analysis, both in the ladle test and the check test from finished rolled bars: Carbon, 0.50 to 0.60 per cent; manganese, 0.60 to 0.80 per cent; phosphorus, not over 0.04 per cent; sulphur, not over 0.04 per cent; and silicon, from 1.90 to 2.20 per cent.

Manufacturing the Steel

The steel should be made by the crucible or electric furnace process, the ingots being not less than 9 inches square at the large end and 8 inches square at the small end. The steel should be poured and the molds coated in such a way as to give a smooth surface to the ingots. Each ingot when cold should be carefully inspected and all blemishes chipped or ground out, leaving a surface which will be free from laps or seams after rolling.

The ingots should be slowly and carefully heated to approximately 2000 degrees F., rolled or forged square to about 3 by 3 inches, and sheared into suitable billet lengths for final rolling. Excessive reduction should not be permitted. Sufficient discard should be made so that no signs of piping or segregation will be found when careful inspection is made. The billets should be allowed to become cold, and a careful inspection made for surface defects. Any slight blemishes should be ground out, leaving a smooth even surface without ragged corners or slivers. The billets should then be heated to approximately 2000 degrees F. and rolled to the finished size, great care being taken to avoid excessive reduction at any one pass.

The bars resulting from this operation should be sheared to length, and carefully inspected for piping, segregation, and surface defects. Each bar should be straight, free from surface cracks, scratches, seams, folds, and indentations, and true to section. The diameter of the bars should not vary more than 2½ per cent from that specified. All bars should be tied in bundles and a metal tag securely attached to each bundle, this tag having stamped on it the requisition number, the heat number, the size of the bar, and the identification mark of the manufacturer. When the bundles are opened, great care should be exercised so as not to nick or in any way injure the bars, as even slight defects should not be permitted.

Coiling and Heat-treating the Springs

Preparatory to coiling the springs, the bars should be heated slowly to a uniform temperature of approximately 1700 degrees F., and immediately coiled over a mandrel preheated to at least 212 degrees F. The mandrel should not be water-cooled, nor should any water be allowed to touch the spring while hot. Notching for length should be done at a dull red heat, and in such a manner as not to cut, scratch, or injure the surface at any other point on the spring.

After notching, the springs should be allowed to cool slowly and uniformly in such a way as to prevent local chilling which might cause surface stresses or cracks. Then the coiled springs should be slowly and uniformly heated to approximately 1290 degrees F., transferred to a furnace held at a quenching temperature of 1650 degrees F., and uniformly heated as near as possible to this temperature, after which they should be quenched in oil. The quenched springs should then be tempered in a salt bath having a temperature of approximately 850 degrees F. in order to relieve the stresses produced by quenching. The tempered springs should be cleansed from the adhering salt by employing a hot soda wash, following with an oil or lime dip to protect them from corrosion.

Determining the Physical Properties of the Springs

The tests employed to determine the physical properties of the springs should be performed in the order to be given, during which the springs should not be rapped or otherwise disturbed.

Solid Height—The solid height is the perpendicular distance between the plates of the testing machine when the spring is compressed solid with a test load of at least 125 per cent of that necessary to bring all the coils in contact. The solid height should not vary more than 1.5 per cent from that specified.

Free Height—The free height is the height of the spring when the load specified in the test for determining the solid height has been released. This free height is determined by placing a straightedge across the top of the spring and measuring the perpendicular distance from the plate on which the spring stands to the straightedge, at the approximate center of the spring. The free height should not vary more than 1.5 per cent from that specified.

Loaded Height—The loaded height is the distance between the plates of the testing machine when the specified working load is applied. The loaded height should not be more than 1.5 per cent over, nor more than 0.75 per cent under that specified.

Permanent Set—The permanent set is the distance between the free height and the height after the spring has been compressed solid three times in rapid succession with the test load specified in the solid height test. Both measurements are to be taken at the same point and in a similar manner. The permanent set should not exceed 0.4 per cent of the free height.

Hardness Test—The Brinell hardness number should not be less than 375 nor more than 450. This test should be made on the coupon resulting from notching to length and which is broken off after the spring has been heat-treated.

Structure—The grain structure of the finished spring should be troostitic or troosto-sorbitic.

Inspection of the Springs

The springs should be straight, of a uniform pitch, and remain straight throughout the working range. The diameter of the single coils should conform to the tolerance given on the drawing. The concentricity of the coils should be determined by means of plug and ring gages extending the full length of the spring. When the length of the spring is 10 inches or less, the outside diameter of the plug gage should equal the specified inside diameter of the spring minus 0.063 inch, and the inside diameter of the ring gage should equal the specified outside diameter of the spring plus 0.063 inch.

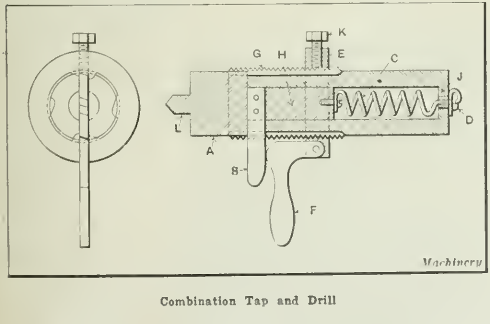
When the length of the spring is over 10 inches, the outside diameter of the plug gage should equal the specified inside diameter of the spring minus 0.094 inch, and the inside diameter of the ring gage should equal the specified outside diameter of the spring plus 0.094 inch. When the drawing specifies a spring with ends squared, and the spring is placed with either end on a flat plate, the axis of the spring should not be at an angle of more than 5 degrees with a perpendicular to the plate. Springs varying from the required finished dimensions may be reheated and reset, but all such reset springs should also be requenched and retempered.

* * *

COMBINATION TAP AND DRILL

By HARRY MOORE

The tool here illustrated may be of interest to readers of MACHINERY who have occasion to machine large quantities of brass packing nuts and other similar brass work. This tool was designed to fit an adapter which, in turn, fitted the tailstock spindle of a lathe. After making tap *G* in the ordinary manner, it was drilled to take the shank *H* of a flat drill *A*, a thin wall *J* being left at the back end of the shank. A slot was then cut in the tap the width of the flat portion of drill *A*. The drill shank *H* was next ground to fit the hole in the tap. A slot was also cut in shank *H* into which the flat stop *B* was fitted and pinned. It will be noted that a spring *C* is attached to the end of shank *H*. The other end of this spring passes through a hole drilled in screw *D* which holds it at this point.



Combination Tap and Drill

Collar *E* is threaded to fit the tap, and is kept from turning by cap-screw *K*. This collar is slotted to receive lever *F*. When ready to tap, the operator pushes lever *F* to the right. This movement permits extension spring *C* to pull the drill back until stop *B* comes in contact with collar *E*. The cutter *A*, used in this particular tool was designed for drilling two concentric holes. The small section or end of the drill at *L* in this case was allowed to project beyond the tap when tapping the hole. To bring the drill back into its operating position, lever *F* is pushed to the left.

ARE THE SOUTH AMERICAN COUNTRIES METRIC?

By C. C. STUTZ

Secretary, American Institute of Weights and Measures, New York

It is stated over and over again by the metric promoters that to develop trade with our neighbors to the south it will be necessary for us to adopt the metric system, because the South American countries are asserted to be metric. Some of our government agencies, notably the Department of Commerce, are defending this view, and at the Pan-American Congress resolutions to this effect were passed, all predicating their stand on a belief that Latin-American countries have abandoned their old measures.

On the other hand, the opponents to the compulsory introduction of the metric system in the United States have contended that compulsory metric laws passed in South American countries have simply aggravated existing conditions by adding new units of weights and measures to the old ones. In other words, the remedy proved worse than the disease.

In 1919, F. A. Halsey, of the American Institute of Weights and Measures, published in his book "The Metric Fallacy" the results of an extended investigation into South American weights and measures conditions. The reports from the different countries confirm the claims of the anti-metric party and justify the oppositions of those opposed to the compulsory introduction of the metric system in the United States.

During the latter part of 1919, but more especially during 1920, the Department of Commerce asked all United States consuls in foreign countries to report on the use of the metric system in the respective countries. Some of the answers to the department's inquiry were published in the *Commerce Reports;* the greater part however, remained unpublished. Recently these unpublished reports were made available for inspection. In December, 1920, similar reports were obtained from foreign consuls stationed in the United States.

In the lists given below are named the various countries which, according to the statements in the "Metric Fallacy," the Department of Commerce consular reports, and reports from their own consuls, suffer from confusion due to a double and in many cases a triple standard of weights and measures. The findings of the "Metric Fallacy" are thus officially confirmed.

The South American countries reported on in "The Metric Fallacy" are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Mexico, Haiti, Nicaragua, Panama, Peru, Porto Rico, San Salvador, Honduras, Uruguay, and Venezuela.

The countries reported on in *Commerce Reports* issued by the Department of Commerce are:

South American—Argentina, Bolivia, Brazil, Chile, Guatemala, Haiti, Peru, San Salvador, Uruguay, and Venezuela. *Other Foreign Countries*—Bulgaria, Denmark, Turkey, and Norway.

The countries from which the Department of Commerce received reports, these reports remaining unpublished, but now available for public inspection, are:

South American—Argentina, Brazil, Colombia, Cuba, Mexico, Nicaragua, Panama, Paraguay, Peru, San Salvador, Uruguay, and Venezuela.

Other Foreign Countries—Austria, Finland, Hungary, Japan, Netherlands, Portugal, and Spain.

The South American countries reported on by their own consuls stationed in the United States are: Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Nicaragua, Panama, Peru, and San Salvador.

Abstracts from the unpublished reports mentioned in the foregoing are given below:

Argentina—From Consul General W. Henry Robertson, Buenos Aires, Argentina, under date of February 13, 1920:

"According to Carlos Aubone, now chief of the Section of Industries of the National Bureau of Commerce and Industries, both laws Nos. 52 and 845 have largely failed of their objects." The author then quotes from *La Prenza* for December 3, 1919, as follows: "The Minister of Agriculture arranged yesterday to send a note to the Department of the Interior, pointing out the propriety of indicating to the provincial and municipal authorities the necessity of exercising a greater vigilance for preventing the frequent violations of the law regarding the decimal metric system. * * * The gallon is used commonly in our country as a measure of capacity for sales of mineral oils, naphtha and paints. There is also used very commonly the bushel as a dry measure. The same thing happens with the foot (pie) measures used improperly in transactions in wood, and also with the pound (libra) for the purchase and sale of tea. * * * The unit vara is used in place of the meter for transactions covering land in the federal capital and suburban centers."

Brazil—From Consul General A. T. Haeberle, Rio de Janeiro, Brazil, under date of August 25, 1920: "The metric system for weights and measures was adopted by the federal legislature of Brazil during 1863 and entered officially as the sole legal standard of the country on January 1, 1864. In the vast interior the measures introduced by the early Portuguese settlers are still somewhat in use. * * * The garaffa (bottle) persists in both cities and country, and the vara (1200 meters) persists in the interior. Especially in the case of land measure the old units are still in use. * * * The English measures, particularly feet and inches, are commonly used in Brazil in those trades where the machinery and materials are imported from the United States and England. * * * The textile industry is the most extensive manufacturing industry in Brazil, and as the machines are almost entirely imported from England or the United States, widths of cloths are commonly given in inches. Carpenters frequently use the English foot and inch."

Colombia—From Bogota, Colombia, under date of August 31, 1920: "The decimal metric system is the only legal system in Colombia. In business transactions, use is generally made of the arroba (25 pounds of 500 grams), of the vara (80 centimeters) and of other capricious measures of weight and length, but these are not legally recognized."

Cuba—From Vice-consul S. B. Cosmer, Havana, Cuba, under date of June 30, 1920: "The International metric system is the sole legal standard of the Republic of Cuba. * * * The circumstances described have resulted in the almost universal retention of certain of the old Spanish weights and measures in the retail trade here and to nearly as great an extent in the trade of local wholesalers. The use of the 'libra' and 'vara' are almost universal. * * * The 'arroba' which is twenty-five Spanish 'libras' is a term in very general use in the interior of the island."

Nicaragua—From Benjamin Jefferson, American Minister, Managua, Nicaragua, under date of September 2, 1920: "The metric system is the legal standard of weights and measures in Nicaragua. Due to the fact that considerable trading is done with the United States, many of the people of this republic, especially on the Atlantic coast, use weights and measures as used in the United States."

Panama—From the American Consul General, Panama, under date of November 7, 1919: "The metric system is the legally adopted standard of the Republic of Panama. However, throughout commercial circles the English system of weights and measures is universally used, the only exception being real estate transactions. The natives of the interior of Panama know nothing of the meter and other metric terms. * * *"

Paraguay—From Consul Henry H. Balch, Asuncion, Paraguay, under date of January 16, 1920: "According to the law of Paraguay the metric system of units is legal in this country, and is the system of weights and measures in general use. In addition to the metric units the following old units of weights and measures are still used to some extent in Paraguay. (Here follows a table of 19 non-metric units.)"

Peru—From Vice Consul James H. Roth, Callao-Lima, Peru, under date of July 12, 1920: "The metric system is a legal standard of weights and measures in Peru, as a law was passed on December 16, 1862, establishing this system throughout the republic. From July 28, 1869 the metric system has been used in all of the public offices of the government, but the commercial houses still used the old Spanish system of weights and measures until the Municipal Council of Lima on April 12, 1916 ordered that all commercial firms use the metric system. However, authority has been granted by special laws to collect certain export charges, as those on sugar and cotton * * * per Spanish hundredweight."

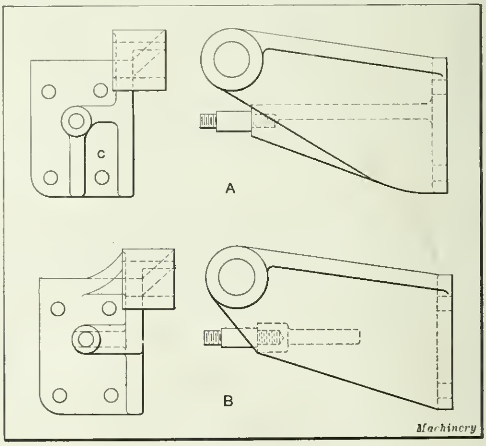
San Salvador—From Vice Consul Lynn W. Franklin, San Salvador, under date of January 9, 1919: The Vice Consul includes a letter from the Foreign Office of the Republic of El Salvadore, which gives particulars regarding legislation for the adoption of the metric system and then proceeds as follows: "But in private practices other units are of common use. * * * It will be some time yet before that system [metric] may be used in all its extensions."

* * *

SIMPLIFYING THE DESIGN OF A SHAFT BRACKET

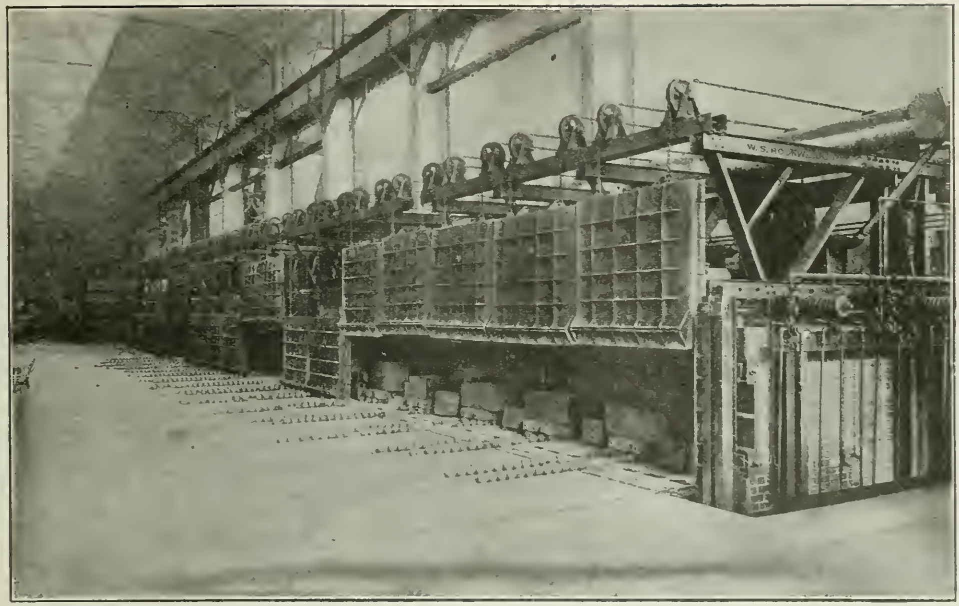
By M. E. DUGGAN

The following example serves to show why it is important for a draftsman to have a fairly good knowledge of patternshop and molding-room practice, and why he should always consult the patternmaker before sending a pattern drawing into the shop if he does not know exactly how the piece he has designed can be molded. In the accompanying illustration at *A* is shown a cast-iron bracket designed by a draftsman who had practically no knowledge of patternmaking and foundry practice. Unlike many draftsmen, however, he was anxious to cooperate with the patternmaker, with the purpose in view of simplifying the work of patternmaking or molding.



(A) Shaft Bracket as originally designed. (B) Shaft redesigned to simplify Production

The bracket with the changes recommended by the patternmaker is shown at *B*. It will be seen by those familiar with molding practice that the few simple changes in the original design made it possible to produce suitable molds without the use of cores such as would be required to form the pocket *C* of the original design. By thus simplifying the design so that the part could be more easily cast a saving in both time and money was effected.



Car and Car-and-Ball Furnaces

Relative Merits ot Heat-treating Furnaces of the Car and Car-and-Ball Types

In heat-treating large and irregularly shaped forgings, steel castings, shafts, or miscellaneous material packed in pots or boxes, the problems of charging and discharging, and of providing supports to permit the circulation of heat under and around each unit of the charge and to prevent distortion are often the determining factors in selecting furnaces for this class of work. Furnaces of the car type, Fig. 2, and of the car-and-ball type, Fig. 3, are frequently used to meet such conditions. Although each has a movable support for the charge, there is quite a difference in the design of the furnace and the car and in the method of applying and utilizing the heat. Interesting facts relative to these two furnaces have been prepared for publication by the W. S. Rockwell Co., New York City, and some of these are presented in the following:

The selection of the type of furnace and the determination of the size, number and arrangement of the chambers and working openings, fuel, etc., must be governed by the nature and quantity of the work to be heated, the accuracy required in the heat-treating operation, and the plant conditions influencing both the method of heating and of handling.

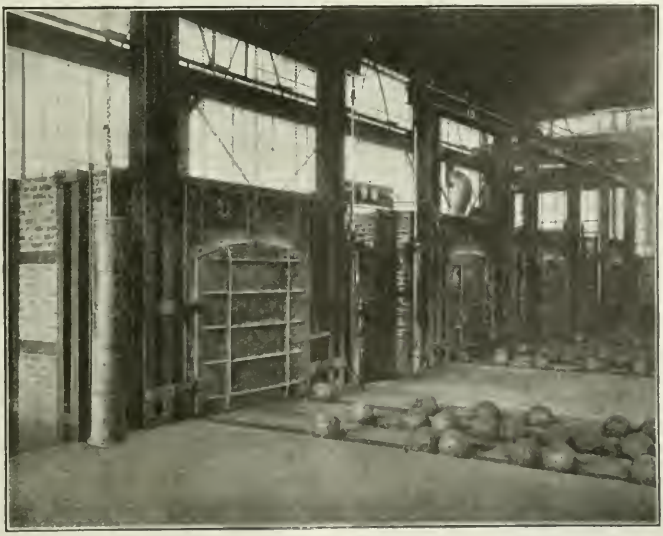


Fig. 1. Front of Car-and-ball Furnaces, showing Balls lying in Runways

Differences in Design of the Two Types

In the car furnace the car itself forms the hearth of the heating chamber, the top alone being exposed to the heat. In the car-and-ball furnace the car rests upon the furnace hearth and is entirely exposed to the heat. The car furnace has well defined limitations in heating, but has certain structural advantages that facilitate the handling of large, heavy, or irregular shaped pieces which cannot be as conveniently handled in other furnaces of better design from the heating standpoint. The car-and-ball furnace, while free from most heating limitations, has certain structural disadvantages which limit the size of the individual car that can be successfully employed.

Car furnaces are generally fired from above the hearth, the upper part of the car, which forms the

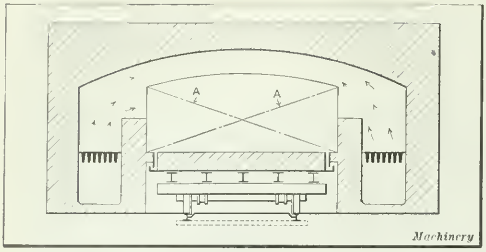


Fig. 2. Diagram showing Typical Construction of an Over-fired Car Furnace

hearth of the heating chamber, being made of refractory material. The lower part is generally made of structural steel and castings, the car being provided with standard car wheels and roller bearings and moving on steel rails. The metal structure is protected from the destructive action of the heat by sand or water seals provided at the sides and end of the car. Provision must be made for the circulation of air under the car to cool the hearth and carry off heat. Car furnaces have been designed with combustion chambers in the body of the car, the heat passing from the chamber through flues in the refractory section. Such a construction, intended to overcome the disadvantages of a comparatively cool hearth, involves structural weaknesses. which, with the factors of expansion and contraction, distortion due to weight of load or abrasion, movement of the car and other conditions, have proved impracticable.

The car in the car-and-ball furnace differs in construction from that in the car furnace in that it is made entirely of metal, being usually cast, and is completely exposed to the heat. The car moves upon balls or rollers operating in runways laid in the floor of the chamber. In Fig. 1 a number of these balls are shown in front of the furnaces. In some cases provision is made to return these balls automatically from one end of the furnace to the other. This type of furnace may be fired from below the hearth as illustrated in Fig. 3. A hotter hearth and a more uniform application of heat to the charge, particularly when the chamber is high, are secured when the furnace is underfired. Even when the heat is generated above the hearth, which is permissible at times when the charge is comparatively low, a hotter hearth is maintained in the car-and-ball furnace than in the car furnace, because of the passage of the spent gases under the floor and the absence of the comparatively cold zone.

There is a limit to the height of a charge that can be properly heated in the car furnace. This is particularly true in a furnace with a high chamber of the over-fired design as shown in Fig. 4. This design would be warranted if the charge were low and the chamber relatively high and wide, and if the nature and quantity of fuel made the perforated arch desirable. In a furnace of this design there is a necessity for supports to raise the charge materially above the hearth and for having each piece free from contact with any other, so that there may be circulation of heat under and around each of the pieces of the charge. The heating of high charges in the car furnace discloses the undesirable combination of heat originating directly above the top of the charge resting upon the comparatively cold hearth of the car and being forced to the bottom of the charge. Results from actual practice in the annealing of steel packed in moderately high pots show that the tops of the pots are distorted by the heat and the material in this section is overheated, while the material at the bottom of the pots near cold zone *X* is below the desired temperature.

Area of Exposure in Both Types

Another disadvantage of the car furnace is the unusual area of exposure and consequent cooling of the chamber when the door is raised and the car withdrawn. The top of the car forms the floor of the working opening, which is indicated by lines *A*, Fig. 2. When the door is raised and the car withdrawn, the actual opening, as shown by dotted lines *C*, Fig. 5, extends to the level of the tracks. Even though the door be lowered to its normal position, closing the door area, there is still an opening under the door, indicated by lines *B*, equal to approximately the width of the chamber and the height of the car, as a result of which there is a rapid cooling of the chamber when the car is removed and much discomfort to the workmen. The heat thus lost, which is considerable if the car is withdrawn for a material length of time, must be restored when the car is again moved into the furnace. The alternate heating and cooling is detrimental to the furnace structure.

This disadvantage may be lessened by using a car furnace of the double-end design in which at least two cars should be employed so that a cold car with its charge may be drawn into the chamber as a hot charge is drawn out, one car being loaded or unloaded while the other is in the furnace. In this way, the maximum productive capacity of the furnace is utilized, and there is a saving in time and fuel by the retention of heat in the furnace. In the car-and-ball furnace, the working opening of the chamber may be fully covered when the car is withdrawn, avoiding the ill effects obtained in the car type.

Heat Loss in Cars

In both the car and the car-and-ball furnace there is a loss of the heat given off by the car when a charge is withdrawn. In the car-and-ball furnace there is also an impairment of the car and balls, which does not occur in the car furnace, but this disadvantage is offset by the better heating conditions. When the nature of the material is such as to require accurate heating and to favor the use of the car-and-ball furnace for handling, it is generally found that the gradual deterioration of the car and balls is more than offset by the difference in the quality of the heated product, decreased fuel consumption, increased production, and longer life of furnace structure.

When the nature of the operation is such that the maintenance of the car and balls is difficult, or the size or shape of the car would render it structurally weak under load and heat, the car furnace, even with the disadvantages referred to, may be preferable, provided, however, that the charge is sufficiently low and the chamber relatively high

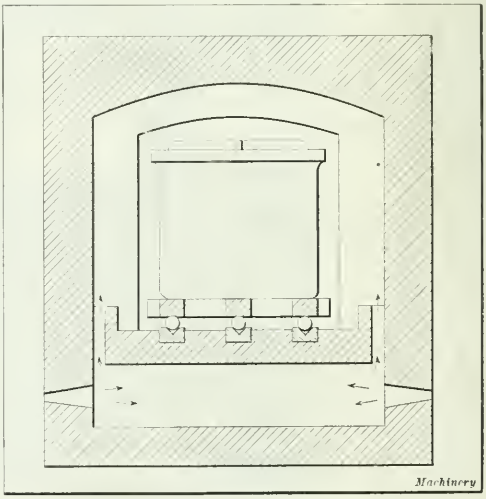


Fig. 3. Under-fired Car-and-ball Furnace in which the Car is entirely exposed to the Heat

and wide to prevent unequal heating of the upper and lower sections of the charge. Whenever the car furnace is used, provision should be made to raise the charge above the car and keep each piece free from contact with the car or other pieces, to insure the circulation of heat throughout the charge.

Heating and Cooling of the Charge

When the operation is a heat-treatment involving quenching or quick cooling after heating, it is difficult to quench or cool each piece in the same manner from either type of furnace. This is particularly true when the charge consists of a number of pieces to be quenched individually. In such cases the pieces must be removed from the car rapidly to offset the difference in rate of cooling due to the difference in the time of exposure to the atmosphere between the first and last piece removed from the car. When the charge to be heated and quenched consists of a number of large pieces, it is frequently desirable to handle the pieces on individual carriages in a car-and-ball furnace. Each piece may then be withdrawn separately from the chamber, with the assurance that it has received the same rate of exposure in heating and cooling. In some works the major part of the heated product may be handled in a car-and-ball furnace, but there may be a quantity of very large irregular shaped pieces which cannot be handled well in any other than a car furnace. In such cases the car furnace is usually selected for convenience in handling the large pieces, and on the assumption that care will be taken to so place the individual pieces on the car that each will be subjected to the heat in the same manner.

Side Opening Furnace

A novel application of the car-and-ball furnace principle, made to meet manufacturing requirements covering the heat-treatment of a variety of large and heavy material, is shown by the side-opening furnace in the heading illustration. This furnace has a chamber which may be divided by movable partition walls into a number of sections, each of which may be heated separately or, after removing the partitions, in conjunction with any or all of the others. thus making possible the heating of pieces ranging from small die-blocks to shafts 100 feet long. The doors covering the working opening are dovetailed and prevent the entrance of cold air or the escape of hot gases. These doors may be raised or lowered independently of one another and are operated by counterweights and pneumatic hoists.

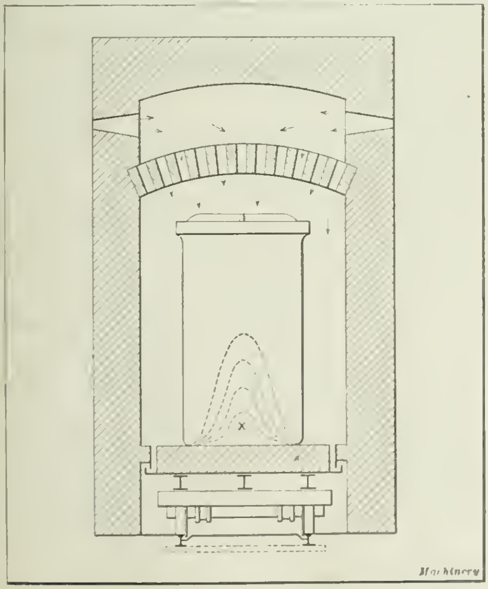


Fig. 4. Design of Car Furnace Likely to produce a Cold Zone at Bottom of Charge

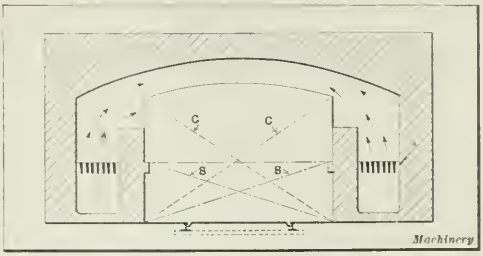


Fig. 5. Relative Area of Exposure with Car in and out of Furnace

The doors are practically balanced by the counterweights, so that very little air is required for their operation. Valves for controlling the individual doors are located at the side of the furnace. The flat roof of the furnace is constructed of tiles, supported by an overhead cantilever construction. Locating the combustion chambers under the hearth insures a hot bottom and the best of heating conditions. To insure proper circulation, part of the gases in the heating chambers are drawn back into the combustion chambers and again circulated through both chambers. The spent gases, which are drawn off below the heating chamber, pass to the top of the furnace and circulate around preheaters. The air passing through these preheaters serves the burners and thus returns to the combustion chambers a material portion of the heat in the spent gases that would otherwise be lost.

Fuels for Car and Car-and-ball Furnaces

Both car and car-and-ball furnaces have been successfully operated for years with coal, gas, and oil fuel. The number and position of combustion chambers or fire-boxes, flues, etc., must be determined by the size of the furnace and the manufacturing conditions governing the operation, which likewise control the selection of the fuel. Car-and-ball furnaces of under-fired design, using coal fuel, show better results in uniformity of operation and cost for high-grade product than car furnaces using oil or gas fuel for a similar product. This is accounted for by the difference in the method of applying and utilizing the heat and not by the nature of the fuel itself. The fuel, like the type of furnace, must be selected with regard to the requirements of the individual case.

Sizes of Furnaces

Owing to the great variety of shop conditions and the many combinations possible with different arrangements of chambers, working openings, kinds of fuel, etc., it is impracticable to standardize these furnaces. Car furnaces have been built in widths up to 12 feet and in lengths of over 100 feet. They have also been made with chambers 30 or 36 inches in width, but as a general rule it is not good practice to build car furnaces in such small sizes, when the material can be conveniently handled in any other type of furnace that will afford better heating conditions. Car-and-ball furnaces may be employed to advantage in relatively smaller sizes, though the maximum length and width should be governed by the structural features of the all-metal car. Although large individual cars may be employed when the temperature is comparatively low, it is the usual practice to employ a number of cars when the requirements of temperature and the size of the charge make the large car impracticable.

The Machine Tool Situation in Scandinavia

By C. E. SIMON, Sales Manager, Swedish Machine Tool Makers Export Co., Ltd., Stockholm, Sweden

IN Scandinavia, as elsewhere, the market is entirely stagnant and there are no signs of recovery so far, although both wages and prices of raw materials have been somewhat reduced. Most of the machine tool factories are working part time only, and have large stocks on hand. There is, of course, no market for imported machine tools. Swedish firms are hoping much, however, from the Bolshevik commission in Stockholm, which is stated to have instructions for purchasing large quantities of Swedish machine tools. Furthermore, as has been mentioned previously in MACHINERY, this commission has already placed large orders for locomotives, their method of procedure being to buy the producing firm outright. This, however, has to be done through a third party, it being illegal under Swedish law for any alien to own more than a fifth of the shares in a Swedish company.

Future Market for American Machine Tools

In Denmark medium and cheaper grades of machines are principally sold: in the latter class the proximity of the German manufacturers makes competition practically impossible under present conditions of exchange, so that the best prospects would appear to be for a medium class of tools. The prices of Danish-built lathes are approximately as follows: Light gap lathe, 12 inches swing (cheaper grade), $400; gap lathe, 16 inches swing (medium grade, weight 1 ton), $900. The Danish exchange has been fluctuating considerably recently, but the foregoing is reckoned on a rate of 5.50 Danish krona = $1.

German tools are offered at about half these prices, but owing to frequent disappointments as to deliveries and variations between contract prices and prices at which machines are eventually delivered, the German sellers do not have as much success as might be expected.

Norway is not a manufacturing country and the market is a small one. Prices ruling there are about the same as in Denmark. In both countries, Swedish-made machines have an excellent reputation, and in ordinary times sell at prices equal to those of American machine tools.

Sweden probably offers the best chances for high-grade machine tools. Up-to-date machines are purchased even by the smaller shops, as is evidenced by the fact that the large machine tool factories in Sweden turn out as many all-geared lathes as cone-driven ones. The machines made locally are in very high repute and in the cases of lathes, milling machines—both plain and universal—and presses, competition will probably always be difficult, while in shapers it is impossible. Automatics and high-production machines are not fully appreciated yet, but there is certainly a market for that class of machines, while the chances for radial, upright and sensitive drilling machines, screw machines, the larger grinding machines and hacksaws, none of which are manufactured to any extent here, should be good when business becomes more normal. Bolt and nut making machinery is produced by only one firm, and its deliveries are slow.

Present Prices of Machine Tools in Sweden

Owing to the high cost and difficulty of working Swedish cast iron, the cost of locally made planers is rather high, $3300 being the cost of a machine to plane 32 inches by 32 inches by 8 feet. There should consequently be a market for a medium grade machine of this type. Machine tool prices ruling at present are as follows: 16-inch shaper, high grade, $775; light 16-inch shaper, cheaper grade, $400; light high-grade quick-change gap lathe, 12 inches swing, $500: cheaper grade (splined lead-screw) $375; high-grade quick-change all-geared lathe, 16 inches swing, $1500; cheaper grade cone-driven gap lathe, $900. The above prices are to the user and are calculated on an exchange rate of 4.50 Swedish krona = $1.

Owing to the exceptional exchange conditions, a number of German machines have been imported into Sweden since the war, but before the war they were not at all popular and only the best German machines found a market. American small tools and grinding wheels are very well known and always find a ready market.

Lathes should have English System Lead-screws

A mistake sometimes made by American manufacturers is to send lathes fitted with metric lead-screws to the Scandinavian countries. Although the metric system is in general use, Whitworth pitches are used for all screws. Another error consists in bracketing the three countries together and appointing one selling agent for all. It is true that one important machine tool dealer has offices in the three capitals, but with this exception separate agents should be appointed, as it is impossible for an agent in any one of the three countries to get good results from the other two.

Trade with Finland through Sweden

Although geographically Finland does not come within the scope of this article, actually the connection between that country and Sweden is much closer than between any two of the Scandinavian countries, nearly half the population—including practically the whole business community—being of Swedish extraction and speaking Swedish in preference to Finnish. In ordinary times much of the buying is done through Stockholm, and, needless to say, Swedish machine tools are much in demand. At the present moment the Finnish rate of exchange, which is rather worse than that of Italy, has made the purchase of Swedish and American tools equally impossible.

Large quantities of woodworking machines are used in Sweden and in Norway, but it is not likely that there would be much of an opening here for American competition, as there are so many excellent machines turned out in Sweden.

Scandinavia as a Competitor in Other European Markets

Prior to the war Sweden had an important export trade in machine tools and small tools, but most of these exports were absorbed by Russia. The war caused a considerable extension in the production of the various machine tool factories, together with the adoption of improved methods of manufacture. To make the most of post-war opportunities Svenska Verktygsmaskinfabrikers Export A. B. (Swedish Machine Tool Makers Export Co., Ltd.) was formed in 1917 by a number of the most important Swedish machine tool manufacturers. This firm was to act as a non-profit-making sales department for the firms of which it was composed. At the same time, by limiting each factory to the manufacture of certain types of machine tools in which it could specialize, increased production and improvement in design were expected.

The firms now forming part of this organization are A. B. Atlas Diesel, A. B. Karlstads Mekaniska Verkstad, Köpings Mekaniska Verkstads A. B., A. B. Lidköpings Mekaniska

Verkstad, Munktells Mekaniska Verkstads A. B., Nydqvist & Holm A/B., and A. B. Svenska Maskinverken. With their own branch office in Brussels and agencies in most European countries, a great deal has been done toward making these machines known. With the exception of the last three months of last year, when the general trade depression in Europe began to make itself felt in the decreased purchasing capacity of machine tool buyers, the results showed that it was not impossible to compete successfully with the better known American tools. There are a number of outside firms doing a certain amount of export trade too, but with two or three exceptions these are competing in a cheaper class. Denmark has a considerable export trade in a medium class of machine tools, principally lathes.

Special machinery of various kinds is also exported to a certain extent from Scandinavia, namely paper-making machines, match-making machines, cigarette-rolling machines, sardine-tin making machines and horseshoe machinery. Swedish small tools are also finding a ready market; particularly is this the case with saws and saw blades, the high quality of the Swedish steel making it possible to sell these despite their high price. Other items in this line are drills, taps and dies, reamers, etc. The names of Bolinders, Beronius, Jonsered and Westmann are known throughout Europe for woodworking machinery and cutters. Sweden is fully alive to the possibilities of the European market for the export of machinery of all kinds, and its competition in these markets is likely to be of increasing importance.

* * *

STANDARD PIPE THREADS

By EARLE BUCKINGHAM

Engineer, Pratt & Whitney Co., Hartford, Conn.

The machine shop is frequently called upon to cut threads on standard pipe. As pipe threading is a distinct specialty, and the majority of this class of work is handled by shops making a specialty of this work, men in the machine shop are seldom as familiar with the various standard pipe threads as they are with other more commonly used standards. A synopsis of the character and uses of the various pipe thread standards should therefore be of interest.

American Standard Taper Pipe Thread

The American standard taper pipe thread was formerly known as the American Briggs standard. The form of the thread is a 60-degree vee, truncated equally top and bottom by an amount equal to 0.033 times the pitch of the thread. The taper of the thread, on the diameter, is 1/16 inch per inch or ¾ inch per foot. As far as the thread on the product is concerned, no change has been made from the former American Briggs standard; but to allow for a reasonable amount of wear on the taps and dies, thus making for more economical production, a modification has been made on the gages. This consists of reducing the crest of the thread gage by truncating it an amount equal to 0.10 times the pitch from the theoretical sharp point. If an old gage is correct in all other respects, it can easily be made to conform to the present standards by grinding off the excess metal at the crests of the threads. Full information in regard to the American standard taper pipe threads will be found in Bulletin No. 1733, "Manual on American Standard Pipe Threads," published by the American Society of Mechanical Engineers. This taper thread can be used for threaded joints for any service.

American Straight Pipe Thread

Straight-threaded female wrought-iron or wrought-steel couplings of the weight known as "standard" may be used with *taper-threaded* pipe for ordinary pressures, as they are sufficiently ductile to adjust themselves to the taper male thread when properly screwed together. For high pressures, only taper male and female threads should be used. The use of this straight thread for male parts is only recognized for one or two very special applications, which are seldom, if ever, required in ordinary machine shop practice.

The form of the American straight pipe thread is identical with that of the American standard taper pipe thread. The gage to be used to check a straight threaded hole is the standard taper thread plug gage which is used to inspect the American standard taper pipe thread. Full information about this thread standard will be found in the A.S.M.E. Bulletin No. 1733, previously mentioned.

Lock-nut Thread

The lock-nut thread is a straight thread of the largest diameter which can be cut on a pipe. Its form is identical with that of the American standard taper pipe thread. In general, "Go" gages only are required. These consist of a straight-threaded plug representing the minimum female lock-nut thread, and a straight-threaded ring representing the maximum male lock-nut thread. This thread is used only to hold parts together, or to retain a collar on the pipe. It is never used where a tight threaded joint is required. Full information about this thread standard will be found in the bulletin previously mentioned.

Special Straight-fixture Pipe Thread

The special straight-fixture pipe thread consists of a straight thread of the same pitches as the American standard pipe thread, but having the U. S. form. This thread, as its name implies, is used for fixture work to hold parts together, but not to make tight threaded joints. The male thread is assembled with a standard taper female thread, while the female thread is assembled with a standard taper male thread. This thread is used on lighting fixtures and work of a similar class when it is desired to have the joint "make up," or stop, on the thread. The gages used are straight-threaded limit gages. Full information about this thread standard will be found in Bulletin No. 1525, "Report of the Committee on Standardization of Special Threads for Fixtures and Fittings," published by the American Society of Mechanical Engineers.

Special Straight Electric Fixture Thread

The special straight electric fixture thread consists of a straight thread of the same pitches as the American standard pipe thread, but having the U. S. form, and is used for caps, etc. The male thread is smaller, and the female thread is larger than those of the special straight-fixture pipe threads. The male thread assembles with a standard taper female thread, while the female thread assembles with a standard taper male thread. This thread is used when it is desired to have the joint "make up" on a shoulder. The gages used are straight-threaded limit gages. Full information about this thread standard will be found in the A.S.M.E. Bulletin No. 1525, previously mentioned.

It will be noted that each of the five different pipe thread standards has a specific name and purpose. If the proper thread is selected, and all taps, dies, gages, etc., are ordered from any maker of small tools and gages by this name, many delays and much confusion will be eliminated.

* * *

A 135-YEAR-OLD BRITISH ENGINE

To the recently published records of the remarkably long life of early British steam engines there should be added the case of an engine which has been in active service for 135 years. This was a pumping engine made by James Watt himself, the inventor of the original condensing steam engine. It was used for pumping a dry dock on the Clyde, and was removed a short time ago because of the closing up of the particular harbor where it was at work. It is stated that it will be placed in a museum.

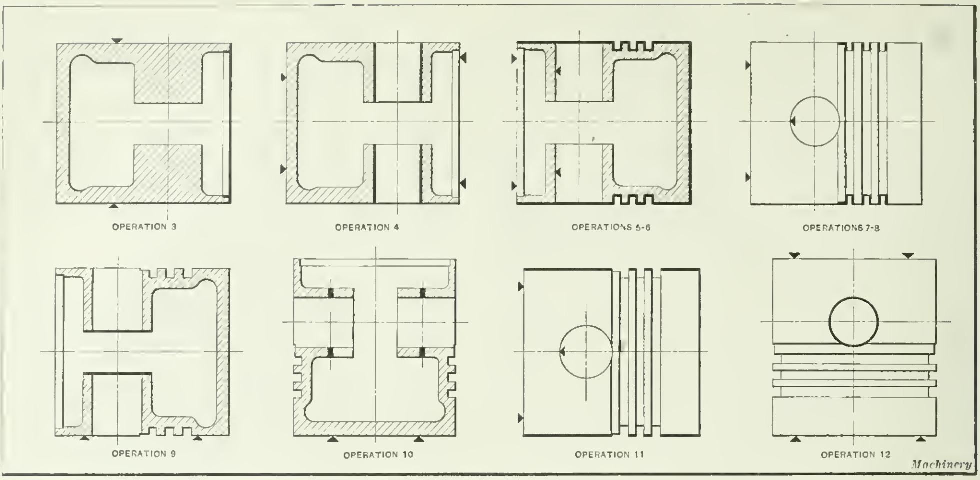


Fig. 1. Order of Machining Operations on Motor Piston

Machining Motor Pistons

Successive Steps and Equipment Employed in Machining Pistons for a High-grade Automobile

By C. H. DENGLER

THE illustration Fig. 1 indicates clearly the various machining operations required in the production of an aluminum piston for the motor of one of the highest priced automobiles made in this country. Like most cars of this class the production is comparatively limited; hence, the methods and tools used in its manufacture vary somewhat from those customarily employed in plants equipped for higher production rates. The first operation performed on the piston, after it is received from the foundry in the form of a rough casting, is that of cleaning. In the second operation the piston is annealed by either of two methods, one of which is to boil it in an oil bath at a temperature of about 300 degrees F. The other method consists of heating the piston in a furnace to a temperature of 800 degrees F., and then allowing it to cool in air. As the first method has proved detrimental to the health of the operators, the second is generally used.

In the third operation the piston is chucked on the outside diameter, and the open end is faced and bored on the surfaces indicated by the heavy black lines in Fig. 1. These finished surfaces are used in locating the work for all subsequent machining operations. As standard tools are used for this operation, no description is necessary. The next or fourth operation is drilling, boring, and reaming the

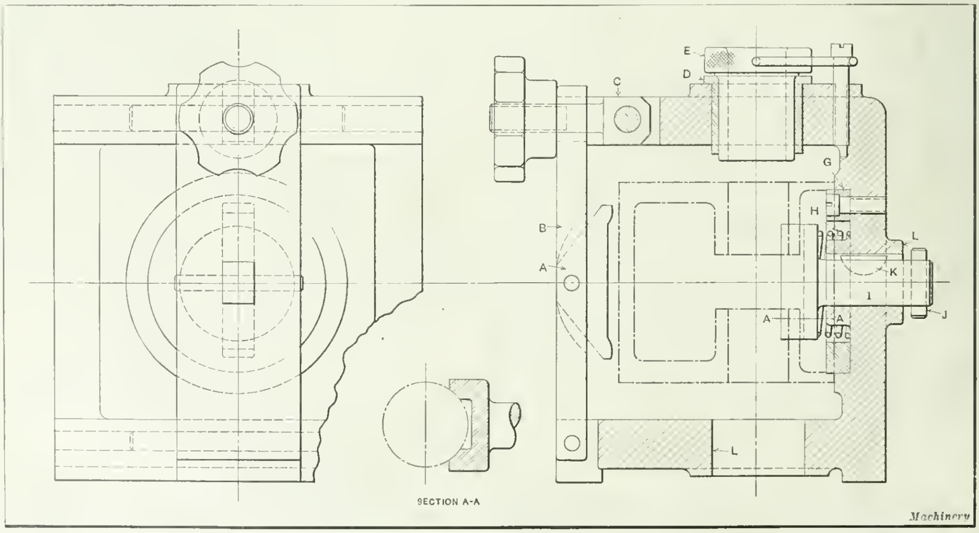


Fig. 2. Jig used in drilling Wrist-pin Hole in Motor Piston

wrist-pin hole to within a few thousandths inch of the finished size. Different methods are used for performing this operation by various companies, but the writer has always obtained the best results with a drilling machine and a suitable drill jig, especially when the work is being done in a small shop.

The jig used in this case is of rugged construction, and is so designed that it will handle work very rapidly. Referring to Fig. 2, it will be noticed that ring *G* centers the piston under the drill bushing *E*, while the sliding V-block *I* serves to bring the bosses of the piston-pin hole into alignment with the center of bushing *E*. V-block *I* is normally held forward by spring *H*, so that pin *J* is in contact with boss *L*. The vee is kept parallel with the drill bushing by means of key *K*. The piston is held in place by the hinge clamp *B*, which is provided with an equalizing arm *A*, eyebolt *C* being employed to tighten the clamp on the work.

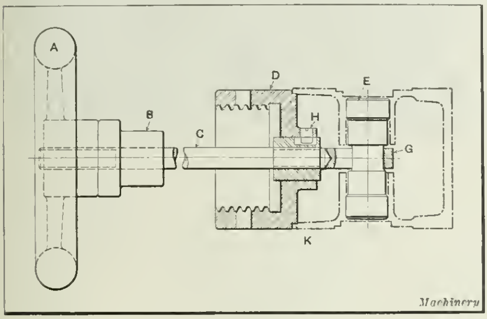


Fig. 3. Chuck used in holding Piston for Turning and Grooving Operations

In the fifth operation the outside diameter is turned to within a few thousandths of the finish size, and in the sixth operation, the end is faced and the ring grooves roughed out. While performing these operations, the piston is held in a chuck, shown in Fig. 3, which is mounted on a lathe spindle. Although this chuck is of simple construction, it has proved very satisfactory. As shown in the illustration, the nose-piece *D* is threaded to fit the end of the lathe spindle. The piston is located so as to be concentric with the lathe spindle by the accurately turned shoulder at *K*, and is clamped to this shoulder by means of pin *E* and draw-rod *C*, actuated by handwheel *A*. The draw-rod is provided with an eye *G* in which pin *E* is held. Screw *H* prevents eye *G* from turning when the handwheel is tightened. Pin *E* is relieved so that it bears only at the outer ends, in order to eliminate distortion as much as possible.

This chuck is also used while performing the seventh and eighth operations, in which the piston is finish-grooved, and the relief is cut for the lower ring, respectively. The ninth operation consists of facing the inside of the piston bosses with a double-faced cutter, which is used in a drilling machine. A simple plate jig, fitted into the open end of the piston is used when drilling the two oil-holes as indicated, in the tenth operation. In this operation location of the oil-holes is obtained by two pins which project from the under side of the jig plate and straddle one of the bosses.

The last two operations finish the bearing surfaces of the piston so that they are brought to size. Any tool marks or blemishes due to handling are also removed at this time. The chuck shown in Fig. 3 is also employed for holding the piston while performing the eleventh or finish-turning operation. In this operation a taper-turning attachment on the lathe is used to finish the outside of the piston to size. By giving the piston a slight taper to obtain the variation in diameter required to compensate for unequal expansion, etc., the customary method of step-turning is avoided.

The twelfth operation consists of hand-reaming the wrist-pin hole to size, using the jig shown in Fig. 2, which was employed for the rough-drilling operation as previously described. Two slip bushings and a piloted double-end reamer are employed for this operation in connection with the jig. A final inspection is given the pistons when they are arranged in sets for assembling in the motors. This inspection includes balancing each set of pistons carefully so that the running or dynamic balance of the engine will be as nearly perfect as possible.

* * *

CONCRETE HOUSES FOR INDUSTRIAL WORKERS

The Ingersoll-Rand Co. has undertaken a building project in order that the employes of its factory at Phillipsburg, N. J., may obtain by rental, or by purchase on easy terms, desirable homes. These houses are made in concrete forms, and care has been taken in making these forms so that they can be used over and over again. The forms are creosoted and painted to preserve them, and oiled and cleaned each time before using.

All the concrete work of the roof, walls, partitions, and under floors is poured in special forms. By this method, a group of houses can be erected by continuous repetition of certain sets of operations, permitting the greatest possible economy in erection. The pouring operation can be completed in from 8 to 11 hours, and the forms can be removed and set up on another foundation in from four to six days after the pouring is completed. The window sashes and door frames, flue lining for the chimney, plumbing, and electric light conduits are placed before the walls are poured. When a certain stage of erection is reached, the conduits and pipes, all of which are alike and fitted in advance, are quickly set in place.

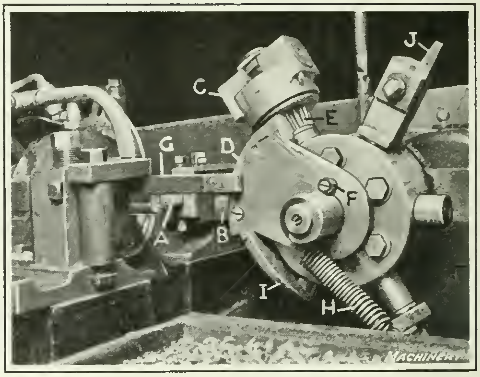
The houses are of four- and six-room size. A four-room house with basement and a 40 by 100 foot lot rents to employes at $16 a month, and may be bought for $2750 on a liberal payment plan. The six-room concrete houses rent for $18, and sell for about $3000. No cash is required at the time of purchase, and the total payments may be as low as $22.44 a month.

Six-room House erected for Employes by the Ingersoll-Rand Co.

These houses are known as the Ingersoll type, on account of the fact that Charles Ingersoll, who has been greatly interested in housing projects for a number of years, is largely responsible for this particular type of construction. The forms for the concrete are covered by a patent controlled by Mr. Ingersoll and his associates.

Machining a Grooved and Tapered Part

By ELMER P. SACREY



IN the manufacture of the double-grooved and tapered brass part illustrated at *A*, Fig. 1, five distinct operations were originally employed. The part is the spiral center of a mist nozzle used for conditioning the air in meat packing houses, and the specifications require that the two grooves be of such a size that when the part is assembled in the nozzle one gallon of water (within about three or four ounces) can be forced at a certain pressure through the grooves in thirty seconds. An idea of the size and shape of the grooves may be obtained by reference to the illustration of the groove-cutting tool, which is shown at *B*. The distance between the bottoms of the two grooves is the same for the entire length of the part.

In the method formerly used, this spiral center was machined from a casting, the five operations being performed in the following succession: (1) The part was turned, faced, and cut off from its supporting end in a hand screw machine. (2) The two grooves were produced on a hand milling machine provided with a special fixture for holding the work. (3) The burrs on the face of the small end were removed on a grinding machine. (4) The burrs on the tapered surface were removed by means of a tool mounted in a drilling machine. (5) A lot number was stamped on the front of the small end in a foot press. The rate of production from this method was unsatisfactory, and so many of the parts were rejected because the grooves were improperly milled, due to the work slipping in the chuck of the milling machine, that the concern was undergoing a considerable loss on the contract. Subsequently, an attachment was designed whereby the part could be produced on a Brown & Sharpe automatic screw machine from 9/16-inch diameter, commercial brass bar stock.

This attachment is shown in the heading illustration, mounted on the turret of the machine and with the various tools in place. It will be seen that the stock extending from the chuck was tapered and grooved at the time that the photograph was taken, and so the next operation consists of cutting off the completed part and turning the tapered surface on the portion of the stock which will form the next part. This operation is accomplished by the forming tool *A*, which is mounted on the rear cross-slide of the machine. After tool *A* has been withdrawn from the work, the stock is fed up against stop *B* which is mounted in the turret. Raised numerals corresponding to the lot number of the part are provided on the front of stop *B*, and the impact of the stock against the stop is such that the number is reproduced on the front of the work. The turret is then withdrawn from the work, after which it revolves until the milling head *C* is brought into the operating position. This head carries two cutters of the dimensions shown at *B*, Fig. 1, for cutting the grooves; the manner in which the cutters are rotated will be described in detail later. As head *C* is advanced over the work, it is also rotated slowly, so that the two grooves will be helical.

This rotary movement is obtained through a bevel gear segment on the back of plate *D* meshing with the bevel pinion *E* which is screwed into the milling head. Thus, when roller *F* comes in contact with bar *G* as the milling head is advanced toward the work, plate *D* is swiveled on its axis, and the bevel segment causes pinion *E*, and the milling head, to be rotated an amount depending on the movement of roller *F*. The milling head is provided with a hardened bushing which slips over the work and supports the latter while the grooves are being machined. Withdrawal of the milling head from the work is accomplished at four times the rate of the advancing speed, and in this step the groove cutters are caused to follow the grooves just milled, by roller *F* being held against bar *G* through the action of the coil springs *H*. Because of the limited amount of space in which the turret revolves it was impossible to use one spring of large diameter and so, in order to secure sufficient tension on plate *D*, it was necessary to use two springs, one being placed inside the other. The two springs are of opposite hand to avoid tangling, and the outer ends are secured to a bracket held in a hole of the turret. It will be evident that the returning movement of plate *D* is ended by the plate coming in contact with a stationary plate *I*, which is also mounted in one of the turret holes.

When the milling head has been withdrawn from the work, the forming tool *A* is again fed forward, cutting off the finished part and tapering the portion of the stock which is to be grooved next. While this operation is being performed, however, tool *J* is brought into position and fed forward, cutting all burrs from the work. By the time that the operation performed by tool *A* has been completed, the turret has again been revolved until stop *B* is in the position illustrated. A plug is placed in the turret hole between tool *J* and the bracket to which coil springs *H* are secured, so that the turret can be kept filled with oil. By the use of this set-up, the average time for machining one part is only fifty-one seconds.

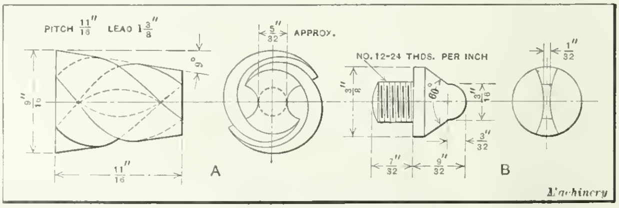


Fig. 1. (A) Spiral Center for Mist Nozzle. (B) Dimensions of Cutters used to produce the Grooves on the Spiral Center

A sectional view of the milling head is shown in Fig. 2, in which bevel pinion *E* corresponds to that in the heading illustration having the same reference letter. This pinion is a running fit on shaft *A* and on the hub of gear *B*, and so is not affected by their rotation. Shaft *A* extends into the turret and is connected through bevel gearing to a horizontal shaft running through the hollow spindle of the turret-slide. The horizontal shaft is driven by a grooved pulley at the back of the slide, which is connected by a round belt to a similar pulley on the countershaft. This belt can be seen in the heading illustration. Referring again to Fig. 2, it will be seen that shaft *A* is screwed into bevel gear *B*, and by this arrangement bevel pinions *C* and *D* are driven when shaft *A* is rotated. These pinions are mounted on opposed spindles to which cutters *F* are attached, and so the latter are rotated with the pinions. Cutters *F* are of the dimensions shown at *B*, Fig. 1. Each cutter-spindle is provided with two ball races. The speed of these spindles is approximately 3600 revolutions per minute. The cutters are made from drill rod, and are hardened and ground. From 2500 to 3000 spiral centers are produced, on an average, before it becomes necessary for a set of cutters to be reground.

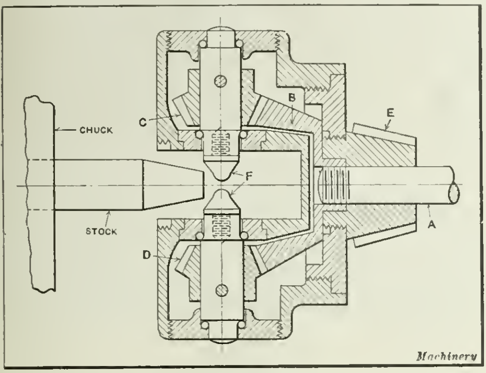


Fig. 2. Sectional View of Milling Head showing Method of driving the Grooving Cutters

* * *

USES OF INVAR

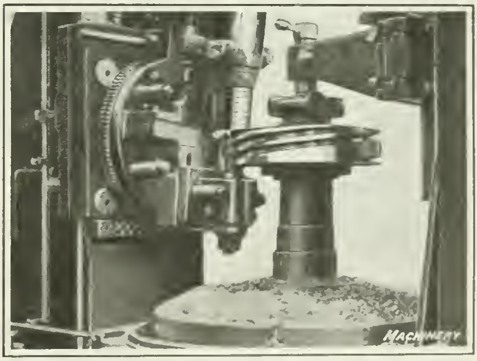
Invar, which is an alloy of steel and nickel in which the latter metal enters to the extent of about 35.6 per cent, has proved its value particularly for measuring tapes and precision measuring means. The characteristic which makes this alloy especially adapted for such uses is its low coefficient of linear expansion, which is 0.00000119. It will be readily apparent that the employment of measuring wires made of invar, which have scarcely any change in length with the changes of temperature, greatly facilitates the accurate determination of lengths on the earth's surface. By employing measuring wires made of this material the number of requisite observers is reduced to one-fifth the number previously required, the time expended is only one-tenth as much, while the expense falls to 2 per cent of the former amount. It is also possible to work on terrain where the older type of apparatus cannot be set up.

Additional applications of this nickel-steel alloy are as follows: (1) For compensating the pendulums of clocks for temperature changes. (2) For improving the time-keeping qualities of watches; where the balance wheel is made of only one metal, a nickel-steel spring keeps the daily loss or gain very small. (3) For the mountings of glass and for leading-in wires to incandescent lamps; an alloy for these purposes is selected which has the same expansion coefficient as the glass with which it is to be used. (4) For measuring standards.

THREAD MILLING ON A HOBBING MACHINE

The cutting of medium and small diameter worms of single thread presents no difficulty to the average shop, as they can readily be cut on a lathe. The cutting of ordinary multiple-thread worms is a more troublesome proposition unless the operation can be performed on a thread milling machine. However, the machining of multiple-thread worms of large diameters is usually difficult for the average shop. If the pitch is small, the worm can sometimes be cut on a plain milling machine provided with a universal milling attachment for the cutter-head and a spiral dividing head for the work, but this arrangement is not sufficiently rigid for heavy work. The illustration shows a hobbing machine built by the Newark Gear Cutting Machine Co., Newark, N. J., which is primarily intended for cutting teeth on spiral and worm gears, cutting a quadruple thread worm of 14.406 inches pitch diameter and $1\frac{1}{8}$ inches linear pitch, by the use of a formed disk milling cutter.

The reason for cutting the worm in this manner was that no hob of this unusual pitch was available. The gearing of the hobbing machine was arranged the same as though a hob was being used instead of the formed disk milling cutter, it being necessary to connect the hand indexing attachment. Only one cut was required for each thread, and after a cut had been taken, the work was moved a trifle away from the cutter to prevent scoring when the cutter-head was raised. By using the rapid traverse of the head, the proper relation between the cutter and the threads was maintained. After the cutter had been raised upon the completion of a cut, the work was properly indexed by hand for milling the next thread. The worm was made of a hard phosphor-bronze, and was cut in $3\frac{1}{2}$ hours by using a carbon steel cutter. A high-speed steel cutter of the desired size was not at hand, but if such a cutter had been available, the operation could probably have been performed in about two hours.



Hobbing Machine set up for milling a Quadruple Thread Worm of $1\frac{1}{8}$ Inches Pitch

* * *

TARIFF ON CATALOGUES IN BRAZIL

According to *Commerce Reports*, ordinary circulars or catalogues sent into Brazil are subject to a duty of 150 reis per kilogram, 15 per cent of the amount being payable in paper and 55 per cent in gold. As gold is now valued at approximately three times the equivalent of paper money, the duty will amount to about 3.2 cents per pound. This applies to catalogues sent in bulk, it being stated that when the duty on a single package of printed matter is small, the goods are delivered immediately without duty being levied. Catalogues that are highly illustrated are subject to a still higher rate of duty, amounting to as much as 32 cents per pound.

Formulas for Spring Design

By EDWARD JACOBI, Chief Engineer, Briggs & Stratton Co., Milwaukee, Wis.

When a spring is required for use in a machine or mechanical device, the greatest pressure it is to exert is seldom known or specified, but nevertheless the designer realizes that it should have certain characteristics that may be termed "feel," for which he cannot easily give dimensions. Accordingly he allows the spring whatever space in his judgment is permitted by the design. When the machine or device is built, trial springs are wound and tested until one is produced which operates satisfactorily. Before this is accomplished, however, it is often found necessary to provide more space for the spring than was first allotted. The formulas given in this article were worked out by the writer to provide a means whereby designers and draftsmen could determine mathematically, the size of wire and the number of coils a spring should have to meet any given requirement, and thus eliminate the lengthy experimental process.

When a spring is extended or compressed, the pressure naturally increases until the end of the stroke is reached. In most cases, however, it is desired that the spring exert as nearly uniform a pressure as possible throughout the stroke, and at the same time maintain its strength through a long period of service. In addition to this, the spring is usually required to exert as great a pressure as can be obtained in the space in which it is required to operate. Stated in another way, the size of wire and number of coils should be so chosen that the greatest possible pressure is exerted at the beginning of the working stroke, and at the same time sufficient flexibility is retained to permit the specified deflection to the end of the stroke without taking a permanent set. This is the condition usually met with in designing various kinds of springs for detents, catches, clips, electric switch contact points, and whatever hand- or foot-operated members are to be returned to their normal positions by springs.

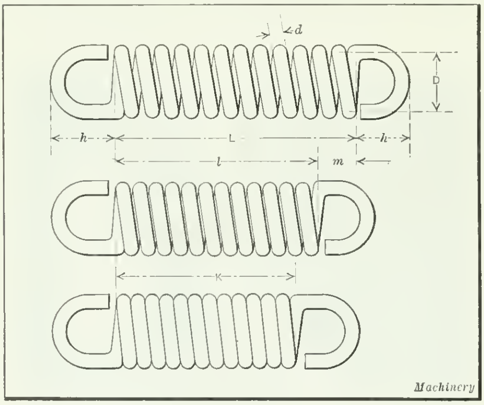


Fig. 1. Application of Formulas for Extension Spring Design

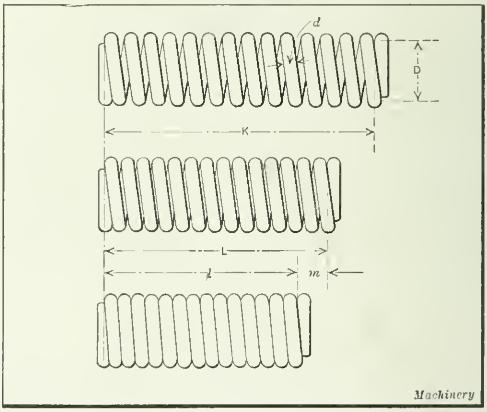


Fig. 2. Application of Formulas for Compression Spring Design

Designing Extension Springs

First let the design of extension springs of limited diameter and length which are wound without initial tension be considered. The hooks at the ends of the springs, which are rigid and contribute nothing to the flexibility, should be disregarded. The strength of the spring can, of course, be increased by using thicker wire, but when this is done fewer turns can be wound in a given length, and if the wire is too thick, the spring will not be sufficiently flexible for the required movement. Referring to Fig. 1, L equals the length of the working part of the spring when fully extended. This is the space allowed for the spring less the lengths h of the hooks. The length l represents the length of the working part of the spring in its initial position or at the beginning of its stroke. Therefore, the working length m of the spring equals $L - l$. The diameter of the wire from which the spring is made is represented by d. The mean diameter D of the spring equals the outside diameter of the coils minus the diameter d of the wire. S equals the working shearing strength of the wire, and E equals the torsional modulus of elasticity. Then under the given conditions of spring space and working range, the maximum pressure at length l will be attained when

$$d = D\sqrt{\frac{3l\pi S}{5Em}}$$

After d has been found, it may be substituted in the strength and deflection formulas for springs given in Machinery's Handbook, to obtain the actual tension of the spring at full extension L and at its initial length l. If the spring is not sufficiently stiff, either D or L, and in some cases l, must be increased in order to permit the use of larger stock or wire.

The number of active coils N will be given by the formula

$$N = \frac{Edl}{\pi SD^2 + d^2E}$$

and the free length of the active part of the spring or $N \times d$ will be found by the formula

$$\frac{3lL}{5L - 2l}$$

The formula thus obtained for the free length of the spring contains no terms but the lengths of the spring. This formula, therefore, gives that relation between the free length and the working range of a spring that enables the strongest possible tension to be obtained at the initial point.

For example, let a toggle mechanism such as shown in Fig. 3 be considered. In this example a certain space is allowed for length L and for the initial length l, at which point it is desired to have the strongest tension that can be obtained with an extension spring which will operate satisfactorily in the available space. It is therefore necessary to find what free length K will give the desired results.

If length K is made too short, the total deflection $L - K$ will be so great as to require a thin and weak spring in order to obtain the necessary flexibility. If, on the other hand, K is made too long, it will be found that while thicker wire can be used and the total strength at point L will be thus increased, the length l, being relatively nearer to K than to L, will cause the spring to reach its initial length l before its strength has increased an appreciable amount from zero. From this consideration the advantage gained by the use of a formula for obtaining K will be readily appreciated.

Tension springs are sometimes required to come to or assume a definite free length, while the initial and final lengths are also fixed. For instance, springs used in certain types of speed-governing devices must return to a certain length at zero tension. To obtain the strongest possible spring under such conditions, the diameter of the wire d is found by the formula

$$d = D\sqrt{\frac{K\pi S}{E(L-K)}}$$

in which K is the free length of the active part of the spring, and L the active part fully extended so that $L - K$ is the total deflection of the spring. For this spring, the number of coils is determined by the formula

$$N = \frac{K}{d}$$

The foregoing formulas for d and N give the strongest obtainable springs for a given total deflection, that is, if a spring is required for a certain total deflection from the free position, these formulas give the dimensions of the strongest spring that will take that deflection without setting, or in other words exceeding the elastic limit.

Designing Compression Springs

In calculating the dimensions of a compression spring which is to give the maximum pressure at the initial point and to be subjected to a further deflection without acquiring a set, the closed coils or other end connections that are inflexible are, of course, disregarded. A compression spring can be strengthened by using larger wire, but when this is done there will not be room for so many turns, and beyond a certain thickness or diameter of wire, the number of coils which it is possible to use will not give a spring of the required flexibility.

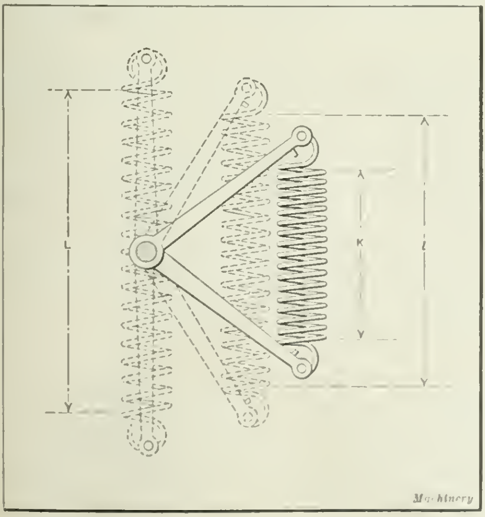


Fig. 3. Toggle Mechanism involving Problem in Spring Design

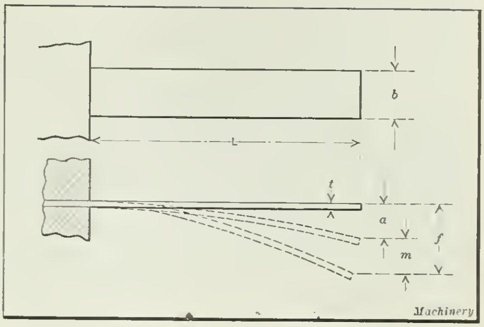


Fig. 4. Diagram illustrating Use of Formulas for Flat Spring Design

To find the size of wire that will give the greatest strength with sufficient flexibility, let l, Fig. 2, represent the length of the actual working part of the spring when compressed to its final or minimum working length. The dimension L is the length of the working part of the spring in its initial position or at the beginning of its stroke and is the spring space allowed in the mechanism less the space occupied by the closed coils. The working range m of the spring, therefore, equals $L - l$. The dimensions D and d, and the values S and E, have the same application as in the case of the extension spring. In the case of the compression spring shown in Fig. 2, the maximum pressure it is possible to have at length l will be obtained when

$$d = D\sqrt{\frac{3l\pi S}{5Em}}$$

The number of active coils N comprising the working part of the spring is found by the formula

$$N = \frac{l}{d}$$

and the free length of the active part of the spring is found by the formula

$$\frac{N\pi SD^2}{Ed} + l = \frac{5l}{3} - \frac{2l}{3}$$

In designing a compression spring, it occasionally happens that the free length K, as indicated in Fig. 2, as well as the initially compressed and final lengths, are fixed by the proportions of the mechanism in which it is to be used. Under these conditions, the strongest spring that can be designed is usually required. Examples that illustrate this are governor springs, detent plunger springs, and electric contact brush springs, which must hold their plungers at a certain definite free height so that they can be assembled in the machines in which they are used without pushing the plungers out of their sockets. As an example, let K, Fig. 2, be the free length of the working part of the spring, and l the length when fully compressed. The strongest spring will be obtained when the wire diameter d is determined by the formula

$$d = D\sqrt{\frac{\pi Sl}{E(K-l)}}$$

in which $K - l$ is the total deflection. The number of active coils N in the spring is found in this case by dividing l by d.

Designing Flat Springs

The proportions of flat metal springs can be readily calculated so that with a given length the greatest pressure will be realized at a given point of deflection and with sufficient flexibility to allow a further working deflection. Referring to Fig. 4 the spring is required to work through the distance represented by m. The initial deflection from its free position is indicated by dimension a and the total deflection from its free position by dimension f. Dimension m in an example of this kind is usually fixed by the requirements of the mechanism in which the spring is to be used, while dimension a can usually be varied by changing the form of the spring. The effective length of the spring from the point of support is designated by dimension L, the thickness by t, and the breadth by b. The working bending stress is represented by S and the modulus of elasticity in bending by E. Therefore, under the given limitation of length, the thickness of spring that will give the greatest possible pressure at a deflection a and still retain sufficient flexibility for a further deflection m is as follows:

$$t = \frac{4SL^2}{9mE}$$

The initial deflection a of the spring is:

$$a = \frac{2SL^2}{3Et} - m = \frac{m}{2}$$

This shows that the thickest and strongest spring of given length and width, and for a given working deflection m, can be obtained when the initial deflection a is made one-half the working deflection. After the thickness and initial deflection have been ascertained, the regular formulas for strength and deflection can be used if it is desired to know the actual pressure exerted by the spring at any point. With a flat spring, it is an easy matter to obtain more strength by making the spring wider, but if there is no room for this, more leaves can be added.

When a flat spring is required to come to rest in a certain free position, and to take a certain total deflection giving a maximum pressure in its fully deflected position or at any intermediate position, the formula for the thickness is:

$$t = \frac{2SL^2}{3Ef}$$

in which f is the total deflection. This is like the formula for the thickest spring that will stand a certain deflection.

To Determine when Springs are Overloaded

From the foregoing formula, a useful formula can be derived for determining whether or not a flat spring is overloaded without knowing the actual load upon it, by observing its deflection. The total deflection f should not exceed

$$\frac{2SL^2}{3Et}$$

If the deflection exceeds this amount, it shows that the spring is overloaded. This formula is similar to a more common one which is used to determine whether or not coil springs are overloaded by noting their deflection. The formula referred to in this case is

$$\frac{\pi SD^2}{Ed} \times N$$

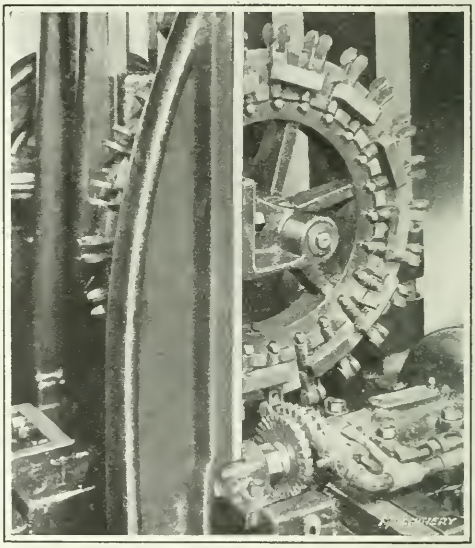
in which N is the number of active coils.

In conclusion it may be mentioned that the formulas given in this article were placed at the disposal of the draftsmen and designers of the Briggs & Stratton Co., Milwaukee, Wis., more than a year ago, and they have proved so useful that they are now employed in proportioning practically all springs used by this company, including delicate flat springs used in electrical instruments and heavy stripper springs used on large drawing dies.

GEAR-CUTTING MACHINE ADAPTED TO STATION MILLING

An unusual adaptation of a Gould & Eberhardt automatic gear-cutting machine in the plant of the Velie Motors Corporation, Moline, Ill., makes possible the milling of drop-forged brake pull-rod yokes on the station milling principle. These forgings are approximately 3½ inches long over all, and the operation consists of milling the two outside and two inside faces of the jaw ends. The accompanying illustration shows the special set-up required for the operation, a large work-holding fixture being mounted on the work-arbor of the machine, and three side milling cutters on the cutter-spindle.

The work-holding fixture provides for holding twenty-four forgings at one time; therefore, the indexing mechanism of the machine is arranged in the same manner as when a spur gear of twenty-four teeth is being produced, the fixture being so secured on the arbor that at the end of each indexing movement, a forging will be in the correct position before the milling cutters. Upon the completion of an indexing movement of the fixture, the cutter-slide advances until the cutters have milled the jaw faces, after which the slide is returned to its original position, the work-holding fixture again indexed, and the previous cycle continued.

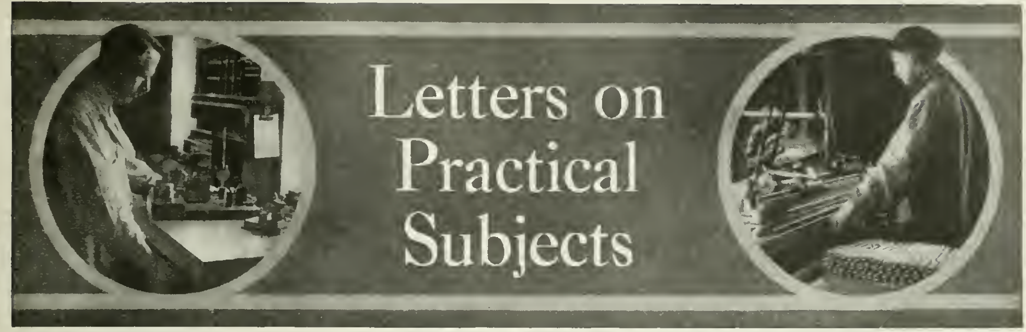

Milling Brake Pull-rod Yokes on Gear-cutting Machine

The operation of the machine is automatic, and the work of the attendant consists only of replacing the finished forgings with unfinished ones as the fixture rotates. The face of the fixture is hollowed out at each station to accommodate the work, and the forgings are located lengthwise by having the shank ends come in contact with projecting pins on the fixture. The clamping members can be swiveled to facilitate unloading and loading the work.

* * *

TAXES ON BELGIAN PATENTS

Belgian patents are now taxed 10 francs during their first year in effect, 25 francs during the second year, 40 francs during the third, 75 francs during the fourth, 100 francs during the fifth, and so on, by increases of 20 francs per year until the maximum of 400 francs is reached. Supplementary patents for the perfection of the original are assessed only once at a fixed amount of 50 francs.



Letters on Practical Subjects

CUTTING CRESCENT-SHAPED GROOVES IN A LARGE ROLL

This description concerns the machining of the driving end of a ten-ton sheet-mill roll. The end of the roll contains four crescent-shaped grooves as shown by the enlarged sectional view in the illustration. It is not usually required to machine these grooves, since the accuracy of the roll does not require such a procedure, but in this particular case it was necessary in order that the roll might be made suitable for a small sheet rolling job. The roll was first turned down on its main and neck diameters in an ordinary roll-turning lathe, after which the equipment illustrated was arranged for cutting the four grooves to form the driving dogs. These grooves are 28 inches long and have a radius of 5½ inches. On account of the size of the work, it was impossible to handle it on any of the regular equipment in the shop. The job was finally performed with the roll mounted in its operative position on the roll-turning table.

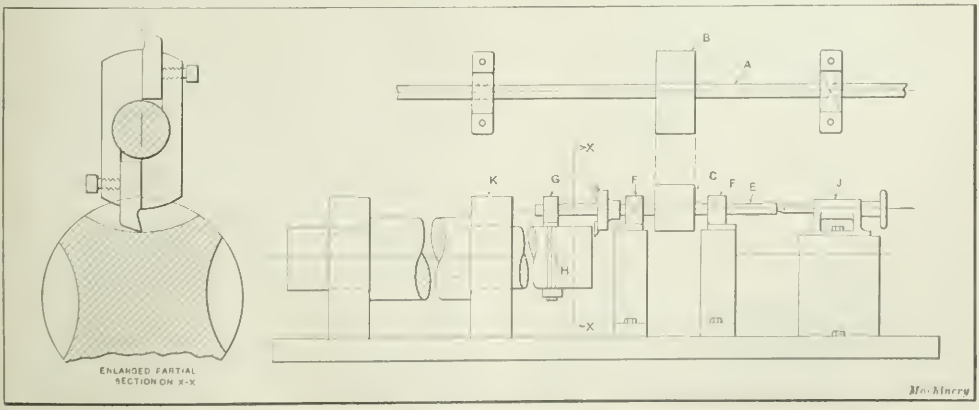
A driving shaft *A*, which was formerly used to drive several machines, was attached to the wall over the roll-turning table in about the position indicated in the illustration. Pulley *B* was fixed to this shaft for driving the boring-bar *E* through another pulley *C* and a 6-inch belt. Pulley *C* was provided with a fixed key so that the boring-bar, which had a corresponding keyway, might slide in it. This bar was supported by bearings *F* on each side of the driving pulley and by the adjustable bearing *G* at the end of the bar. This end bearing was secured to the neck of the roll by long tie-bolts *H*. The relative position of the tools carried in the boring-bar is shown in the enlarged sectional view, which also shows the position of one tool at the bottom of a cut. It will be evident from the illustration that the bar is fed longitudinally by hand through the medium of an ordinary lathe tailstock *J*, the bar sliding through the bearings and pulley *C*.

On account of the length of the grooves and the depth of cut necessary, it was impossible to perform the operation at one setting. After the boring bar had been advanced sufficiently to bring the tools close to bearing *G*, it was necessary to shift the position of the bearing and of the tool-holder so that the tools could work right up to housing *K*. A considerable amount of overhang was thus caused, but by taking the cuts carefully the job was quite satisfactorily finished. In the completion of the operation, three cuts were taken, the first being ¾ inch deep, the second ½ inch deep, and the finishing cut ¼ inch deep. The boring-bar was driven at a speed of five revolutions per minute, and the total time required to finish the job, including the grinding of the tools, resetting, etc., was four eight-hour days. The accuracy with which the job was accomplished will be appreciated when it is stated that there was only a radial error of 1/64 inch in 28 inches of length.

Cleveland, Ohio C. F. George

AN ECONOMICAL TOOL-CRIB ARRANGEMENT

A line of highly paid machinists stood waiting before the little window of the tool-crib in a large manufacturing plant. The boy inside was endeavoring to supply each man with the tools required, and although he understood his work, the line of men shortened but slowly. The foreman appeared irritated, and a little thought will show that he had a good reason for showing concern. Multiply the number of men who were waiting by the average time each stood in line, and then multiply by the average number of times per day the line formed before the window and



Set-up of Drive for Boring Tool used in machining Crescent-shaped Grooves in Large Roll the final result will show a considerable amount of time which the foreman saw slipping away as lost or non-productive time.

The method described in the following offers a means of saving some of this lost time. Probably no one operation takes up so much of the tool-crib man's time as receiving, measuring, and sorting returned drills or reamers, and finding, measuring, and giving out drills or reamers. Sizes stamped upon drills soon become illegible, and regular sized drills, numbered drills, and lettered drills require different gage plates. To avoid mistakes, all drills and reamers should be calipered when checked out and also when returned to the shelves. The provision of a means for facilitating this work, such as that to be described, is therefore the logical method of saving time.

The various drills or reamers are placed on shelves, which are grooved or cleated to separate them, each in the order of its size. Along the front edge of the shelf is fastened, by screws, a strip of iron or steel about 1/8 inch thick and 3/4 inch wide or wider. A hole the exact size of each drill on the shelf is drilled through the plate. The holes are so placed and the grooves of the shelf are so arranged that a drill lies directly behind a hole in the plate which is the exact size of the drill.

The size of the drilled hole is also stamped on the plate. This arrangement provides a drill gage upon the edge of the shelf. The drills lie in the order of their size upon the shelves and the classification—number, letter, regular, or special, as the case may be—is indicated by different colors painted on the plate. If desired, the shelves may also be painted different colors, as, for instance, black for regular size drills, white for special drills, and so on. When given out on check, the drill is calipered in the plate. When returned, very little effort is required to find immediately its size and proper place.

F. E. C.

GRADUATING A MICROMETER TO TENTHS OF A THOUSANDTH

During the war, when it was difficult to obtain machinists' tools, even at high prices, the writer had the misfortune to have his best micrometer disappear. This micrometer was graduated to tenths of a thousandth and was the only one the writer possessed with this feature. After an effort to replace the tool had resulted in failure, an older type micrometer was graduated to tenths of a thousandth to take the place of the one that had disappeared. This micrometer was found to give as accurate results as a standard tool when checked up by the use of size blocks. The accompanying illustrations, Figs. 1 and 2, show how the work of graduating the micrometer was accomplished. In the upper view at *A*, Fig. 1, is shown a section of the cylinder *C* and barrel *D* of the micrometer. At *E* is indicated the relative positions of the graduation lines that were made on the cylinder.

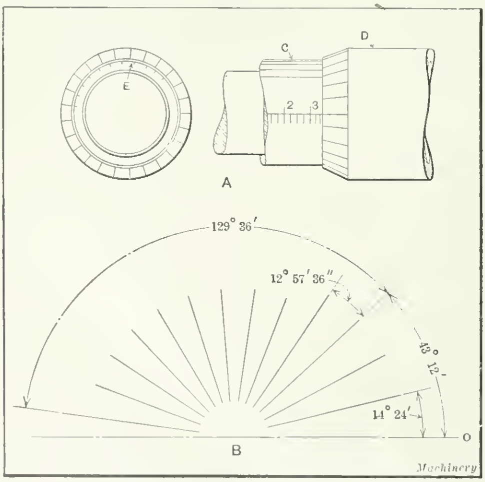


Fig. 1. Diagram showing Angular Spacing of Micrometer Graduations

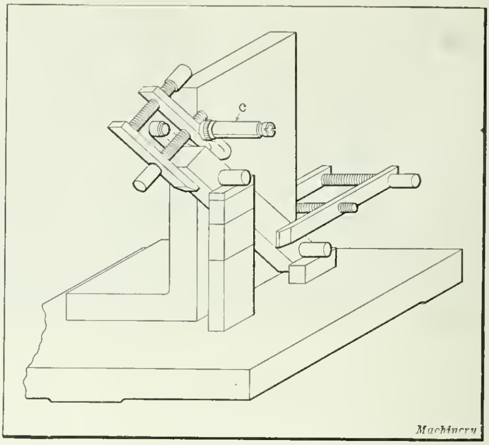


Fig. 2. Method of using Sine Bar to graduate Micrometer Cylinder

The diagram at *B* shows the angles which it was necessary to take into consideration in graduating the cylinder. As barrel *D* was divided into twenty-five equal parts by the regular graduation lines on its circumference, it is evident that each part or space represented an angle of 360 ÷ 25 or 14 degrees 24 minutes. Nine of these parts, therefore, equalled the ten parts which were to be scribed on cylinder *C* or 9 × 14 degrees 24 minutes. Dividing this result, or 129 degrees 36 minutes, by 10 gives an angle of 12 degrees 57 minutes 36 seconds, which was the angle corresponding to each space between the graduation lines that were to be scribed on cylinder *C*.

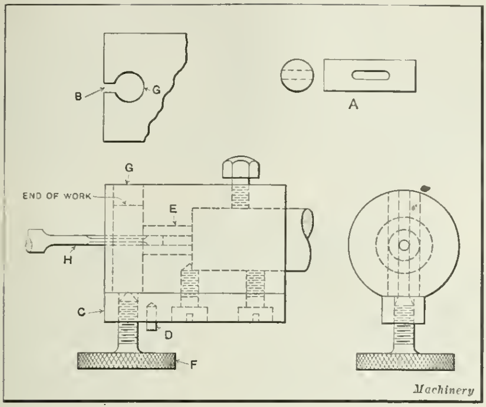
The first line to be scribed was located three spaces above the zero line, or at an angle of 43 degrees 12 minutes with the zero line, this angle being determined by multiplying 14 degrees 24 minutes by 3. The next graduation line was scribed at an angle of 12 degrees 57 minutes 36 seconds to the left of the first line, and the angle of each succeeding graduation was increased by this amount so that the ten divisions represented an angle of 129 degrees 36 minutes or the equivalent of the angle represented by nine divisions of the barrel.

Fig. 2 shows how the micrometer was clamped to a sine bar so that it could be set at the required angles for scribing by the use of standard size blocks. Before scribing the lines, cylinder *C* was given a thin coating of beeswax so that the lines could be etched by the usual method.

New York City G. Youngquist

LATHE FIXTURE FOR MILLING AN ELONGATED HOLE

The lathe fixture shown in the accompanying illustration was made for use in milling an elongated hole in parts like the one shown at *A*. The body of the fixture is made from a piece of machine steel, bored out at one end to fit the spindle of the lathe tailstock. At the other end, a hole *G* is drilled and reamed through the body and at right angles with the spindle hole, to receive the work. A bushing *E* serves as a support for cutter *H*. A slot *B* is milled across the face of the fixture in line with the hole in which the work is placed, in order to enable the operator to see if the



Lathe Fixture designed for milling Elongated Hole

work is properly located. This slot also facilitates the removal of the work and provides a means of cleaning out the chips.

The piece *C* is held to a slabbed flat on the body of the fixture by two screws, and is tapped to receive the knurled screw *F*. The whole fixture is clamped to the tailstock spindle by a cap-screw as shown. Before placing the work in hole *G* of the fixture, it must, of course, be drilled, so that milling cutter *H* can be passed through it by advancing the tailstock. The hole through the work must be drilled to line up with bushing *E* when the work is pushed up against piece *C*. It will be noted that the cutter is made with a plain end, thus giving a good bearing in the bushing. After locating the work in the fixture, the tailstock spindle is advanced until the plain end of cutter *H* has entered bushing *E* for the purpose of preventing the long slender cutter from springing or breaking under the cut. The work is then fed forward by means of the knurled screw *F*, the head of which comes in contact with stop-pin *D* when the proper length of slot has been machined.

Rosemount, Montreal, Canada HARRY MOORE

A SYSTEM OF FIT ALLOWANCES

The article "A System of Fit Allowances" on page 452 of the January number of MACHINERY was of considerable interest. It has been the writer's experience that the allowances given in tables and charts cannot be relied upon to give satisfactory results unless the length of the hole in the work is taken into consideration. Take, for example, an electric car wheel having a bore diameter of 4 inches and a hub 4 inches long. An allowance of 0.015 inch gives a pressure of about 35 tons, which is the pressure recommended by the car wheel foundry. Nevertheless this allowance is greater than that shown on the chart. In the case of a different type of wheel having a hub 15 inches long and a bore 5⅛ inches in diameter, an allowance of 0.002 inch gives a pressure of fifty tons which is excessive, and this necessitated cutting a recess at the center of the hub so that it would have a bearing only at the ends. In this case the allowance of 0.002 inch is much less than that given in the chart for a 5-inch hole. It is always preferable to taper slightly the parts that are to be a press fit, as otherwise the wear resulting from pressing the parts together will affect the tightness of the fit.

As an experiment a 1¼-inch hole was drilled and reamed in the center of an iron block 3 by 4 by 3 inches. A pin 0.001 inch larger than the hole for about 3 inches of its length and 0.010 inch larger for the remaining 3 inches of its length was turned up and pressed into the hole in the block. It required a pressure of 3 tons to force the small end of the pin into the hole and a pressure of 6 tons for the larger end of the pin. It is probable that if the casting had been much lighter it would have been cracked or fractured by this pressure. In pressing pins into holes in steel hubs, the pressure is generally higher for the same allowance than it is for cast iron. However, a tighter fit is required in steel than in cast iron.

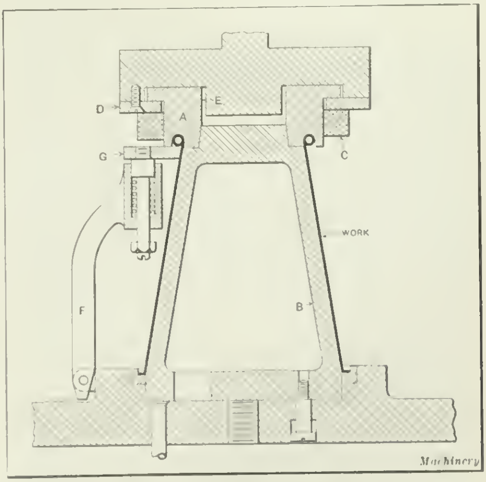
A pressure of 60 tons was required to press a shaft having an allowance of 0.004 inch into the hub of a cast-steel pinion having a 6-inch bore and a hub length of 12 inches. As this pressure was excessive, a recess was bored in the center of the hub leaving a bearing of 2 inches at each end. In this way the pressure required to assemble the parts was reduced to 25 tons. The charts in the article in the January number of MACHINERY previously referred to give approximately the correct fit allowance when the length of the hub is about the same as the diameter of the bore. Therefore, when using these charts this should be borne in mind, and in case the length of the hub exceeds the diameter of the bore, a recess should be bored in the hub if possible, leaving bearing surfaces at the ends of the hub, the combined lengths of which are approximately equal to the diameter of the bore.

Portland, Me. H. K. GRIGGS

[The pressure required for assembling cylindrical parts depends not only upon the allowance for the fit, but also upon the area of the fitted surfaces, the pressure increasing in proportion to the distance that the inner member is forced in. The physical properties of the material from which the parts are made, as well as the outside diameter of the outer member, must also be taken into consideration in calculating the pressure required to force the parts together. On page 885 of MACHINERY'S HANDBOOK is given a formula which, when used with the table of constants accompanying it, will give the approximate pressure required to force a machine-steel shaft into a cast-iron hub when the fit allowance, diameter of the hole, and length of the hub are known.—EDITOR]

WIRING AND FLANGING DIE WITH EXPANDING PUNCH

In the manufacture of coffee pots of the seamed type, the die shown in the accompanying illustration is employed to flange the bottom end and to wire the top. An unusual feature of this die is that punch *A* is composed of five sections which are moved radially from the center of the punch-



Punch and Die for wiring and flanging Coffee Pots holder as they are forced over the tapered surface of the work-holder *B* on the downward stroke of the ram. By this arrangement the wiring edge of the punch is expanded to correspond with the increased diameter of the shell. The punch sections are again forced together on the return stroke of the press, by means of the heavy rubber ring *C*.

The sections of punch *A* are attached to the punch-holder by means of ring *D*, there being a sliding fit between the punch sections and the surfaces of the parts with which they come in contact, so as to permit easy movements. In making the punch sections, they are first turned to the proper outside diameter, bored to the smaller inside diameter, and machined on the sides which make contact with the adjacent sections, so that they will fit well when assembled on the punch-holder. After being mounted on the latter, the lower end of the opening of the sections is turned to the largest diameter to which the sections must expand, and then the opening is tapered to coincide with the tapered surface on work-holder *B* with which the sections engage. Next the sections are again machined on their adjacent faces to permit the inside faces *E* to be drawn in contact with the projecting cylindrical surface at the center of the punch-holder.

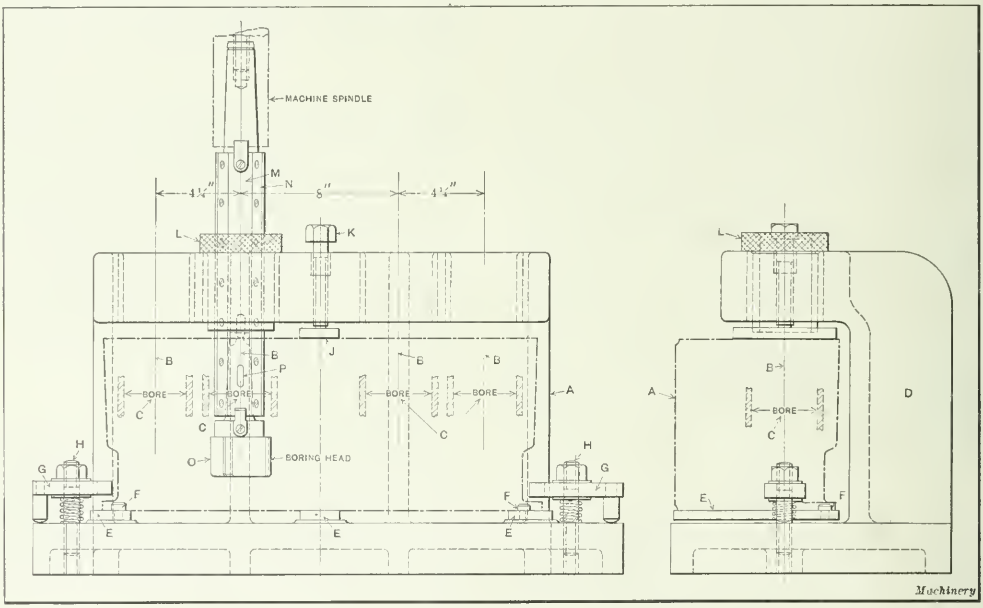
The illustration shows the various parts in the positions occupied at the completion of the downward stroke of the press. Prior to an operation, work-holder *B* is raised by pins bearing against its base, which are actuated by a rubber buffer beneath the die. The movement of the work-holder is regulated by the heads of screws attached to the base which operate in counterbored holes in the die-block. In order to slip work over the holder, it is necessary to swing three arms *F* away from the die. After the work has been located, these arms are returned to the position shown, and a ring of wire formed in a preceding operation is laid on the upper surface of three supports *G* and around the end of the tapered shell.

Supports *G* are spring-actuated, being raised an amount dependent upon the position of the adjustable nut on the rod, by means of which each support is held to its respective swinging arm. Upon the downward stroke of the press ram, the upper end of the shell is forced around the wire on supports *G* as the expanding punch comes in contact with the work, and the flange at the bottom of the shell is formed by forcing the shell on a hardened ring in the die-block as the work-holder is pushed down. In similar operations where the small end of the work is not wired but simply curled or beaded, the construction of the punch and die may be identical with those described except that arms *F* and their attached parts are unnecessary.

Toledo, Ohio J. Bingham

CYLINDER BORING FIXTURE

The fixture shown in the accompanying illustration was designed for use on a heavy-duty Moline "Hole Hog" for finish-boring a four-cylinder automobile engine cylinder block *A* represented by the heavy dot-and-dash lines. The position of the four cylinder bores is indicated by the partial sections *C*. In the illustration only one boring-bar is shown, the other three being omitted as they are of the same construction. The four boring-bars are located in line at intervals indicated by the dimensions between the vertical center lines *B* of the cylinder bores.



Fixture used in boring Cylinder Block for Four-cylinder Engine

The body of the fixture *D* is of the heavy U-type design, which enables the work to be slid into the fixture from the front of the machine, the three hardened guide strips *E* serving as supports for the work while it is being slid into place. Pins *F*, which fit into the end strips *E*, locate the work in position for performing the finish-boring operation. The work is clamped in the fixture by means of two end clamps *G* actuated by screws *H*, and by clamp *J* actuated by screw *K*. The pressure exerted on the work by these clamps is directed against the hardened guide strips. This method of clamping prevents distortion of the casting and insures bores that will be square with the base of the cylinder block.

Guide bushings *L* are provided for each of the boring-bars *M*. These bushings are of the slip type, and are made 5 inches long in order to insure a rigid guide for the bars. Bar *M* is of the built-up type having four hardened strips *N* attached to the body by machine screws. These strips serve as bearing surfaces in slip bushing *L*. The boring-head *O* is separate from the bar and is of the inserted-blade type having three blades. This head is held in the bar by means of a Morse taper shank and a wedge *P*.

The design of this bar permits the boring head to be removed for grinding the cutters, without taking the whole bar from the fixture and machine spindle. This fixture enables cylinder bores 9 inches long to be bored accurately so that there will be practically no error as to straightness and squareness with the base.

Pittsburg, Pa. WILLIAM OWEN

CUTTING GEARS HAVING A PRIME NUMBER OF TEETH

In the following, is described a method of cutting a gear having a prime number of teeth, by the use of an ordinary indexing head equipped with a standard index-plate. Fig. 1 shows a gear with 179 teeth being cut by the method described. The first step in setting up the machine was to find an indexing circle that would give as nearly 179 divisions as possible, or in this instance 180 divisions or spaces. The number of holes in this circle (54) was multiplied by 40, which is the number of turns of the indexing head worm required for one complete revolution of the work.

Thus 54 times 40 equals 2160, and this number divided by 179 or the number of teeth desired gives 12 12/179, which is approximately 12 1/15. The error occurring in these fractions is so slight that it need not be considered. Therefore, to cut 179 teeth it is evident that the indexing pin should be moved 12 1/15 spaces on the 54-space circle for each tooth, but in order to solve the problem of indexing a fraction of a space, a chart as outlined in Fig. 2 was designed and mounted on the index-head. By the use of this chart, the pin could be indexed exactly 12 holes and the fractional part of a division obtained by an additional movement of the index-plate.

The chart was laid out as follows: A circle of about 15 inches in diameter was drawn on manila paper. One-half of this circle, or 180 degrees, was then divided into 27 spaces to represent those on the index-plate. Commencing at the sixth line, each of the following 12 spaces was subdivided into 15 sections, making a total of 180 divisions. The chart was then given a thin coat of shellac, after which it was tacked on a board and mounted firmly on the dividing head, care being taken to have the chart concentric with the index-plate. This was easily accomplished by drawing a circle *A* on the chart having a diameter equal to that of the index-plate.

In connection with this chart, it was necessary to provide a hand *B*, Fig. 1, which was made of an old saw blade and riveted to a piece of square cold-rolled steel *C*, which was, in turn, soldered to the outside edge of the index-plate. The stop which holds the index-plate in position was released, so as to allow the latter to turn. In setting the arrangement in position, the indexing pin was placed in the zero hole of the 54-hole circle, and hand *B* on the first line *D*, Fig. 2, of the lay-out, where it was secured in position by means of a small clamp.

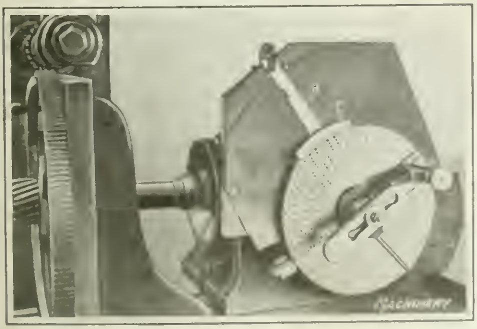


Fig. 1. Index-head equipped for cutting Gears having a Prime Number of Teeth

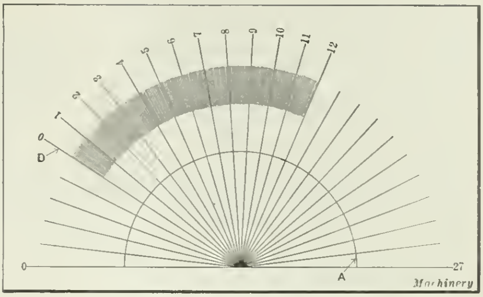


Fig. 2. Diagram showing Lay-out of Chart employed in Connection with Index-head

For each tooth cut, the index-pin was advanced 12 holes in a clockwise direction, the clamp on hand *B* loosened, and the bar moved ahead one division. The result showed, at the 179th cut that by advancing the hand on the chart one line per cut, the 180th tooth had been eliminated, or in other words, 179 teeth had been cut. In checking the gear for accuracy, it was found that at no place did it show a discrepancy of more than 0.0015 inch. A gear of 181 teeth could, of course, be cut by using the same chart, if the indexing pin is operated in a clockwise direction, and the hand on the chart in a counter-clockwise direction.

Plainfield, N. J. HENRY DAUT

PULLEY-CROWNING TOOL FOR TURRET LATHE

A device for crowning pulleys, which has been developed for use on a turret lathe and which has proved quite successful, is shown in the accompanying illustration. This tool was designed to be employed in conjunction with other tools mounted on the turret, to provide a means of completing the machining of crowned pulleys such as shown at *P*, at one setting in the chuck of the turret lathe. The operations performed on this pulley prior to crowning, which is the last operation, are as follows: Boring and reaming the hole; facing one end of the hub and back-facing the other end; rough-turning the periphery of the pulley straight, and facing the two edges.

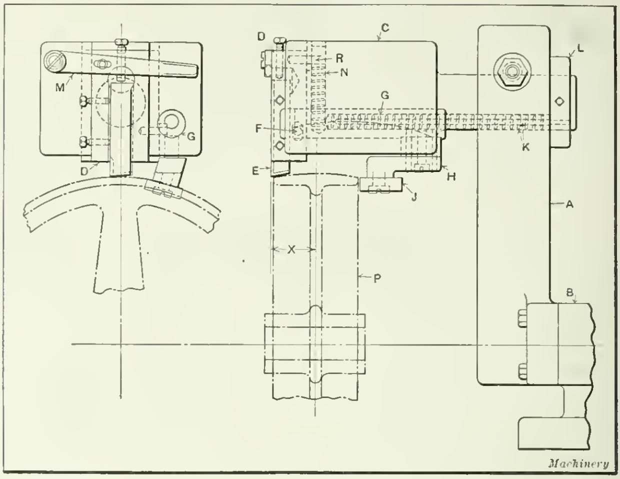
Referring to the illustration, *A* is the tool-holding member which is attached to one face of the turret at *B*. In this holder is mounted the body *C* of the crowning tool, which is clamped in place by screws (not shown). In body *C* is mounted a slide *D* which carries a cutting tool *E* and also a pin *F* projecting into an elongated slot in body *C*, so that it can move up and down with the slide. Another important member of this tool is the forming bar *G*. To this bar is attached, by screws, a block *H* which carries a roller *J*. A spring and stud *K* attached to a collar *L* enter a hole in bar *G*. These parts, with the exception of lever *M*, complete the essentials of the tool, the operation of which is described in the following:

With the pulley finished, except for crowning, the turret-slide is advanced until roller *J* (which is then in its extreme forward position or slightly advanced beyond the cutter) comes against the edge of the pulley rim. As the turret continues to advance, block *H*, being prevented from moving forward, remains stationary and also prevents further forward movement of forming or templet bar *G*. Now as body *C* continues to advance, it slides over bar *G* and when pin *F* comes in contact with the formed guiding surface or templet of bar *G* slide *D* is caused to slide in body

C so that the cutter will turn the crowned surface on the pulley to correspond with the contour of the curved surface of the templet bar *G*.

Pressure is exerted by spring *N* on pin *R*, so that pin *F* in slide *D* is kept in contact with the formed templet surface of bar *G*, except when the slide is advanced by hand by lever *M*, so that the turret can be brought up to a fixed position to facilitate adjusting the cutter in its proper position relative to bar *G*.

In tracing the detail drawing of body *C* and bar *G*, blank circular spaces are left for certain dimensions so that the proper lengths may be filled in on the blueprints when making tools to accommodate pulleys of different size. This tool provides a successful and economical means of performing the class of work described, being an application of a single-point tool for forming operations on a turret lathe. This method is often found preferable to that of employing a broad formed tool for work of this kind. F. H.

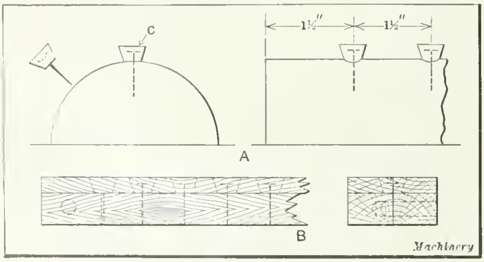


Pulley-crowning Tool for Turret Lathe

ANCHORING BABBITT LININGS TO CASTINGS

It is commonly known by those familiar with pattern shop and foundry methods that bearing surfaces, such as journal boxes and guiding surfaces in which slides operate, are usually babbitted. Anchorage holes are generally provided for securing the babbitt to the base metal of the casting. Coring is probably the most economical means of obtaining this result, although it is sometimes done by drilling holes in the casting. This is often an awkward job, especially in bearing boxes, on account of the fact that the surfaces are not always readily accessible and a portable drill is likely to be required. In all cases, therefore, the practice of coring these babbitt linings should be followed, if it is possible to do so. It is the opinion of the writer that in all such cases the anchor holes can be cored, and that the failure to designate the coring method on the drawing is often due to the unfamiliarity of the draftsman with molding procedure. Existing core-room equipment can often be employed with slight additional work in the production of these cored anchorage surfaces.

Suppose it is required to babbitt a 3½-inch diameter journal box, and that among the core-room equipment there is a box suitable for producing a plain core of the required diameter and of the proper length. In this case no special core-box is required for the main core. It is necessary, however, to construct a core-box for the anchor cores, which may be designed after the manner indicated at *B* in the illustration. The cores should not be less than 5/16 inch in height, about ½ inch in diameter at the small end, and should taper as shown at *C*. The core-box for these anchor cores should be split longitudinally on the center line, as shown in the end view. The upper part of the core-box is made of two pieces of wood of the same thickness as the depth of the core, and the bottom part should be deep enough so that the nail which is subsequently baked in the core may not protrude beyond the bottom of the box. These two lower halves are doweled together, and small holes are drilled through at the parting to accommodate the nails. The position of these nails is indicated in the illustration. The nails are pressed into the holes so as to bring their heads about in the center of the core pocket.



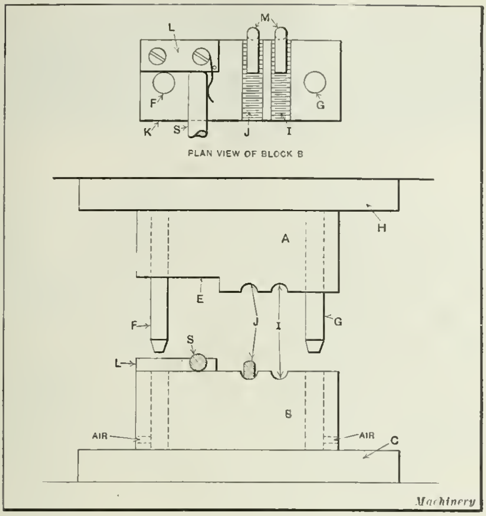
Core-box for making Anchor Cores, and Method of placing them in Main Bearing Core

The upper part of this illustration shows a plain half-core for a bearing, lying on the drying board. The small anchor cores should be made up in quantities and kept in stock so that they may be used when desired, by inserting them into the unbaked cores in the manner indicated in the illustration. These small cores should be arranged in rows, either straight or zigzag, as desired. The green sand half-cores, with the small ones inserted, are then placed in the oven and baked, and the two halves stuck together in the regular way. In the illustration, these cores are shown arranged in straight rows spaced 1½ inches apart, but this merely furnishes an idea of an arrangement that might be followed for a core of this size. The finished core is set in the mold in the regular way.

Kenosha, Wis. M. E. Duggan

DIE FOR FORMING SCREW THREADS ON A POWER PRESS

The accompanying illustration shows a small die used on a Toledo press for forming threads on soft steel wire rods 0.2437 inch in diameter. The specifications for this job called for 1/4-20 threads on which semi-finished hexagon nuts could be screwed. These nuts, after being screwed on the rods, were to be tin-plated, and were not required to be removed. As the work could not be done on any of the thread-cutting machines in the shop without interfering with other work, and as the press room at the time was not overloaded with work, it was decided to use a small Toledo press for the job by equipping it with a suitable die. The die developed for this purpose consisted of two tool-steel blocks *A* and *B* provided with guide pins *F* and *G*. Blocks *A* and *B* are attached to cast-iron shoes *C* and *H* by means of screws. Shoes *C* and *H* are, in turn, fastened to the bolster plate and ram, respectively.



Die used to form Screw Threads on Soft Steel Rod

In making the dies, blocks *A* and *B* were clamped together and drilled and tapped with a 1/4–20 tap at *J* and *I*. After this had been done, the blocks were separated and a step *E* planed on block *A*. When the die is in operation, the stock *S* is placed on face *K* against stop *L* where it is swaged or flattened on the first stroke of the press. On the second stroke the stock is placed in the threaded groove *J* in an edgewise position against stop *M*, so that when the blocks come together the metal is subjected to pressure which causes it to conform with the thread grooves in the die. This forces out the flat sides which were produced by swaging. Threaded groove *I* serves as an extra groove to be used only when the first one becomes excessively worn or chipped. The purpose of swaging is to keep the metal from running or flowing outside of the thread-forming portion of the die and thus forming fins where the two guide blocks come together. A few trials were made to determine the proper depth of step *E* in order to have just enough metal to fill the thread die. The dies were lubricated with a mixture of lead and oil. The threads produced on this die proved to have sufficient accuracy and strength to meet requirements satisfactorily.

West Lafayette, Ind. M. A. Blu

SEMI-AUTOMATIC ADJUSTABLE CENTER-PUNCH

The tool shown in the accompanying illustration was designed by the writer after observing the comparatively crude methods employed in laying out and center-punching copper bars for drilling. It was made primarily to enable the coppersmith to center-punch copper bars more rapidly and with greater accuracy than could be done by the usual method. However, the application of this punch may be extended to include bar stock of any material, if the size comes within its range of adjustment.

The time required for setting up and adjusting the tool to the stock makes it impracticable for use when less then ten or twelve pieces are to be center-punched, but when a larger number of pieces are involved its use results in a distinct saving in time. The original method of laying out and center-punching by hand requires the use of five tools—a try-square, a scale, a scratch-awl, a center-punch and a hammer. When the device shown in the illustration is employed, it requires only the use of a hammer. The following table shows a time study or comparison of the two methods:

Old Method

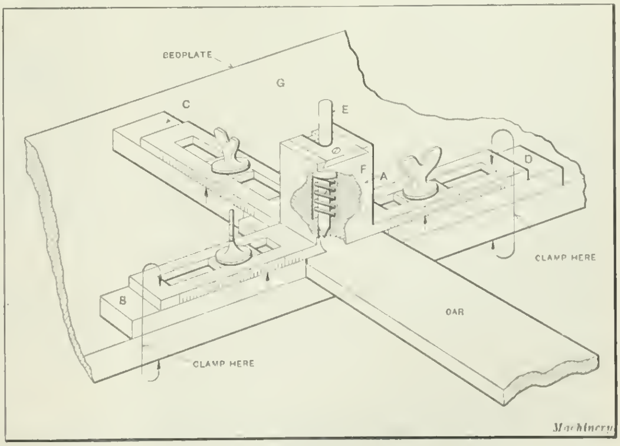
Operation	Time, Hours
Lay bar on table	0.0005
Pick up square and place on bar crosswise	0.0008
Pick up scale and move square to the proper distance from the end of the bar	0.0010
Lay scale aside	0.0003
Pick up scratch-awl and scratch line crosswise	0.0011
Mark bar in two places the proper distance from edge	0.0017
Turn square lengthwise with bar and scratch line through the two points just marked	0.0013
Lay square and awl aside	0.0004
Pick up center-punch and hammer	0.0009
Place point of punch on intersection of two lines and punch	0.0010
Lay punch and hammer aside	0.0004
Lay bar aside	0.0004
Total time per hole	0.0098

New Method

Take bar and place end in punching tool	0.0011
Punch	0.0004
Lay bar aside	0.0004
Total time per hole	0.0019
Saving per hole	0.0079
	0.0098

Under the ideal conditions of having sufficient work to keep the tool in use continuously, production would be increased about 400 per cent, and the direct labor cost reduced about 80 per cent. From this table the approximate saving in time with the new tool is readily apparent. The greater accuracy obtained by the use of the adjustable center-punch results in less scrap and a better product. The work is also made easier for the worker as eye-strain resulting from reading scales is eliminated after the tool is once adjusted.

The body *A* is made of forged steel, and is machined accurately to insure close sliding fits for the guide blocks on slides *B*, *C*, and *D*. The center-punch *E* is made of tool steel and is accurately ground. A spiral spring *F* holds the punch up so that it clears the opening in which the bar is located when performing the punching operation. It will be noted that scales or graduation marks are provided on the arms which extend from body *A*. It will also be seen that indicating points are scribed on sliding blocks *B*, *C*.



Device for center-punching Bar Stock

and *D*. By the use of these scales the sliding blocks can be quickly adjusted for any width of stock and any desired location of the center mark within the capacity of the tool. After the slides have been properly set, the device should be clamped down to an iron or steel bedplate *G*, as shown, or the top of a bench in order to provide a solid foundation which will insure rigidity. By placing blocks under the sliding members *B*, *C*, and *D*, the tool can be employed for center-punching stock of considerable thickness. With this tool the operator can hold the hammer in one hand and use the other for picking up the bar, inserting it in the fixture, and laying it aside.

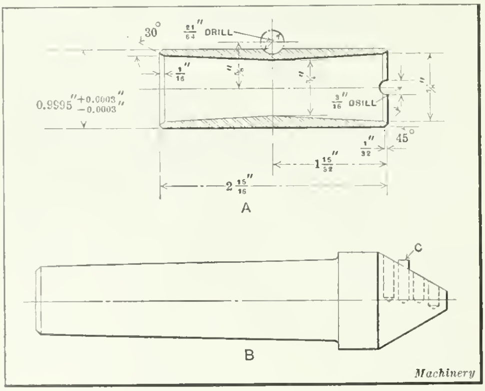
Swissvale, Pa. S. M. Lowry

MAKING PISTON-PINS

The piston-pin shown at *A* in the accompanying illustration is used in the motor of a high-grade car, the design of which has been carefully worked out with a view to obtaining light weight combined with great strength. In order to accomplish this, each part of the car is carefully proportioned and made of the strongest material available. In the case of the motor piston-pin, the material selected was alloy steel tubing. By using 1-inch tubing, 0.020 inch over size, the only operation required in finishing the outside diameter to size is a finish-grinding operation, which is performed after the pin has been hardened. This method of using over-size tubing proved to work out very well, and not only saves material but considerable work as well. The procedure in machining the pin is easily followed by referring to the accompanying operation sheet, which shows the various operations required and the equipment used.

After cutting off to the length specified in the operation sheet, the pieces are carburized and then finish-bored to size. This removes the carbon from the inside so that later, when hardening, the inner surface will be left soft, while the outside surface will be hard, thus giving a tough but elastic tubing which will stand up under the pressure exerted by the explosions in the cylinder. By performing the boring operation after the work has been carburized, the usual process of packing the holes in the pins for the hardening operation is eliminated. Operation 6 is quickly performed in a drilling machine. Operation 8 consists of grinding a 30-degree chamfer at each end of the hole in the pin. The surfaces thus ground serve to locate the pin on centers when grinding the outside diameter. In the latter operation, which completes the machining of the pin, a special center shown at *B* is employed. This center is provided with a pin *C* which engages the notch produced by the 3/16-inch drill at the end of the piston-pin. It will be noted that there are four drilled holes in the conical end of this center, which permits pin *C* to be properly located for piston-pins of different sizes.

Irvington, N. J. C. H. Dengler



Piston-pin, and Lathe Center used when grinding Outside of Pin

OPERATION SHEET FOR MAKING PISTON-PINS

Oper. No.	Operation	Machine	Tool and Number
1	Anneal tubing	Furnaces	
2	Saw off tubes 3 1/16 inches long	Power saw	
3	Carburize (do not harden here)	Furnaces	
4	Chuck in soft jaws	W. & S. screw mach.	
	A. Face end	W. & S. screw mach.	
	B. Drill through 11/16 inch	W. & S. screw mach.	
	C. Bore through ¾ inch ± 0.003 inch	W. & S. screw mach.	
	D. Ream taper hole in one end	W. & S. screw mach.	Reamer No. 1316-T-2
5	Reverse piece		
	A. Face to length (2 15/16 inches)	W. & S. screw mach.	
	B. Ream other end		Reamer No. 1316-T-2
6	Drill 21/64- and 3/16-inch holes in pin	Drilling machine	Drill jig No. 1316-T-1
7	Harden pins	Furnaces	
8	Grind 30-degree chamfer at both ends	Grinder	Collet No. 1316-T-5
9	Grind outside diameter to size (0.9995 inch ± 0.0003 inch)	Grinder	Special centers No. 1316-T-3

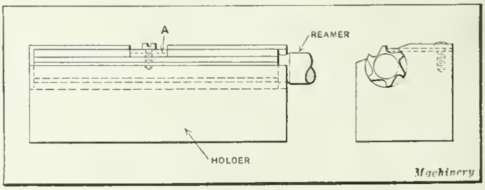
Machinery

HOLDER FOR STONING REAMERS

The accompanying illustration shows a simple device made by the writer to facilitate the stoning down of small reamers, a large number of which were required to be reduced about 0.002 inch on their diameters. As the small reamers were awkward to hold in the hand, this holder proved to be a great convenience. Without the holder the stone had a tendency to rock. Moreover, with the position of the teeth constantly changing, it was a difficult matter to determine the proper angle at which to hold the stone in order to give the cutting edges the correct amount of clearance.

One advantage of the holder is that it permits both hands to be used in manipulating the stone. It also locates each cutting edge in the same position for stoning, thus enabling a uniform clearance to be maintained. The holder is made from a piece of square stock drilled for its entire length, as shown, with a drill the size of the reamer. After drilling the hole in which the reamer is to be located, the corner of the block is ground and filed away to expose the reamer blades. A groove cut in the top of the holder is supplied with a piece of saw blade *A* held in place by a round-head screw. The piece *A* serves as an index stop, and not only prevents the reamer from turning while it is being stoned, but also locates each succeeding cutting edge in the same position for stoning as it is indexed into place.

Rosemount, Montreal, Canada Harry Moore



Reamer-holder used in stoning down Cutting Edges

SHOP AND DRAFTING-ROOM KINKS

SLIDE-RULE KINK

Almost all users of the slide-rule experience more or less difficulty in placing the decimal point in the quotients and products when performing simple arithmetical calculations. The difficulty is due principally to the fact that the rule governing this is not easily memorized. Accordingly, the writer devised the table shown, in which these rules are graphically presented. Its use will greatly aid in slide-rule work, if the table is hung on the wall or some other place where it can be plainly seen. The letters L and R refer to the end of the rule from which the slide projects—that is, left and right. Letters a and b represent the number of digits to the left of the decimal point in the two multiplication factors, or in the dividend and divisor when the arithmetical operation is division. By this handy graphic method, the number of places in the product and quotient may be quickly determined.

TABLE TO AID SLIDE-RULE WORK

L		R	
×	$a + b$	×	$a + b - 1$
÷	$a - b$	÷	$a - b + 1$

Machinery

Baltimore, Md. HENRY R. BOWMAN

FALSE JAWS FOR AIR-HAMMER REPAIR VISE

A little kink which the writer has found useful in repairing air-hammers is to provide a bench vise with false jaws made from leather belting. This enables work to be held in the vise without distorting it or injuring finished surfaces. The false jaws are made in the form of disks and are provided with split pins *D*, as shown at *B*, Fig. 1. Three of these disks are attached to each jaw of the vise by drilling 3/16-inch holes in the jaws, as indicated at *C*, Fig. 2. Of course two disks can be attached to one jaw and only one disk to the opposite jaw if a three-point grip on the work is desired, or the disks can be arranged in any way that will provide the best means for holding the work. The 3/16-inch holes are countersunk to facilitate inserting the pins *D*, Fig. 1, which are driven tightly into the leather disks and remain in them when they are removed from the vise.

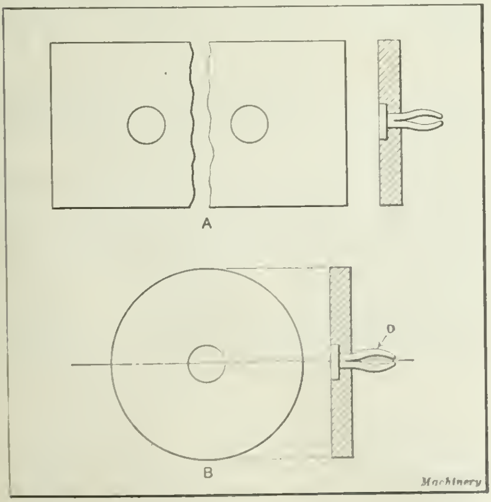


Fig. 1. False Jaws for Bench Vise

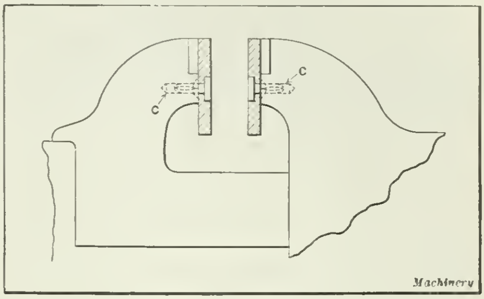


Fig. 2. Diagram showing how False Jaws are attached to Vise

The disks or false jaws can be attached quickly by simply inserting the pins in the 3/16-inch countersunk holes. The reason for using circular disks is that grooves are formed much quicker in straight jaws like the one shown at *A*, which must always be located in the same position, whereas the disks can be turned around so that new surfaces are presented for gripping the work as soon as grooves begin to form in the leather.

The disk jaws do not project over the vise jaws, and the spaces between them can be used for gripping work in the regular way without their removal. For work which requires a soft surface the whole length of the vise jaw, a strip of leather like that shown at *A*, Fig. 1, can be used in place of the disks. It might be mentioned that three shingle nails driven through the leather quite close together may be used in place of the split pins to hold the false jaws in place.

Saint Paul, Minn. ARTHUR MUNCH

ENAMELING COMPOSITION

An enameling composition consisting of 25.55 per cent sand, 22.33 per cent feldspar, 32.98 per cent borax, 9.58 per cent soda, 3.20 per cent fluor-spar, 3.20 per cent saltpeter, 2.12 per cent black oxide of manganese, 0.80 per cent cobalt, and 0.21 per cent oxide of copper may be used as a slush coat for enameling sheet-metal articles. The application of enamel by slushing consists of pouring the enamel over the surface to be coated and allowing it to drain off and dry. The ingredients should be melted together, after which 10 per cent of clay should be added to the melt. The mixture should be burned not less than four hours in the muffler. The ingredients listed in the foregoing can be obtained from commercial chemists, who would doubtless also be prepared to furnish complete information regarding the mixing and application of this enamel.

Cleveland, Ohio D. C. OVIATT

* * *

Figures available from official Soviet sources published in Moscow show that the cotton-spinning industries in Russia during the first six months of 1920 turned out 2 per cent of the 1914 production.

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

FINDING ANGLE OF SPRING CLAMP

J. O.—Referring to Fig. 1, will you please show how to find angle ϕ? This dimension is required in laying out a perforating, embossing, and cutting-off die for producing a spring clamp. Fig. 1 shows a side view of the clamp.

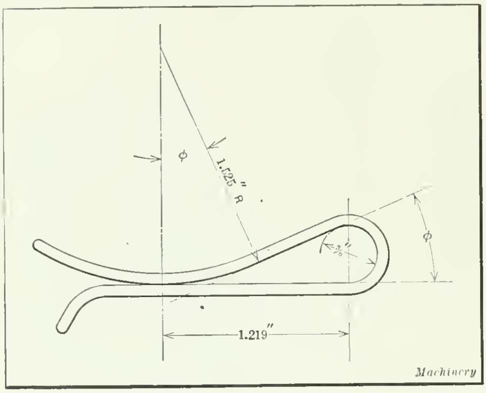


Fig. 1. Side View of Spring Clamp

A.—First construct the diagram shown in Fig. 2, making $c = 1.219$ inches, $R = 1.525$ inches, and $r = 3/16$ inch. From the right triangle AOB, it will be seen that

$$\text{Tan } \alpha = \frac{R - r}{c} \quad (1) \quad \text{and } h = \frac{R - r}{\sin \alpha} \quad (2)$$

From the right triangle AOE,

$$h = \frac{R + r}{\sin (\phi + \alpha)} \qquad (3)$$

From (2) and (3) by comparison,

$$\text{Sin } (\phi + \alpha) = \frac{R + r}{R - r} \sin \alpha \qquad (4)$$

Inserting numerical values in (1), we find

$\alpha = 47$ degrees 39 minutes 14 seconds

Then from (4) we find

$\phi + \alpha = 71$ degrees 8 minutes 23 seconds

$\phi = 71$ deg. 8 min. 23 sec. — 47 deg. 39 min. 14 sec.
= 23 degrees 29 minutes 9 seconds. W. W. J.

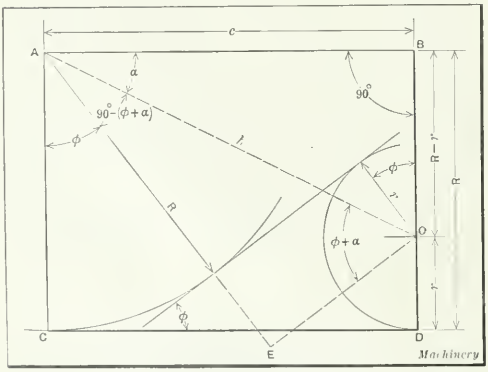


Fig. 2. Diagram illustrating Method of finding ϕ Fig. 1

FINDING THE LENGTHS OF TWO SIDES OF A TRIANGLE

B. I. H.—Referring to the accompanying illustration, lines $a + b = 150$ inches, $o = 30$ inches and $c = 50$ inches. How can the length of sides a and b be determined?

A.—The easiest method of solving this problem is to assume approximately correct values for lines a and b, then determine the magnitude of angle C for the assumed value of line a, and finally determine the length of line c with the assumed values of lines a and b. After a few trial calculations are made in the manner suggested, the exact value of line a can be obtained by interpolation, as explained in the following.

If the diagram illustrated is laid out to scale, it will be found that the length of line a is approximately 57 inches, and that of line b, 93 inches. Assuming these values to be correct, it is obvious that $\tan C = \frac{30}{57}$ and $C = 27$ degrees 45 minutes 31 seconds. Then, the length of line c can be calculated by means of the well-known trigonometrical formula for finding the length of a side of an oblique-angled triangle, when two sides and the included angle are known. This formula is given in MACHINERY'S HANDBOOK on page 152 as follows:

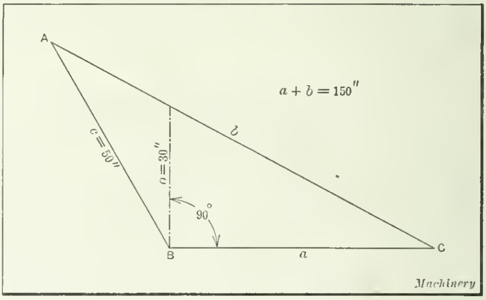


Diagram of Problem to find the Lengths of Sides a and b

$$c = \sqrt{a^2 + b^2 - 2ab \cos C}$$

By inserting the assumed values in this formula, and solving, it will be found that the length of line a will be 50.1607 inches. Thus, the error from the true value equals 50.1607 — 50 or 0.1607 inch.

Now, assuming line a to be 57.1 inches long and the length of line b to be 92.9 inches, angle C will be 27 degrees 43 minutes 2 seconds. Again calculating side c by means of the formula, it will be found to equal 49.9900 inches. In this case there is an error equal to 50 — 49.9900 or — 0.0100 inch. The difference between the two errors equals 0.1607 — (—0.0100) or 0.1707 inch. The length of side a that will give an error of zero when calculating side c by means of the formula, can be determined by interpolating as follows:

$$57 + \frac{1607}{1707} \times 0.1 = 57.094 \text{ inches}$$

This gives the correct value of line a to the third decimal place. The value of line b, of course, equals 150 — 57.094 or 92.906 inches. If greater accuracy is required, repeat the computation with the last value found for side a and interpolate again. W. W. J.

Industrial Conditions in France, Holland and Italy

Special Correspondence to MACHINERY

Paris, April 4

CONDITIONS in France do not seem to improve very rapidly. Now and then a factory reports that its business is improving somewhat, and additional men are hired, but the improvement does not appear to be permanent. The Hispano-Suiza Automobile Co. was working two shifts on my last visit, but I do not understand where all the cars made are sold, for the price is 78,000 francs for the bare chassis. At the Citroën plant about a month ago they were building about thirty cars a day, many of which were for export. Most of the other automobile concerns are working about forty-eight hours a week, but with a smaller number of men than when they are working to capacity.

The works La Sté Alsacienne des Constructions Mecaniques, in Grafenstaden, Alsace, have received a big order for locomotives for the French railroads. This contract is practically completed, and whether or not they will receive an additional contract is not yet known. In Lille, the Fives-Lille Co. is quite busy on railroad material, and some other factories in the same city are fairly busy building and repairing textile machinery.

I am rather inclined to be pessimistic about the immediate future of France, and do not see how she can get into motion again without quite a large amount of money; and with Germany refusing to pay I do not see how she will be able to get on her feet without borrowing money, although she has about all the debts that she can stand up under now. I do not expect to see the value of the franc come up to less than ten to the dollar for a good many years.

Conditions in Holland

I have just spent two weeks in Holland where the majority of the machine shops are engaged in shipbuilding and repairing, but they are not very active just now. The Dutch complain of an exchange unfavorable to them by 17 per cent, but I pointed out that they were fortunate as compared with France, Belgium, and Italy, where the exchange was unfavorable by 300 per cent or more.

There is a great number of bicycles to be found in Holland, but most of them are imported. I saw some good looking bicycles at $20 of German make. The Trompenburg Co. at Amsterdam builds the Spyker automobile. It is a very fine looking six-cylinder car, but only 500 or 600 of these cars are built a year when business is good, and at present the company is doing next to nothing. It has in its show-room a six-cylinder car built, I believe, in 1902, which is claimed to be the first six-cylinder car in the world. The cylinders were all cast separately, so that the hood is very long.

I have found no one anywhere who is willing to make any prophesy as to when business in France, Belgium, and Holland will be better. Of course, everyone hopes that it will be better in a few months, but it is difficult to see any good foundation for this belief.

The French Machine Tool Trade

Paris, April 12

The market for machine tools has slightly improved. Some dealers in American machine tools who have accepted 10 francs for a dollar have been able to sell a number of machines. One dealer reports sales amounting to 500,000 francs in one month and another, sales of 1,000,000 francs.

After the armistice, French manufacturers of machine tools expected that they would find a big market for their product in the devastated portions of France. Their building programs were discussed with Le Comptoir Central D'Achats, a bureau having in charge the rehabilitation of the devastated regions. It appeared quite certain that much machinery and building material would be required. Ultimately, however, these requirements were filled to a large extent by machines bought from Germany, in addition to many important orders which were placed in the United States for machines which later became very expensive on account of the exchange.

The "Comptoir" has not disposed of all the machines that it ordered from Germany and the United States, but finds its warehouses filled with stocks, and being in need of funds has begun to bring pressure to bear on the manufacturers of the devastated districts in order that these may give preference to the machines that the "Comptoir" has in stock. Manufacturers who require only very simple machine tools for intermittent work, say, for example, simple milling, find themselves asked to accept a universal milling machine at a very high price which does not at all suit the needs of their shop. In some cases, the manufacturers have had to buy machines entirely too complicated for their needs from the "Comptoir."

Many of the large French shops and state arsenals have begun to manufacture machine tools, and are thus coming into competition with the regular manufacturers at the critical period that the country is now passing through. Furthermore, it is feared that the machines produced by the firms mentioned will be inferior to those manufactured by the regular machine tool builders.

Employment in French Industries

The number of working hours per week has been reduced in many districts. One of the large steel plants is working only sixteen hours per week. In the nut and bolt business, a six-hour day prevails and wage reductions have taken place. In some cases such reductions have caused strikes, in others the reductions have been accepted without controversy. The workmen understand thoroughly the seriousness of present conditions. The labor unions no longer seem to have as great an influence as in the past upon the general opinion of labor.

Several new companies have started in business even at this time. Among the most important may be mentioned Compagnie Generale de Construction de Locomotives, which has built a factory at Nantes. It is expected that this plant will turn out ten locomotives per month at first, and this output will be increased later. It is also expected that a certain number of locomotives per month will be repaired at the plant. The equipment and arrangement of the plant are the most modern, and ultimately the plant may employ 30,000 workers. A village of 450 houses has been built for the workmen so far.

Societe d'Outillage Mecanique & D'Usinage d'Artiellerie is now making machine tools, power presses, hydraulic presses, farm tractors, etc., in addition to war materials.

In the machine tool field, this firm is planning on quantity production. The same policy will be followed in regard to tractor manufacture. In spite of the crisis which the French industry is passing through, it is stated that the orders received by this company have been very satisfactory. The Bulgarian state railways are in the market for twenty-five locomotives and a number of freight cars.

Conditions of Italian Industry

The Italian industry has undergone a change that is very interesting to note. The low exchange of Italy has in some ways proved a stimulus to its economic development. The steel mills and steel foundries have shown considerable activity and progress. At the recent fair at Milan there were exhibited truck tires, parts of agricultural machinery, pulleys, etc., made of steel castings that were remarkably uniform and homogeneous. Some of these steel castings appeared to be fully satisfactory for use where forgings have been employed in the past.

During the war, numerous electric furnaces were installed in all the large foundries, and molding machinery was substituted for hand molding. For this reason, there are a number of important iron and steel foundries capable of a large output. On the other hand, the forging industry has not seen any remarkable progress, although there has been some development in the drop-forging field, and there are numerous shops that compete with foreign products in this line.

Italy has even entered the export trade in machinery, having exported some lathes, milling machines, and drilling machines; but Italian builders of machine tools do not seem to have entered the field of high-class precision machinery. It appears to an observer that the machine shop industries in Italy have acquired an unexpected power and strength, and that they are likely to have a prosperous future. This optimistic belief is due to the fact that satisfactory products have not been turned out by only a few large plants, but by a number of medium-sized and small plants.

What will happen when the extraordinary requirements that now exist have passed and when conditions again become normal and general competition governs business activity is difficult to say. Then the question of production costs will again become important, and it is difficult to see how manufacturers not building in large quantities will be able to compete with those who can advantageously devote themselves to quantity production. Large factories are not as frequently seen in Italy as in the other leading European countries, and it is doubtful if the smaller factories, upon which all efforts now seem to concentrate, will be able to retain their present position when conditions of business again become normal.

* * *

SOUTH AMERICAN TRADE

Even before the European war the United States was rapidly making inroads into the long entrenched foreign business in most of the Latin-American countries in machinery and related supplies. During the war period and the resultant almost complete cutting off of the European supplies, the more enterprising American manufacturers were able to increase their advantage greatly. At the present time it is largely a question of retaining their hold against the reviving competition from Germany, England, Belgium, and France.

America's greatest handicap in all the Latin-American territory lies in the fact that most of the men in charge of the operations where machinery of any kind is used are of European nativity or ancestry. Naturally they favor the machinery made in their respective countries; and in cases of English, German, or French control of the companies, their orders invariably go to home country manufacturers. The few exceptions usually prove to be where an American product of unquestionably superior merit is available.

Importance of Selecting the Right Kind of Dealer

It is important for American manufacturers to give careful consideration to the choice of their Latin-American dealers. There is an inclination among these dealers to look upon their American connections as merely side lines. Most of them have been handling European machinery for years; they are familiar with it and with the trade. Their relations have been for the most part agreeable; and it is characteristic of the Latin-American to let well enough alone. Many an American company has found that the dealer took on its line largely as a matter of self-protection and with no definite idea of pushing it aggressively. The American manufacturer's first important step is to assure himself that he is securing an active agent.

South American Demand for Machinery

Generally speaking, the machine shops of South America are behind the times. There are usually two or three that stand preeminently above their competitors in size and equipment. Some of these are equipped almost entirely with American machinery. The railroad shops are perhaps the most efficiently equipped, and in this statement the electric railroads are included. Electrical development has been particularly progressive.

The extensive mining operations afford a constantly increasing demand, and American mining machinery is growing more and more in favor. With the electrical development, American superiority is generally recognized, but there is frequently difficulty in overcoming the influence of foreign invested capital in these projects; this is a condition that must be taken into consideration in every line and in every quarter.

Probably the greatest success has been scored by those concerns, particularly in agricultural machinery, who have established their own branch sales departments and have on the ground constantly an alert sales force which keeps closely in touch with conditions, development, and demand. This in fact is by far the best solution, and with a greater degree of cooperation among manufacturers of non-competing lines, whereby the expense of such a distribution depot could be jointly met, excellent results should be accomplished. Lately there is also a growing furniture manufacturing interest, particularly in Brazil. Here there is a promising and profitable market for American woodworking machinery. This interest is also advancing in Argentina, and to a less degree in Chile. In several states, during the last few years, there has been a rather keen development in the textile industry. Recently increasing activity in the development of the Colombian oil fields affords a demand for all the machinery and apparatus necessary in this line of work.

Coming Foreign Trade Convention

Machinery manufacturers generally will doubtless profit greatly from the discussions at the Cleveland convention, May 4 to 7, of the National Foreign Trade Council, where the leaders of the export business will get together for one of the most comprehensive reviews of the foreign trade situation that has ever been held in the United States. American industry, today, as never before, appreciates what an extensive and permanent foreign demand means to industrial production. This convention will attract the leaders of every line of American manufacturing—men familiar, through long years of application, with the various foreign fields. There will be special sessions arranged for various industrial groups, in addition to the regular program, so that each line may have ample opportunity to consider its own peculiar problems and outline a cooperative effort toward their solution.

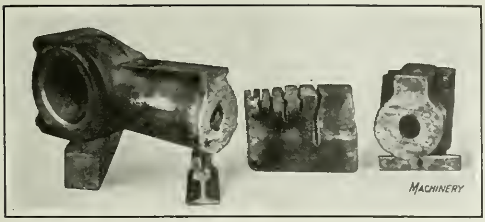


Fig. 1. Crank-arm with Section cut out by Oxy-acetylene Torch

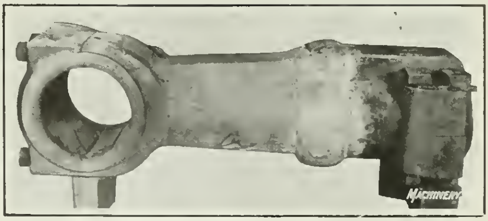


Fig. 2. Crank-arm after being welded by Thermit Process

SHORTENING A PRESS CRANK-ARM

It was recently found necessary in the plant of the New Jersey Tube Co., Harrison, N. J., to equip a drawing press with a crank-arm 18 inches shorter than the one with which the press was provided. This crank was of cast iron and of the hollow cylindrical type, the outside diameter of the cylindrical part being 18 inches. Instead of buying a new crank-arm which would have cost from $350 to $400, the company saved from $200 to $250 by removing the crank-arm from the machine, cutting an 18-inch section out of the crank by means of an oxy-acetylene torch, lining up the two sections in a horizontal position, and then welding the end sections together by the thermit welding process, which cost only $150. The crank with the piece cut out is shown in Fig. 1 as it appeared before welding, and in Fig. 2 as it appeared after the weld had been made.

* * *

EXTERNAL BROACHING ON WRENCH JAWS

On page 501 of the January number of Machinery, was described and illustrated equipment used in performing some interesting broaching work on an adjustable jaw wrench. The present article deals with additional broaching work on the adjustable wrench, the part to be broached being the jaw, which is shown in detail in Fig. 1. It will be noted that the jaws have a cylindrical body, 0.305 to 0.308 inch in diameter, and a connecting web to the main part of the forging. All these surfaces are externally broached, the equipment illustrated in Figs. 2 and 3 being used. It is required to remove from the forging from 0.006 to 0.008 inch of metal on the cylindrical and connecting portions, and on the adjacent surface of the jaw proper there is approximately 1/32 inch of metal to be removed.

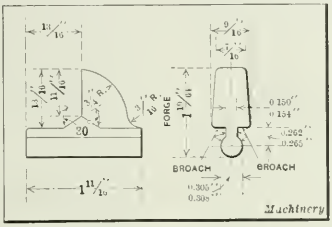


Fig. 1. Wrench Jaw broached on Machine shown in Figs. 2 and 3

In broaching these adjustable wrench jaws, the smaller size broaching machine made by the American Broach & Machine Co., Ann Arbor, Mich., was employed, equipped with a fixture of very simple design. In Fig. 2 the work is shown located in the fixture, between the two broaches, at the beginning of the stroke. The forging is merely dropped in between the two broaches and locates itself in the fixture without auxiliary means. A better view of the fixture and the contour of the edge of the teeth in the broaches, can be obtained from Fig. 3. It will be evident that there are provided merely a seat and a backing for the forging, and that the broaches work close together and thereby enclose the cylindrical part of the forging to the extent required in removing the desired amount of metal. The time required to finish one of these wrench jaws is ten seconds.

* * *

The American Foundrymen's Association has appointed a committee to act in an advisory capacity to the United States Bureau of Standards, with a view to making investigations and promulgating standards for foundry practice.

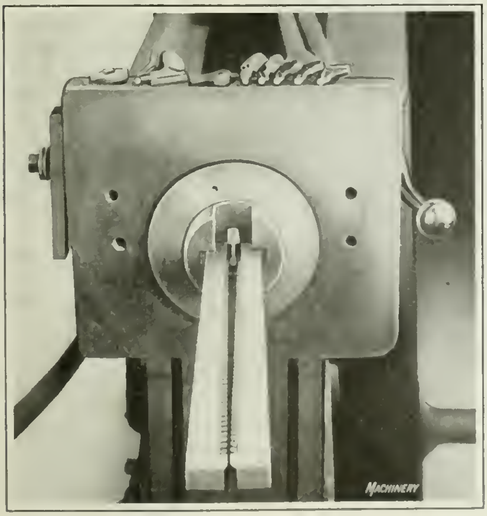


Fig. 2. Broaching Machine with Jaw in Place, before Beginning of Cut

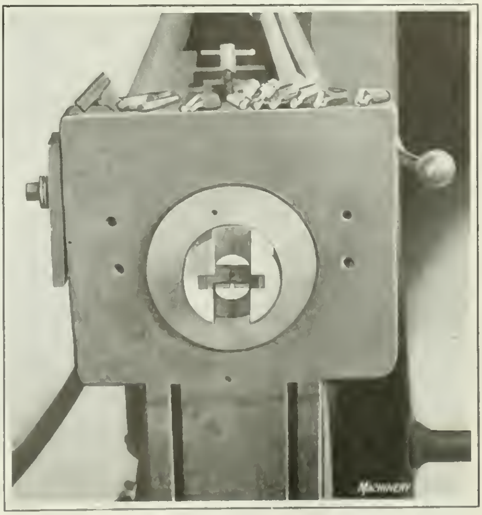


Fig. 3. Broaching Machine at Completion of Cut, with Work removed

CONVENTION NEWS

ANNUAL MEETING OF THE AMERICAN WELDING SOCIETY

The American Welding Society, 33 W. 39th St., New York City, held its annual meeting April 27 to 30 in the Engineering Societies Building, New York City. During the first meeting day, the committees on gas welding, resistance welding, welding wire specifications, and the so-called "welding conference committee" made their reports. The following day the committee on specifications for steel to be welded made its report, and the business session of the society was held. At the technical session, which was held on the evening of the second day, papers were presented on "Applications of the Automatic Welding Machine," by P. O. Noble; "Production Welding with the Gas Flame"; and "Results of Recent Thermit Welding Research," by J. H. Deppeler. This last paper dealt with the standardization of thermit welding practice, the cost and method of elimination of defects in thermit welds, blow-holes, shrinkage cavities, etc. The committees on electric arc welding, welding of storage tanks, and training of operators made their reports during the last two days of the meeting.

AMERICAN GEAR MANUFACTURERS' CONVENTION

The fifth annual meeting of the American Gear Manufacturers' Association was held in Cincinnati, Ohio, April 27 to 30, the headquarters being at the Hotel Sinton. The program of the meeting included an address of welcome by Hon. John Galvin, mayor of Cincinnati; an address by the president, F. W. Sinram; and addresses by J. B. Doan, president of the American Tool Works Co.; G. M. Bartlett of the Diamond Chain & Mfg. Co.; Hon. George Wilder Cartwright, Senator from California; Edward S. Jordon, president of the Jordon Motor Car Co.; Charles Woodward, vice-president in charge of personnel of the Hydraulic Steel Co.; A. R. Mitchell of the Andrews Steel Co.; and J. B. Foote, president of Foote Bros. Gear & Machine Co.

Reports were presented by various committees including the Commercial Standardization Committee, C. E. Crofoot, chairman; Committee on Worms, Worm-gears and Spirals, J. C. O'Brien, chairman; Inspection Committee, E. J. Frost, chairman; Sprocket Committee, C. R. Weiss, chairman; Hardening and Heat-treating Committee, C. B. Hamilton, chairman; Composition Gearing Committee, John Christensen, chairman; Herringbone Gear Committee, A. F. Cooke, chairman; Committee on Gears and Pinions—Electrical Railway and Mine, W. H. Phillips, chairman; Keyway Committee, Henry J. Eberhardt, chairman. On the last day of the convention there was an interesting discussion on the subject of testing and inspecting large and medium size industrial gears. A more complete report of the meeting will be given in June MACHINERY.

CONVENTION OF THE NATIONAL METAL TRADES ASSOCIATION

On April 20 and 21, the twenty-third annual convention of the National Metal Trades Association was held at the Hotel Astor, New York City. The first meeting was convened at 9:30, and after the usual preliminaries, reports were read by President Albert E. Newton, Treasurer Frank C. Caldwell, Commissioner John D. Hibbard, and Secretary Homer D. Sayre. Following these came the report of the Committee on Industrial Education read by its chairman, Harold C. Smith of the Illinois Tool Works, Chicago, Ill. William S. Kies of Aldred & Co., New York City, then addressed the convention on "Economic Conditions in Europe and How They Affect Us." Mr. Kies called attention to the fact that America's industrial prosperity is largely dependent upon the re-establishment of normal conditions in Europe. He emphasized the importance of adopting an aggressive and liberal policy in developing export trade.

A. T. Simonds of the Simonds Mfg. Co., Fitchburg, Mass., opened the afternoon session with an address entitled "Quit Deceiving Yourself." Mr. Simonds prefaced his discussion with a statement that for years the study of economics had been one of his favorite hobbies, and he went on to say how greatly a comprehensive knowledge of this subject had helped in the management of his business. M. W. Alexander, managing director of the National Industrial Conference Board, New York City, followed Mr. Simonds with a discussion of "Timely Industrial Problems." His address dealt with factors which affect the wages paid to industrial employes and was illustrated by charts. The Hon. Charles L. Underhill, Member of Congress, Somerville, Mass., addressed the convention on the subject of "Labor Unions in Time of War."

The Thursday morning session was called to order at 9 o'clock and was addressed by the Rev. E. Victor Bigelow, Andover, Mass., on "Mistakes of the Inter-Church Steel Report." Following this address came a discussion of practical methods of industrial training. This included the annual report of Philip C. Molter, superintendent of the Department of Industrial Training of the National Metal Trades Association, and addresses entitled "Our Experience with Training," by George A. Seyler, works manager of the Lunkenheimer Co., Cincinnati, Ohio; "Modernized Apprenticeships," by J. E. Goss, supervisor of apprentices, Brown & Sharpe Mfg. Co., Providence, R. I.; and "Recent Developments in Training Instructor Foremen and Plant Leaders," by D. J. MacDonald, professor of vocational education, University of Cincinnati, Cincinnati, Ohio.

The officers of the association for the coming year will be: President, Albert E. Newton, Hobbs Mfg. Co., Worcester, Mass.; first vice-president, George O. Rockwood, the Rockwood Mfg. Co., Indianapolis, Ind.; second vice-president, W. W. Coleman, Bucyrus Co., South Milwaukee, Wis.; treasurer, F. C. Caldwell, H. W. Caldwell & Son Co., Chicago, Ill. These men were all re-elected to the offices which they held for the year 1920-1921. Justus H. Schwacke, William Sellers & Co., Inc., Philadelphia, Pa., was elected an honorary counsellor in recognition of the able service which he has rendered to the association over a long period of years.

* * *

TESTS FOR COLLEGE STUDENTS

The Dartmouth College has instituted a new system of tests for undergraduates, having recognized in common with a number of other colleges the fact that a student's scholarship is not necessarily an accurate indication of his ability to cope with the difficulties of his profession. These tests are general and personal, but are not like the psychological tests which certain other colleges have been giving. Under this system the instructors rate each of their students, using the regular letter scale (A, B, C, D, E, with A the highest), under the following headings:

1. Intelligence—Ability to grasp a situation, alertness of mind. (Not to be confused with scholarship.)
2. Aggressiveness—Personal force, initiative, assurance, decisiveness.
3. Reliability—Dependability, sense of responsibility, perseverance, attentiveness, punctuality.
4. Personality—Bearing, neatness, courtesy, personal acceptability.

Nearly every man in the college was rated by one or more instructors, about 1500 being rated by from three to five. It was found that four men in every five created almost exactly the same impression upon all their judges. Since the agreement was so great and the facts valuable, the plan will be continued this year.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool Descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Alfred Herbert Thread-cutting Lathe. Alfred Herbert, Ltd., 54 Dey St., New York City 899

Whipp 12-Inch Crank Shaper. Whipp Machine Tool Co., Sidney, Ohio 900

Morton Railroad Shaper. Morton Mfg. Co., Muskegon Heights, Mich. 901

Johnson & Miller Universal Center-tester. Johnson & Miller, 42 Murray St., New York City 902

Van Keuren Plug Gages. Van Keuren Co., 362 Cambridge St., Allston Station, Boston, Mass. 902

Toledo Double-screw Press. Toledo Machine & Tool Co., Toledo, Ohio 902

Newton Special Straddle-milling Machine. Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. 903

Ames Dial Comparator. B. C. Ames Co., Waltham, Mass. 903

Reed-Prentice Suspension Drilling Machine. Reed-Prentice Co., 677 Cambridge St., Worcester, Mass. 904

Universal Thread Milling and Grinding Machine. Automatic Machinery & Equipment Co., 1110 Land Title Bldg., Philadelphia, Pa. 904

Jacobs Drill Chuck. Jacobs Mfg. Co., Hartford, Conn. 905

Winfield Electric Butt Welder. Winfield Electric Welding Machine Co., Warren, Ohio 905

Wilson Planer Improvements. Morley Machinery Corporation, 215-217 N. Water St., Rochester, N. Y. 906

Hendey Duplex Centering Machine. Hendey Machine Co., Torrington, Conn. 906

Fosdick Upright Drilling Machine. Fosdick Machine Tool Co., Cincinnati, Ohio 906

O-Z Cutmeter. O. Zernickow, 15 Park Row, New York City 906

Bath "Easy-cut" Ground Taps. John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. 907

J. N. Lapointe Keyway-broaching Set. J. N. Lapointe Co., New London, Conn. 907

Anderson Hand Scraper. Anderson Bros. Mfg. Co., 1910 Kishwaukee St., Rockford, Ill. 907

Hinckley-Myers Cylinder Reboring Mill. Dearborn Equipment and Hinckley-Myers Co., 6 N. Michigan Blvd., Chicago, Ill. 908

Bardons & Oliver Piston-turning Machine. Bardons & Oliver, Cleveland, Ohio 908

American Electric Spot-welders. American Electric Fusion Corporation, 1906 N. Halsted St., Chicago, Ill. 908

Van Dresser Cylinder Reboring Tool. International Purchasing & Engineering Co., 1558 Penobscot Bldg., Detroit, Mich. 909

Badger Piston-ring Grinder. Badger Tool Co., Beloit, Wis. 909

Randa Reamer and Counterbore Holder. Randa Mfg. Co., 1316 E. Jackson St., Muncie, Ind. 910

Cincinnati Leveling Wedges. Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio 910

Eastern Automatic Drill Chuck. Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y. 910

Rockford Geared-head Lathe. Rockford Lathe & Drill Co., 1827 Fourteenth Ave., Rockford, Ill. 910

Adjustable Tap Wrench. Consolidated Tool Works, Inc., 296 Broadway, New York City 911

Cogsdill Center Drill. Cogsdill Mfg. Co., 5132 Grand River Ave., Detroit, Mich. 911

Alfred Herbert Thread-cutting Lathe

THE production of thread gages with any style of thread may be accurately accomplished on a precision lathe recently developed by Alfred Herbert, Ltd., Coventry, England, who maintains a branch office at 54 Dey St., New York City. A general view of the machine is shown in Fig. 1, from which it will be seen that the bed is of box section and rests on three ball feet secured to the base in such a manner as to allow the bed to expand and contract with changes of temperature. This construction and mounting of the bed eliminates warping, springing, and vibration.

The headstock is provided with a three-step cone pulley, on the shaft of which there is mounted a pinion that meshes with teeth on the periphery of the driving plate to rotate this member. The left-hand end of the driving plate spindle is provided with a pinion that drives the lead-screw through a train of change-gears. The work-center does not revolve. The tailstock is provided with a fine adjustment across the bed so as to maintain the alignment of centers. The sleeve that carries the tailstock center is clamped in position through the operation of a handle, and it is prevented from turning through the employment of a suitable device.

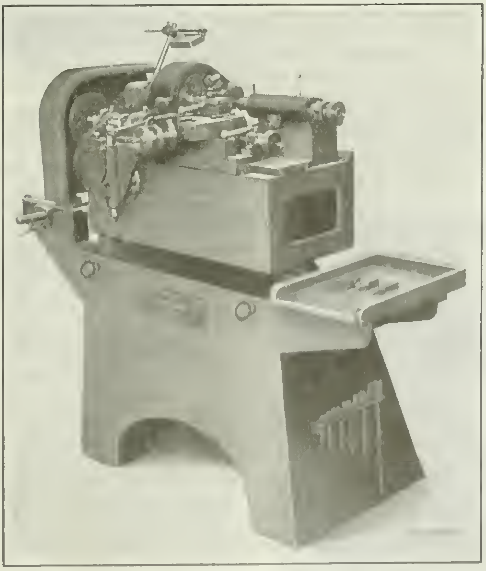


Fig. 1. Lathe for cutting Thread Gages, which is built by Alfred Herbert, Ltd.

Construction of the Saddle

From Fig. 2 it will be seen that the saddle is of ample length to obviate any tendency to lift or twist. There are two slides on the saddle, a top slide and an intermediate one. The tool is held in an eccentric bushing on the top slide, the eccentricity of the bushing allowing the tool to be adjusted to the correct height. A micrometer dial reading to 0.0001 inch is provided to enable the tool to be fed accurately to the correct depth of cut. A nut on this feeding mechanism is adjustable to compensate for wear of the micrometer screw. The intermediate slide has a longitudinal micrometer adjustment for setting the tool relative to the required length of the work, and it is then locked in position by means of a handle. A gear segment actuated by a lever and meshing with a rack on the top slide is furnished on the intermediate slide for the purpose of withdrawing the tool quickly when reversing, or bringing it rapidly up to the work.

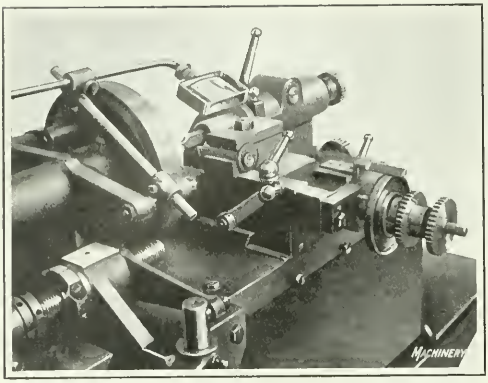


Fig. 2. Construction of Saddle, and Method of attaching it to Lead-screw

Accuracy of the Lead-screw

The lead-screw is located above and between the V-guides of the saddle, as shown in Fig. 3. In order to insure the accuracy of this important member, the lead-screw is cut on a lathe which is provided with a lead-screw correct over its entire length of 24 inches to within 0.0002 inch. The lead-screw of the Alfred Herbert precision thread-cutting lathe is 6 inches long and has eight square threads per inch. The thrust on the lead-screw is taken by a bracket doweled to the top of the bed at the left-hand end. Instead of the usual split nut, a solid phosphor-bronze nut is used for transmitting motion to the saddle. The threads are cut in a renewable white-metal lining cast in the nut opening.

Pitch-varying Attachment

In the production of thread gages, it is necessary to make certain allowances to compensate for shrinkage or elongation of the part during the hardening process. The proper allowances can be readily made on this machine by means of the pitch-varying attachment illustrated in Figs. 3 and 4. The desired result is obtained by rotating the lead-screw nut with a uniform motion independent of that of the lead-screw. If the rotation of the nut is opposite to that of the lead-screw, the pitch of the thread being cut will be longer than would be obtained if the nut were stationary. This increase in the pitch will be greater as the amount of movement of the nut relative to the screw per revolution of the lead-screw is increased. If the nut revolves in the same direction as the lead-screw, the conditions will be reversed, and the pitch of the thread which is being cut will be shortened. Very little time is required to make the adjustment necessary to lengthen or shorten the pitch of a thread.

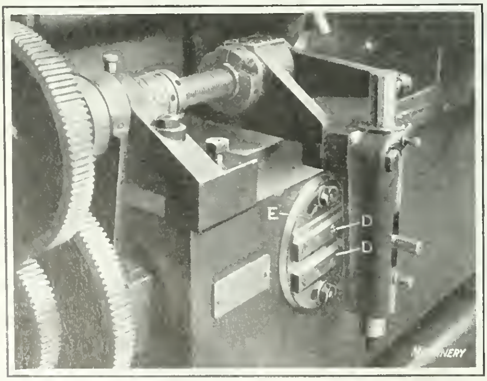


Fig. 3. Attachment for increasing or decreasing Pitch of Screw

Referring to Fig. 4, it will be seen that the attachment consists mainly of a bracket *A* attached to the saddle and carrying a plunger *B* which is provided with a hardened steel plug *C*. One end of this plug travels in a slot formed by two strips *D* (see Fig. 3) which are made of hardened steel and fastened to disk *E* attached to the bed of the lathe. This disk can be swiveled either way to give the plug slot the required amount and direction of inclination. A small portion of the disk edge is graduated, each graduation indicating an increase or decrease in the lead of the thread being cut, of 0.0001 inch per inch of the lead-screw length. The lead-screw nut has a projecting arm *F* which is provided at the outer end with a hardened pin that engages a slot cut horizontally across the upper end of plunger *B*. As the plunger is raised or lowered, according to the slope of the central slot, when the saddle is traversed, the speed of the saddle is increased or retarded, as the case may be, relative to the motion of the lead-screw.

Special Jig for Grinding Tools

In the cutting of threads, many of the errors are due to the use of an improperly ground tool. To eliminate this source of error, a specially designed fixture is furnished with the machine, which permits tools to be readily ground to the desired angles. The machine described in the foregoing has a capacity for work up to 2½ inches in diameter, will hold work from 3 to 6 inches in length, and will cut threads to a length of 3 inches. One horsepower is required for driving the machine, and its weight is approximately 1600 pounds.

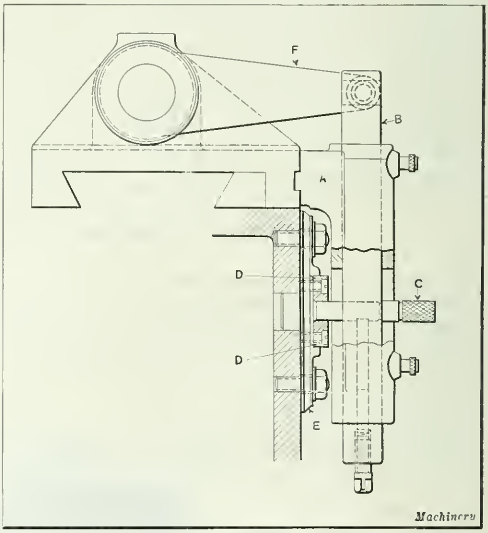


Fig. 4. Pitch-varying Attachment shown diagrammatically

WHIPP 12-INCH CRANK SHAPER

In the June, 1920, number of MACHINERY was published a description of 16-inch single-geared and 20-inch back-geared crank shapers then placed on the market by the Whipp Machine Tool Co., Sidney, Ohio. This concern has now developed a 12-inch single-geared crank shaper which is of essentially the same design as those dealt with in the article mentioned. On the new machine the maximum length of stroke is 14 inches; the horizontal travel of the table, 18 inches; the vertical travel of the table, 14 inches; the maximum distance from the table to the ram, 16 inches; the keyseating capacity, for shafts up to 2½ inches in diameter; and the maximum opening of the vise jaws, 8 inches.

MORTON RAILROAD SHAPER

The special heavy-duty draw-cut railroad shaper here illustrated was developed by the Morton Mfg. Co., Muskegon Heights, Mich., primarily for the machining of driving-boxes, crown brasses, shoes and wedges, connecting-rod brasses, etc. However, it may be employed for the performance of various classes of work. The column is a heavy box-section casting provided with square bearings for the cross-rail. The latter is raised and lowered by screws, and can be clamped in position. A counterweight is furnished for the cross-rail on account of the weight of special attachments that are used on this machine. The saddle is fitted to square rail bearings on the cross-rail. Two sides of the table are provided with T-slots, the upper one furnishing a bolting surface for the vise, top table, and attachments. An angular extension bolts to the other T-slotted surface to facilitate the clamping of driving-boxes when machining the shoe and wedge fit.

The vise is so constructed that the cutting strains are transferred through the solid vise jaw to a back-bearing and the collar. Two screws control the motion of the sliding jaw. The stationary jaw has parallel planed ends which can be set snugly against the adjustable back-bearing. The base of the vise is graduated through 180 degrees. The adjustable back-bearing is mounted on a post bolted to the cross-rail. It may be moved vertically to the desired position or swung to one side and out of the way when using special attachments. An auxiliary back-bearing is bolted to the top of the machine for transferring the thrust of the cut to the column when using the driving-box attachment furnished as regular equipment.

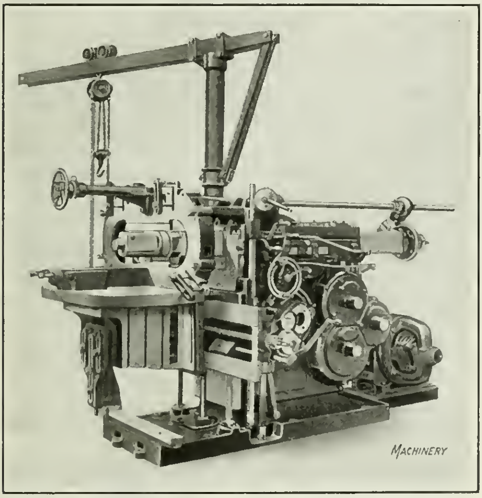


Fig. 1. Heavy-duty Draw-cut Railroad Shaper which is a Product of the Morton Mfg. Co.

The ram is hollow and has a bearing surface on all four sides throughout the length of the column, except for a small space at the center where the rack is lubricated. The ram is bored at each end to receive an arbor. A rotating arbor gives the circular feed to the rotating head for cutting the crown fit in driving-boxes, the head being mounted on the front of the arbor. The rotary feed of the latter is obtained from the regular automatic feed by means of a gear and ratchet working in connection with a vertical rack. The rotary motion is transmitted through a splined shaft and gears to the arbor, which may be fed automatically in either direction. The shaper head is graduated and may be set at any angle by means of a suitable clamping device

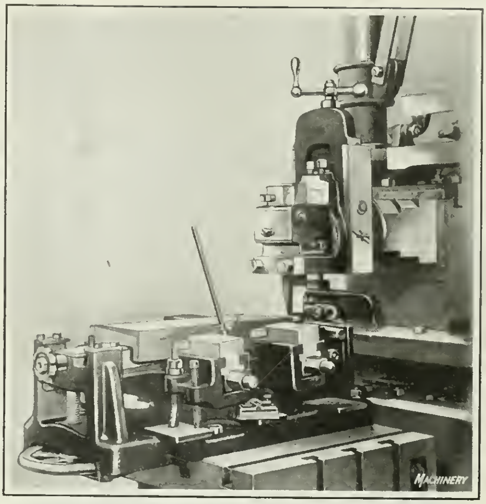


Fig. 2. Special Attachment used in machining Wedges

The reciprocating motion of the ram is obtained by the use of compound disk friction clutches. A simple shifting bar and revolving cam reverse the clutches for the return stroke. The machine can be started and stopped by a clutch independent of the driving motor, and the ram can be moved as little as 1/16 inch if desired. The ram stroke is adjusted by tappets on a circular disk and can be altered while the machine is in operation.

A rapid power traverse is provided for raising and lowering the cross-rail and moving the saddle sidewise in either direction. Any horizontal or vertical feed within a wide range is obtained quickly by setting tappets on a disk. A belt-driven machine is furnished with a two-speed countershaft. A motor drive for either direct or alternating current can be furnished. The crane and hoist are furnished as regular equipment to facilitate the handling of the vise, attachments, and work that is too heavy to be loaded and unloaded by hand. Some of the special attachments which may be furnished are as follows: Shell or crown brass planing attachment, driving-box shoe and wedge planing attach-

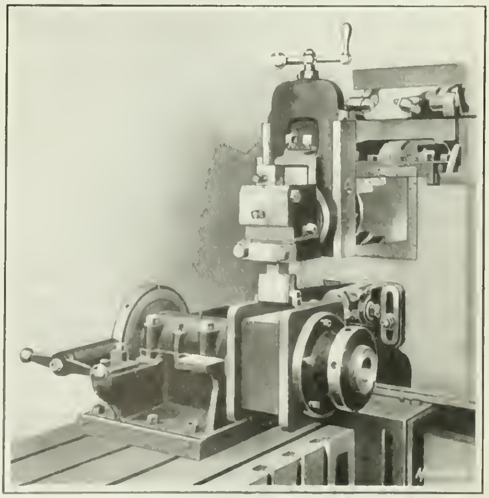
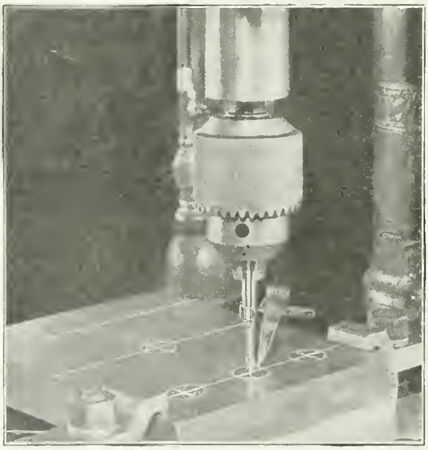


Fig. 3. Attachment employed in machining Connecting-rod Brasses

ment, connecting-rod brass planing attachment, small rotary head, and double cutting head. The driving-box shoe and wedge planing attachment is shown in use in Fig. 2, while Fig. 3 shows the method of employing the connecting-rod brass planing attachment.

JOHNSON & MILLER UNIVERSAL CENTER-TESTER

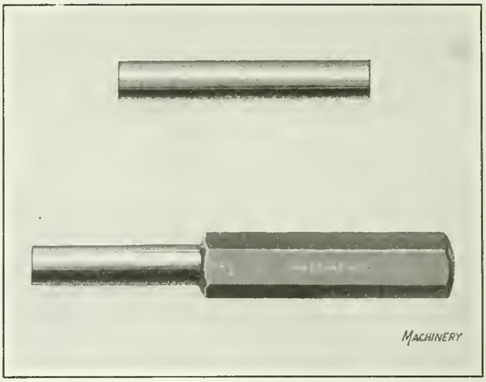
The illustration shows an "Ideal" universal center-tester being employed in locating a prick-punch mark on a piece of work, central with the spindle of a drilling machine. This device has recently been placed on the market by Johnson & Miller, 42 Murray St., New York City, and is used in connection with their "Ideal" universal test indicator. When employing the tester as shown, the center rod is placed on the prick-punch mark. Then, as the spindle of the machine is rotated, if the prick-punch mark is not central with the machine spindle, this condition will be apparent, due to the indicator contact point tracing an eccentric circle about the center rod. The work is then shifted until the contact point of the indicator rotates on the center rod without causing deflection of the indicator needle. This tester may also be used to locate a prick-punch mark central with the spindles of milling and boring machines, for truing up marks on work on the faceplate of lathes, etc.


Use of the "Ideal" Center-tester sold by Johnson & Miller

VAN KEUREN PLUG GAGES

A line of precision plug gages of unusually simple construction has recently been placed on the market by the Van Keuren Co., 362 Cambridge St., Allston Station, Boston, Mass. One of these gages is shown in the accompanying illustration, the lapped cylinder being shown at the top, and the cylinder inserted in the hexagonal handle, at the bottom. The cylinder is placed in the handle for about one-third its length and cemented therein with shellac. It is stated that by this method the two parts are held so securely together that if the plug is clamped between the jaws of a vise and a wrench applied to the handle, the plug will not become loosened. However, in order that both ends of the plug may be used, the plug may be readily removed from the handle when the exposed end is worn, after heating the handle in a flame to about the temperature of boiling water. The worn end is then secured in the handle.

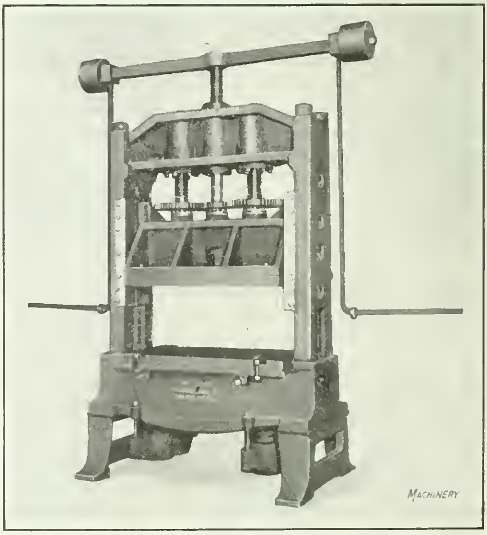
It is claimed that by means of a special process of manufacture, an extremely accurate plug is obtained. A ¼-inch plug tested by the Bureau of Standards was only out of round two millionths inch; at the middle it was within four millionths inch of the exact size, while close to the ends it was correct within three hundred thousandths inch. These gages are made in standard sizes up to ½ inch in diameter. A different handle is provided on larger sizes.



Reversible-end Plug Gage made by the Van Keuren Co.

TOLEDO DOUBLE-SCREW PRESS

To meet the demand for a screw press of sufficient capacity to try out blanking, forming, drawing, stamping, and other dies for sheet metal, which are too large for the ordinary single-screw press, the Toledo Machine & Tool Co., Toledo, Ohio, has designed and built the large double-screw press shown in the accompanying illustration. The frame is of the four-piece tie-rod construction, which is a design commonly employed for presses to be used under heavy stresses. The machine is equipped with two 4-inch diameter screws, and the bed is arranged with a powerful spring-pressure drawing attachment intended for use in trying out combination and deep forming dies. Some of the principal dimensions of the press are as follows: Top of bed, 30 by 54 inches; opening in bed, 20 by 48 inches; slide face, 24 by 49 inches; minimum height of slide from top of bed, 14½ inches; maximum height, 32½ inches; thickness of bolster plate, 2½ inches. The weight is about 14,000 pounds.



Double-screw Press designed and built by the Toledo Machine & Tool Co.

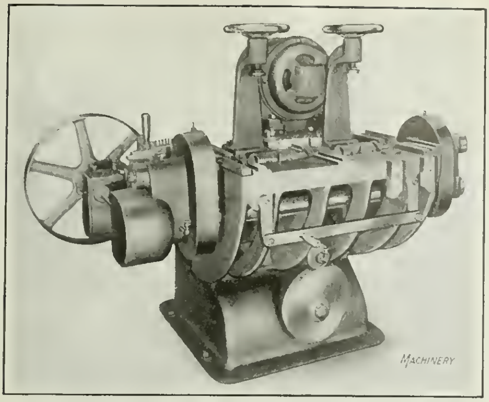


Fig. 1. Special Type of Straddle-milling Machine built by the Newton Machine Tool Works, Inc.

NEWTON SPECIAL STRADDLE-MILLING MACHINE

A special type of straddle-milling machine for facing the crankshaft bearings of crankcases with the caps removed, and at the same time milling the oil slinger groove, has been developed by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. This machine is shown in Fig. 1 unloaded, while Fig. 2 shows a crankcase being machined and a completed one lying at the base of the machine; in the latter illustration, the motor is not in place. The table is raised and lowered successively when the machine is in operation, being actuated by a cam provided with a slow feed and a quick return as on the machine in Fig. 1, or by an eccentric crank as in Fig. 2. Loading and unloading of the work is done at the top of the stroke, at which time it is intended that the table will be in line with a conveyor system.

The table is provided with hardened steel jig plates and with locating pins that are raised and lowered by means of the lever shown extending across the front of the machine. As a result of this arrangement, there are no obstructions preventing the free mounting and removing of work. The crankcase is clamped in place through the use of two overhead clamps which are operated by handwheels. The cutter mandrel is driven from both ends, and is adequately supported between cutters by bearings.

Eight cutters are required for milling the crankcase shown in Fig. 2, three bearings being faced on both sides, thus requiring six cutters; another cutter is necessary for machining the oil slinger groove; and a small cutter is provided for finishing the bore of this groove. The production obtained on this operation is twenty-five pieces per hour. Spacing collars giving a variation of 0.002 inch are provided for holding sets of cutters the proper distance apart. Provision is also made so that the rate of feed or the time consumed by the cycle of one operation may be increased or decreased, according to whether the machine is being used on cast iron or aluminum. A larger machine of the same general construction is built for performing an identical operation on crankcases without removing the bearing caps.

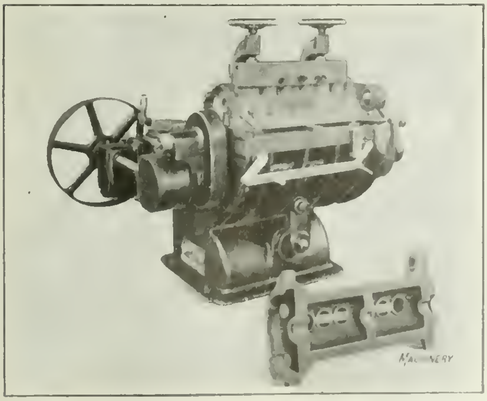
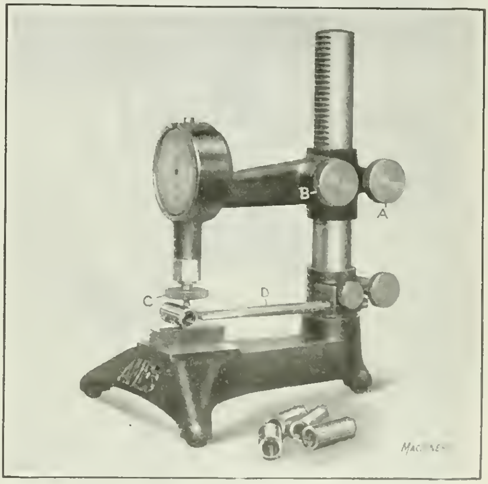


Fig. 2. Machine in Use straddle-milling the Crankshaft Bearing Faces and Oil Slinger Groove of a Crankcase

AMES DIAL COMPARATOR

The B. C. Ames Co., Waltham, Mass., has added a dial comparator to its line of dial gages, which is intended for use in measuring bushings, pins, shafts, plates, and other parts ordinarily checked by micrometers. With this instrument the personal element does not enter into the operation, as the gage is controlled by a spring. All parts are protected from dust, and all bearings are hardened and ground. The dial of the gage is 1⅞ inches in diameter and is graduated to 0.0005 inch, each graduation space being 1/16 inch wide, and so readings of one-quarter of a thousandth inch can readily be approximated. In using this gage the knurled handle *A* of a clamping screw is loosened, and the arm supporting the dial is raised or lowered by rotating the knurled head *B* which is mounted on a pinion shaft, until the contact point of the gage touches the work or a standard placed on the anvil.



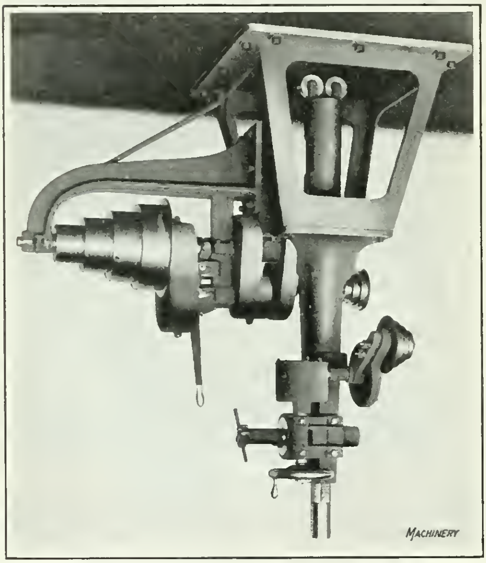
Dial Comparator developed by the B. C. Ames Co.

The clamp is then tightened and the indicator of the gage brought to zero by turning the knurled screw *C* either to the right or left The gaging point has a travel of ¼ inch, so that although the instrument is set to a 0.500-inch standard, it will measure from that dimension to 0.750 inch. This feature makes it useful for the measuring of parts of more than one diameter. A stop *D* is furnished to permit the rotation of work under the contact point in order to ascertain the amount that a part is out of round, etc. Two hardened and ground anvils are furnished with each gage, one of them being ½ inch wide by 2 inches long, while the other is 2 inches square and grooved. Special anvils can readily be made to fit the groove in the base. The comparator is 10½ inches high and weighs 10 pounds.

REED-PRENTICE SUSPENSION DRILLING MACHINE

An unusual departure in drilling machine design has been made in the machine here illustrated, which is a development of the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass. The machine is intended to be suspended from a ceiling or overhead beams. Its peculiar field is the drilling of work of cumbersome size, and so it is used extensively by manufacturers of electrical equipment for the drilling of switchboard slates, and in boiler shops and sheet metal works. The frame is sufficiently rigid so that no truss rods are required for its support.

The spindle is counterbalanced and is provided with power feed and a quick-return movement. Three feed changes are furnished regularly; but, if desired, change-gears may be supplied to give any required rate of feed. The lever for operating the back-gears can be furnished in any desired length. A countershaft is provided in addition to the equipment shown in the illustration. The machine has a capacity for drilling holes up to about 2 inches in diameter in cast iron. The spindle is provided with a No. 4 Morse taper hole. The vertical traverse of the spindle is 19 inches, and the distance from the ceiling to the lower end of the spindle, when it is at its maximum height, is 68 inches. The weight of the machine is approximately 1800 pounds.



Ceiling Drilling Machine developed by the Reed-Prentice Co.

UNIVERSAL THREAD MILLING AND GRINDING MACHINE

The universal thread miller and grinder here illustrated was recently developed by the Automatic Machinery & Equipment Co., 1110 Land Title Bldg., Philadelphia, Pa., for milling and grinding worms and threads. It can also be used for milling, fluting, and grinding taps in one setting, for cutting gears and ratchets, for splining shafts, etc. The entire mechanism is mounted on a cast-iron tilting base which is mounted on another cast-iron base that may be attached to the cross-slide of a lathe as shown. A constant-speed motor of 1724 revolutions per minute is mounted directly on the tilting base and is connected to the main driving shaft through sliding helical gears of combinations permitting grinding wheel speeds of 6900 revolutions per minute for internal grinding, and 1725 revolutions per minute for external grinding, and thread milling cutter speeds of 86 and 344 revolutions per minute.

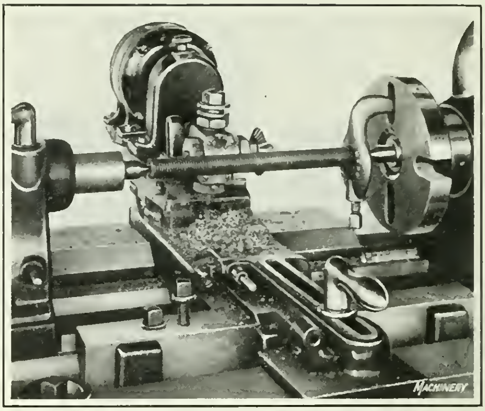


Fig. 1. Thread Milling and Grinding Machine produced by the Automatic Machinery & Equipment Co.

The cutter-head carries two spindles at right angles to each other. When one is held in a horizontal position, the other is in a vertical position. One of these spindles is intended for carrying the grinding wheels, while the thread milling cutters are mounted on the other. The grinding wheel spindle is so arranged that a wheel may be carried on either end, thus making it possible to come close to a shoulder without interference. A cutter can also be carried on either end of the thread milling cutter spindle. The cutter-head swivels through an arc of 360 degrees to permit either of the spindles to be brought into the working position and to provide for tilting the head to suit the helix angle of the thread being ground or milled. Fig. 1 shows a thread being milled, while Fig. 2 shows a thread being ground. An extension spindle is provided for the accomplishment of internal grinding operations.

The cutter-head is of compact design, the grinding spindle being driven from the driving shaft by a pair of tool-steel miter gears. The grinding spindle, in turn, has a tool-steel single-pitch worm which engages a tool-steel worm-wheel on the thread milling cutter spindle and rotates the latter. The cutter-head contains five thrust bearings, two for both the grinding wheel and milling cutter spindles and one on the driving shaft behind the miter gear. The grinding wheel and milling cutter spindles are supported by bronze

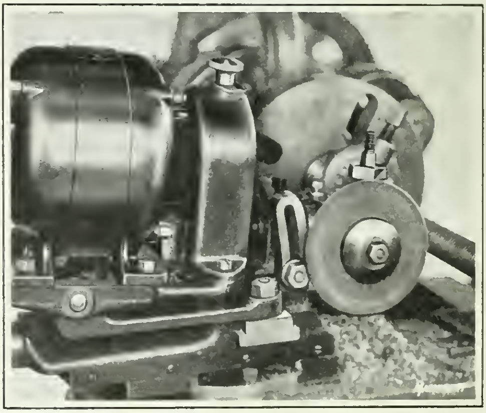


Fig. 2. Device being used for grinding a Threaded Part, the Milling Cutter Spindle being in a Vertical Position

split taper bearings which can be adjusted for wear. The cutter-head is filled with oil for lubricating the gears and bearings. The driving motor may be furnished to suit any current; normally, a 1/6-horsepower motor is furnished, but the base will accommodate a ¼-horsepower motor if such a size is desired. A diamond truing device is furnished for dressing the grinding wheel to any desired angle. The entire equipment measures 8 inches in height, 6 inches in width, and 14½ inches in length. The weight is about 45 pounds.

JACOBS DRILL CHUCK

Improvements that are said to have greatly increased the efficiency have been made on what is known as the "Super" drill chuck produced by the Jacobs Mfg. Co., Hartford, Conn. While the outward appearance of this improved chuck is quite similar to that of the old design, as will be apparent to users by reference to Fig. 1, it will be seen from Fig. 2 that the internal construction is considerably different. Body *A* is made from a steel of special analysis and deeply casehardened through a process in which the taper hole *B* is left soft, thus adapting the chuck for use on a hardened and ground arbor. The threaded plug *C*, placed in the hole tapped through the center of the body, may be easily removed by a screwdriver to permit the insertion of rods, etc., through the chuck.

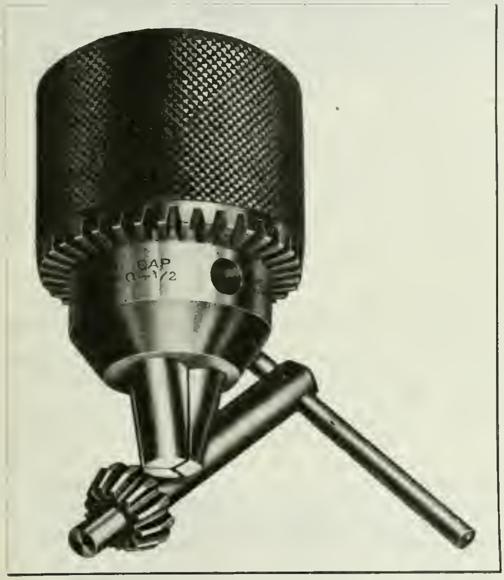


Fig. 1. "Super" Drill Chuck made by the Jacobs Mfg. Co.

A ball bearing inserted between nut *D* and the body reduces the friction between these members to a minimum, and makes it possible to provide a coarser pitch thread on the nut and jaws than was previously used. The reduction of friction between the nut and body also makes it possible to tighten the chuck with greater ease than formerly, and so considerably lessens the wear of keys, sleeves, and other parts. An oil-hole provided in the back end of the body permits the lubrication of all working parts. It is said that an actual test has shown that on the new chuck the pressure required on the key in tightening the chuck to produce the same results as in chucks of the previous design, is only one-half of that formerly necessary. The change in the pitch of the thread on the jaws and nut has also resulted in reducing to one-half, the number of turns of the sleeve necessary to tighten or loosen the chuck jaws. The weight of a chuck of the improved type is the same as that of one of the original design.

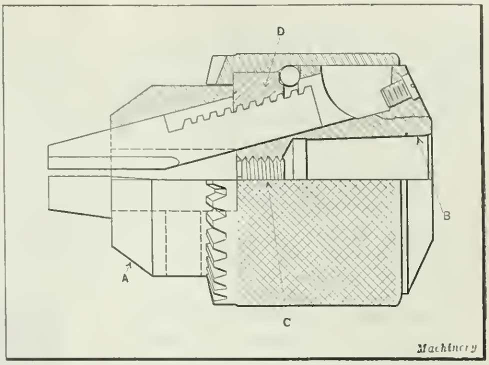


Fig. 2. Construction of Improved Jacobs Chuck

WINFIELD ELECTRIC BUTT WELDER

The accompanying illustration shows an electric butt welder designed for welding high-speed drills, which is a product of the Winfield Electric Welding Machine Co., Warren, Ohio. The construction is such that no flash from the weld can get into moving parts and bearings. One set of four welding dies is furnished with a machine. The lower dies are made of copper and the upper dies of tool steel. They are located at the front of the machine to permit work to be readily placed in them and also to bring the welding point away from the bearings and slides. The work is clamped in the dies by means of hardened steel cams, operated by clamping levers placed well back of the dies and clear of the flash. A single-toggle hand-lever is used for upsetting the weld.

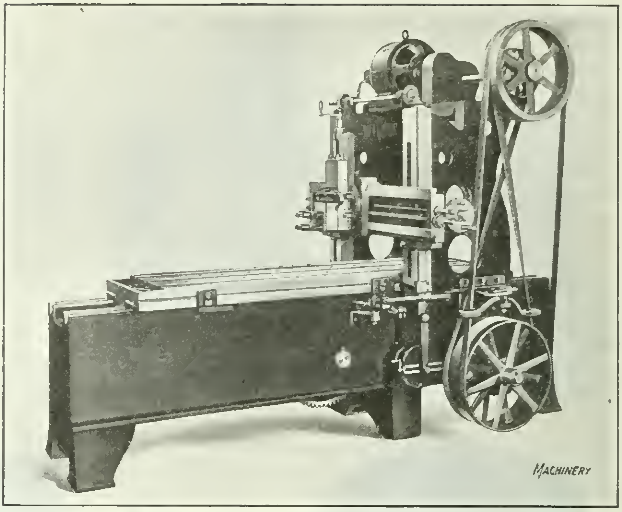
The left-hand slide is adjustable in order to regulate the amount of take-up in welds, and also for aligning the work in all directions. Adjustable stops are provided for backing up the work. The electric switch is located on the hand-lever and operates semi-automatically. It is set by means of a thumb-latch, and is automatically tripped when a weld is completed. Water is circulated through all-copper terminals, and it is unnecessary to break the water connec-

Electric Butt Welder developed by the Winfield Electric Welding Machine Co.

tions when changing dies. The machine has a capacity for welding stock from ¼ to ¾ inch in diameter or other shapes having an equivalent cross-sectional area. A 15-kilowatt transformer is part of the equipment. The weight of this butt welder is approximately 1000 pounds.

WILSON PLANER IMPROVEMENTS

A number of improvements have been made to the line of Wilson planers now being manufactured by the Morley Machinery Corporation, 215-217 N. Water St., Rochester, N. Y. The ends of the bed have been squared, and this member has also been strengthened. Additional support has been provided under the uprights, wider bearing surfaces on the cross-rail, steel racks in place of cast-iron ones, and a simple but rugged arrangement for a plain motor drive. A support is furnished on the uprights of all planers, whether the latter are belt- or motor-driven, so that a belt-driven machine may be readily converted to be driven by motor if a customer should so desire.

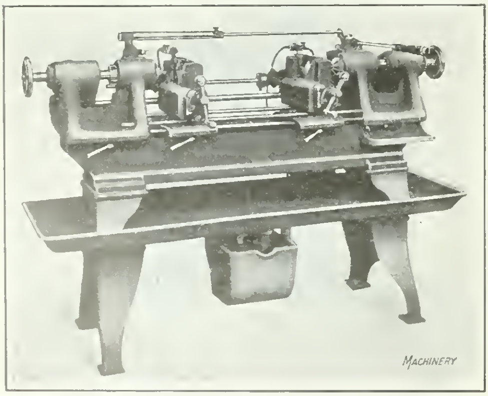


Improved Line of Planers built by the Morley Machinery Corporation

HENDEY DUPLEX CENTERING MACHINE

The Hendey Machine Co., Torrington, Conn., has recently produced the centering machine here illustrated, which is provided with two headstocks and two vises to permit the simultaneous drilling and countersinking of both ends of the work. Each head is driven by a sprocket and chain from a shaft extending the length of the machine at the rear, this shaft being driven from a pulley connected to an overhead countershaft or from a motor bolted to the bed. The driving shaft is supported by sliding pillow-blocks, which furnish the necessary tension on the driving chain.

The rear housing of each headstock is provided with two radial-thrust ball bearings on which the sleeve of the upper of the chain sprockets rotates, the load of the drive being thus taken by these bearings. The front housing carries a sleeve with a taper bearing for the spindle and ball thrusts. The hardened and ground steel jaws of the vise have a total width of grip of 1½ inches. The rear jaw is screwed to the sliding block under spring tension so that the jaw has a floating alignment and insures that the front jaw will be held rigidly in position and govern the aligning of the work with the corresponding drill spindle. The rear jaw serves only as a clamping member. It is stated that the alignment of the jaws is sufficiently accurate to center the work to within 0.001 inch. A motor of ½ horsepower is recommended for the machine when a motor drive is desired. The machine can be furnished with beds varying from 5 to 12 feet in length, the maximum distance between spindles of a five-foot bed being 30 inches.



Duplex Centering Machine manufactured by the Hendey Machine Co.

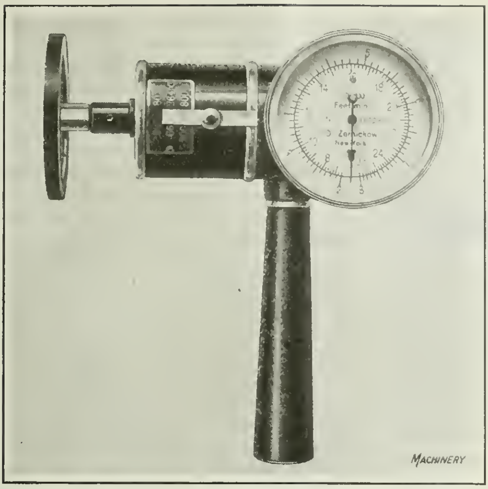
FOSDICK UPRIGHT DRILLING MACHINE

The Fosdick Machine Tool Co., Cincinnati, Ohio, has just placed on the market a heavy-duty upright drilling and tapping machine which has a capacity for drilling to the center of a 21-inch circle. This machine is of similar design to the 25-inch machine described in the September, 1919, number of MACHINERY. On the 21-inch machine, the maximum distance from the base to the spindle is 49½ inches; the maximum distance from the table to the spindle, 33 inches; the spindle traverse, 11 inches; the sliding-head traverse, 22 inches; and the net weight, 2100 pounds. The machine may be built in styles having from two to six spindles for gang drilling.

O-Z CUTMETER

An instrument known as the O-Z cutmeter, intended for determining the cutting speeds of lathes, milling machines, planers, radial and upright drilling machines, etc., and the surface speeds of pulleys, belts, and ropes, is shown in the accompanying illustration. This device has recently been introduced by O. Zernickow, 15 Park Row, New York City. When the instrument is used with a cutmeter wheel attached as shown, surface speeds in feet per minute are indicated direct on the dial without the necessity of timing or making calculations. When a rubber point provided for the purpose is mounted on the instrument, the number of revolutions per minute of a rotating shaft can be obtained. In this way variations in speed can be instantly detected.

The range of the instrument is from 20 to 800 feet per minute and from 30 to 1200 revolutions per minute. There is no vibration of the indicating hand, due to an arrangement which neutralizes shocks and vibration of the part under test. This provision enables easy reading of the cutmeter, even at arm's length. It is claimed that the accuracy of the instrument is not affected by changes in temperature and moisture or by magnetic fields present in

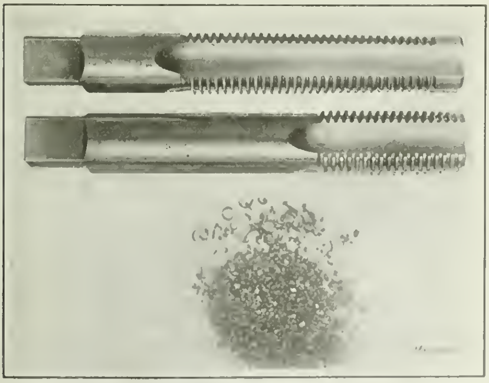


Cutmeter recently introduced by O. Zernickow

shops using electric power, and it may be used in vertical, horizontal, or angular positions. The diameter of the dial is 2⅜ inches; the length of the instrument over all, 5¾ inches; and its net weight, ¾ pound.

BATH "EASY-CUT" GROUND TAPS

A new line of taps for which remarkable cutting qualities and accuracy are claimed has been placed on the market by John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. The illustration shows 1½-inch diameter roughing and finishing Acme taps. It will be seen that the roughing tap at the top of the illustration is provided with a pilot, and that the first few teeth are similar to the U. S. standard, the remainder gradually taking the Acme form. As the pilot centers the tap in a hole and the tap is well tapered, the starting of a tapping operation is easy, and the cutting is distributed over the full length of the tap. Alternate sides of the teeth are relieved, so that only one side of a tooth cuts, thus the teeth have the cutting action of lathe side-tools and roll the chips out easily into the flutes. There is no jamming of chips in the flutes so as to choke the tap, and the breaking of teeth is obviated by the easy cutting action of the tool.

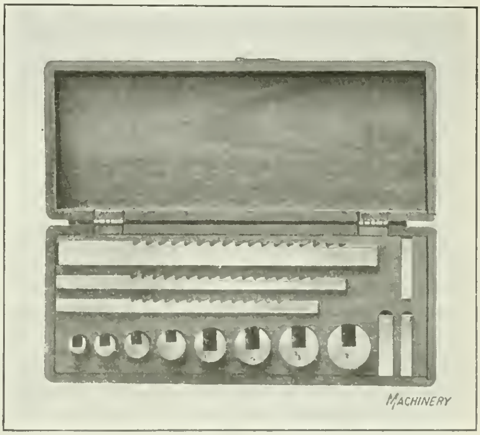


"Easy-cut" Taps placed on the Market by John Bath & Co., Inc.

The finishing tap has the same special relief as the roughing tap, and it is ground in the threads, thus correcting the lead, angle and distortion produced in hardening. The roughing tap cuts out large pieces of metal, while the finishing tap produces long curly chips, the result being a smooth and well finished threaded hole. The "Easy-cut" taps are also made for U. S. standard, S. A. E., Löwenherz, and international threads. The action of a tap for a thread having the sides inclined at an included angle of 60 degrees, is identical to that of an Acme tap, except that the curled chips are smaller. For all ordinary sizes of 60-degree threaded parts, the use of a roughing tap is unnecessary, as the thread may be satisfactorily cut and finished with a single tap.

J. N. LAPOINTE KEYWAY-BROACHING SET

The J. N. Lapointe Co., New London, Conn., has recently placed on the market the combination set of three keyway broaches and eight work bushings shown in the accompanying illustration, which are intended for use in connection with an arbor press for cutting keyways in gears, pulleys, bushings, and other machine parts not manufactured on a quantity production basis. With this set it is possible to cut ⅛-, 3/16-, and ¼-inch keyways in holes ranging from ⅝ to 1½ inches in diameter and lengths up to 2 inches. This set is particularly suitable for use in small shops and garages, and will be found useful by machine tool manufacturers who do not have a sufficient amount of work of this nature to warrant the purchase of a broaching machine and equipment.

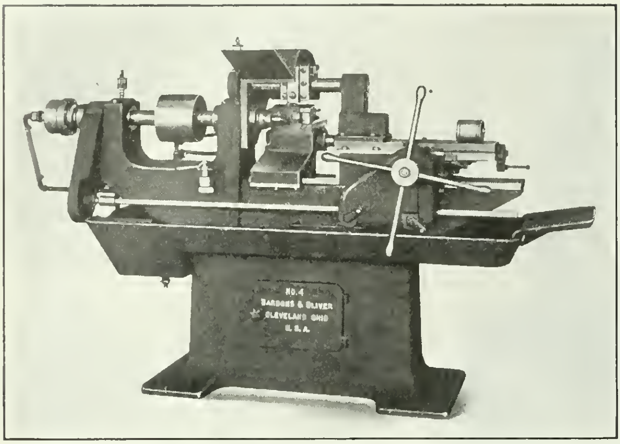


Keyway-broaching Set made by the J. N. Lapointe Co.

ANDERSON HAND SCRAPER

The Anderson Bros. Mfg. Co., 1910 Kishwaukee St., Rockford, Ill., has recently placed on the market the hand scraper here illustrated, which is provided with blades made from the same special steel as those furnished on the Anderson pneumatic scraper. It is claimed that blades made from this special steel have a high degree of hardness, hold an

Hand Scraper made by the Anderson Bros. Mfg. Co.



Piston Turning, Grooving, and Facing Machine built by Bardons & Oliver

exceptionally keen edge, and do not scratch. The clip is notched on the inside to receive and hold the blade positively in place, and there is a lug on the rear end of the blade that prevents it from slipping back. The clip automatically tightens when pressure is applied.

HINCKLEY-MYERS CYLINDER REBORING MILL

A new machine of interest to the automobile trade is the power cylinder reboring mill built by the Dearborn Equipment and Hinckley-Myers Co., 6 N. Michigan Blvd., Chicago, Ill. The top of the base is sufficiently close to the floor to enable one man to readily load an ordinary cylinder block without employing a chain hoist or crane. The slots in the top of the base provide for clamping the cylinder casting securely in position. The cylinders are centered with the work-spindle by means of a device at the extreme left of the parts beneath the base.

This centering device is split and fits around the pilot bar which extends through the spindle and into a bushing in the base. After a cylinder has been centered, the casting may be quickly clamped in position. The pilot bar is lifted and automatically secured in the raised position to permit the loading and unloading of work. The three-blade cutters supplied with the machine are of simple design and easily set for reboring cylinders of any size within their capacity. Each cutter blade is set separately to a gage, and a positive locking device renders it impossible for a blade to slip or change position while an operation is being performed. The "Sizeometer," which is the second of the parts from the left, of those beneath the base, permits the accurate setting of the cutter blades to within one-quarter of a thousandth inch.

BARDONS & OLIVER PISTON-TURNING MACHINE

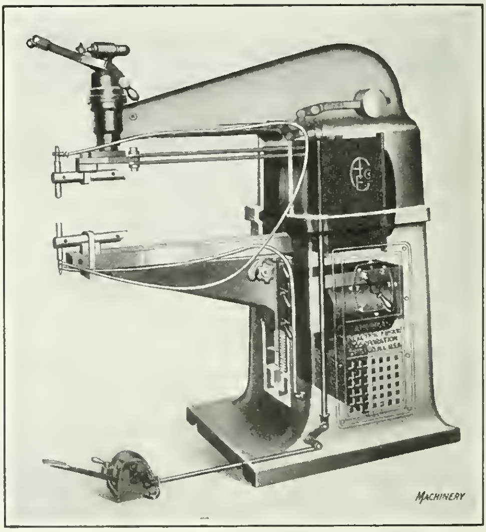
A machine intended for performing operations on aluminum and aluminum-alloy pistons has been developed by Bardons & Oliver, Cleveland, Ohio, and is here illustrated. The spindle is driven by a pulley of small diameter having a face 8 inches wide, so that sufficient power is supplied to enable heavy cuts to be taken while the work is being rotated at a high speed. The nominal speed for a piston 3½ inches in diameter is about 800 revolutions per minute. The spindle is provided with a draw-back chuck for clamping the pistons to the nose of the spindle, this being accomplished by means of an eye-bolt and a pin which passes through the wrist-pin holes of the work.

The tool for turning the cylindrical surface of the piston is carried in the tool-block mounted on the heavy over-arm, the latter being supported on one end by the housing of the machine and on the other end by a slide. The block on which the tool is mounted moves horizontally on the over-arm, and is provided with an automatic trip which causes the withdrawal of the tool after a cut has been finished, and automatically resets the tool prior to taking the next cut. The tool-holder and block are adjustable for the various sizes of pistons within the range of the machine.

The end of the piston is faced and the three grooves are cut by the four tools mounted on the slide at the rear of the machine. This slide is of heavy construction and is actuated by a cam controlled by the slide carrying the turning tool. This cam provides a coarse feed for the facing of the piston end and a fine feed for the cutting of the grooves. An adjustment is provided on the cam so that it may be set for various sizes of pistons. The machine is intended for taking either roughing or finishing cuts. When used for finishing, it is generally provided with an attachment to center the end of the piston preparatory to the grinding operation.

AMERICAN ELECTRIC SPOT-WELDERS

The American Electric Fusion Corporation, 1906 N. Halsted St., Chicago, Ill., has brought out a line of production spot-welders, the various sizes of which have nominal throat depths of 12, 24, 36, and 48 inches. The accompanying illustration shows the 36-inch machine, which has a capacity for welding two pieces of stock up to 5/16 inch in thickness. This welder is equipped with a unique treadle mechanism, which causes the pressure applied on the points to be at a maximum when needed and permits the operator to always be in a comfortable position. These advantages are also present in using the handle provided for hand-operation.



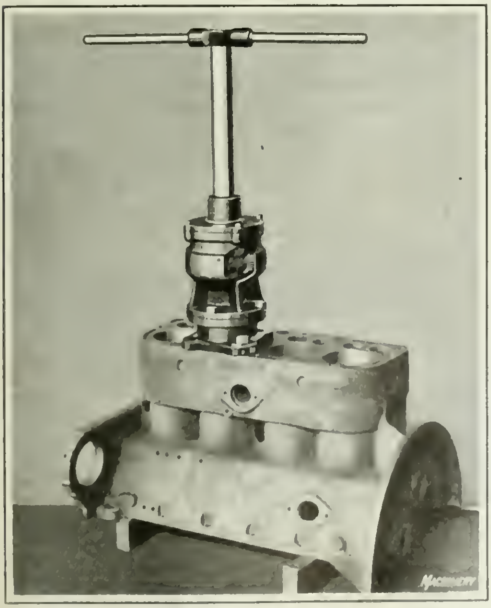
Thirty-six-inch Spot-welder developed by the American Electric Fusion Corporation

The electrode-holders are die-formed pieces of copper, and so eliminate the possibility of joints becoming unsoldered if an operator should neglect to turn on the water circulation. The bolts holding the points to their holders are made of a non-rusting alloy. The machine is of box construction, and all moving and high-voltage current-carrying parts are placed inside for safety purposes. All parts are accessible through panels at the sides and rear of the base. The machine is so designed that all heating at joints is eliminated.

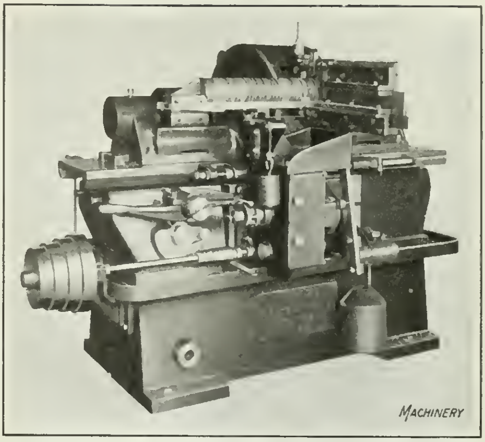
VAN DRESSER CYLINDER REBORING TOOL

The International Purchasing & Engineering Co., 1558 Penobscot Bldg., Detroit, Mich., is the sole sales agent for the Van Dresser automobile cylinder reboring tool shown in the illustration. This tool may be operated by hand through a feed-shaft rotated by the handle attached to the upper end, or by power by removing the handle and connecting the feed-shaft to the spindle of a drilling machine. A feature of interest is that no screw is used for feeding the reamer, the feed-shaft being provided with rack teeth. After the reamer has been fed to the desired depth, the feed-shaft may be lifted or dropped through the cylinder by releasing the feeding mechanism. A floating driving socket is provided when the tool is used with a drilling machine to eliminate any inaccurate finishing of a cylinder due to a misalignment of the reboring tool.

The reamer blades are made of high-speed steel, and are held in a head having a long tapered shank, which is drawn into the socket in the lower end of the feed-shaft by means of a screw. The reamer head does not need to be removed from the feed-shaft in order to adjust the blades. The reboring tool can be instantly removed from the work without disturbing the base, which is centered separately over the cylinder bore. This allows the operator to ascertain the fit of a piston before boring the cylinder completely through, and if another adjustment of the reamer blades is necessary, the reamer will again be placed central with the unfinished bore when it is reinserted.



Van Dresser Automobile Cylinder Reboring Tool sold by the International Purchasing & Engineering Co.



Piston-ring Grinding Machine developed by the Badger Tool Co.

BADGER PISTON-RING GRINDER

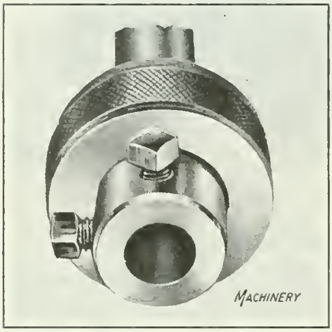
The Badger Tool Co., Beloit, Wis., has recently developed and placed on the market the No. 220 automatic piston-ring grinder here illustrated, which has been developed from the No. 220 disk grinder described in the June, 1920, number of MACHINERY. The function of the new machine is to rough-grind the parallel sides of individually cast rings, bringing them down to approximately the desired size preparatory to the performance of the finish-grinding operation on some precision type of machine. The automatic feed of the machine permits high rates of production, and enables one operator to easily handle two machines.

The illustration shows the front view of the grinder with the various hoods and guards removed to enable the construction to be observed. The piston-rings are placed in the hopper track as shown, the track having a capacity for one hundred rings, 3¾ inches in diameter by ¼ inch thick, although the track could be extended to receive two hundred rings, if preferable. The rings in the hopper track are backed up by a pusher attached to a weight by means of a cable, so as to bring the rings successively in front of a reciprocating ram. The latter forces one ring at a time between the two grinding wheels. Bars are provided for guiding the rings past the grinding wheels, these bars being supported at the front and rear of the machine. The grinding wheels are automatically spread apart as a ring enters at the front, a finished ring, at the same time, leaving the grinding wheels at the rear of the machine and falling into a chute which conveys it into a suitable container. The rings pass across the entire grinding face of the wheels, which are 18 inches in diameter.

After a ring has entered the grinding wheels, these are brought together by means of a lever and weights, the force of which may be increased or reduced by adding or removing the weights. A positive micrometer stop screw is located at the front. From installations and tests it has been found that an adjustment is not required more often than once for every 3000 to 4000 rings. However, as in all types of grinding machines, the frequency of compensation for wheel wear is largely dependent upon the kind of wheel used and the amount of metal being removed. A micrometer adjustment must be made following each dressing of the wheels. A throw-out clutch is placed on the driving shaft. The countershaft is provided with an extra cone pulley for driving the automatic parts of the machine, four speeds being available. The countershaft is also furnished with a pulley for driving either a dust-exhauster or a water pump. The machine is adjustable to take rings from 2¾ to 4½ inches in diameter and from ⅛ to ½ inch in thickness. All moving parts, such as gears, cams, rollers, and slides are provided with guards.

RANDA REAMER AND COUNTERBORE HOLDER

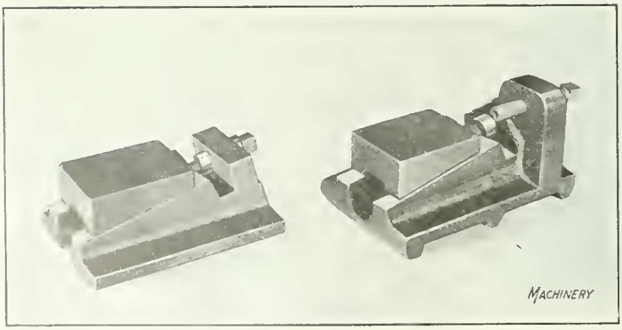
The illustration shows a floating reamer and counterbore holder which, it is claimed, will always hold a reamer parallel with the axis of the spindle on the machine on which the tool is being used. This holder has been placed on the market by the Randa Mfg. Co., 1316 E. Jackson St., Muncie, Ind., for use on automatic screw machines, turret lathes, boring mills, and all machines provided with turrets. It may be furnished for any size of reamer shank, either straight or tapered. All wearing surfaces are hardened and ground. Three sizes of holders are regularly carried in stock, the No. 1 having a capacity for holding reamers up to ½ inch in diameter, the No. 2, from ½ to 1⅛ inches in diameter, and the No. 3, for sizes greater than 1⅛ inches in diameter.



Reamer and Counterbore Holder made by the Randa Mfg. Co.

CINCINNATI LEVELING WEDGES

The machine leveling wedges shown in the accompanying illustration, which have been placed on the market by the Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio, were originally developed for use in leveling the tables of planers, but owing to their convenience in making accurate adjustments, they have also been used for the same purpose on other types of machines. In planer installations the wedges are placed on concrete foundations and support the bed of the machine on the sliding member. These slides can be adjusted to the proper height by means of a screw in the base of the wedges. The wedges are furnished in the two styles shown, the one at the right being provided with a lug and an additional screw for obtaining endwise movement of the machine bed. The angular surfaces and the top of the slide are finished, while the adjusting screw is of a fine pitch so as to permit accurate adjustments.



Machine Leveling Wedges made by the Cincinnati Engineering Tool Co.

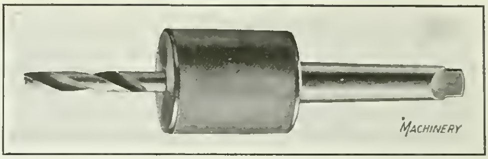


Fig. 1. Automatic Straight-shank Drill Chuck made by the Eastern Tube & Tool Co., Inc.

EASTERN AUTOMATIC DRILL CHUCK

An automatic straight-shank drill chuck enabling an operator to change drills readily while the spindle of the machine is in operation, by simply retarding the rotation of the knurled sleeve of the chuck with one hand and at the same time grasping the drill as it becomes loosened, removing it and then inserting another, has been developed by the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y., and is here illustrated. The shank of a drill is held securely in the chuck by means of the three cammed rollers seen in Fig. 2; in this illustration the lower end plate of the chuck has been removed. Pinion teeth are cut on the upper end of each roller, and these mesh with an internal gear on the sleeve. By this arrangement, when the rotation of the sleeve is retarded, the internal gears cause the rollers to revolve and release the pressure of the cam surfaces on the drill shank.

As soon as the chuck sleeve is released, a spiral spring forces the sleeve forward relative to the stationary parts of the chuck, and causes the rollers to be brought against the drill shank. Then when the drill is brought in contact with the work, if the tendency of the drill at first is to revolve in the chuck, this action causes the cams to bear more firmly on the shank so that the drill is held securely. The chuck is regularly made in two sizes, one of which has a capacity for holding drills from ⅛ to 25/64 inch in diameter, and the other for drills ranging from 3/16 to 33/64 inch in diameter. Various sizes of shanks may be provided for a chuck, as the shank is screwed in place, thus permitting a ready replacement when it is desired to use the chuck on a machine provided with a spindle socket which does not correspond to the shank that is in the chuck at the time.

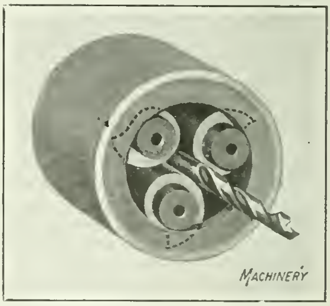
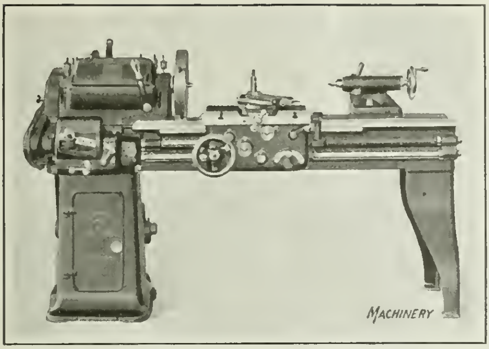


Fig. 2. Chuck Plate removed to show the Three Cammed Rollers

ROCKFORD GEARED-HEAD LATHE

The "Economy" 14-inch swing, motor-driven geared-head quick-change lathe shown in the accompanying illustration was designed by the Rockford Lathe & Drill Co., 1827 Fourteenth Ave., Rockford, Ill., to serve the purpose of a small heavy-duty lathe. The headstock is driven by a single pulley running at 400 revolutions per minute. The spindle has a 1 5/16-inch hole extending for its entire length. The tailstock is of the offset type, allowing the compound slide to be set parallel with the bed. The tailstock may also be set over for the turning of tapered



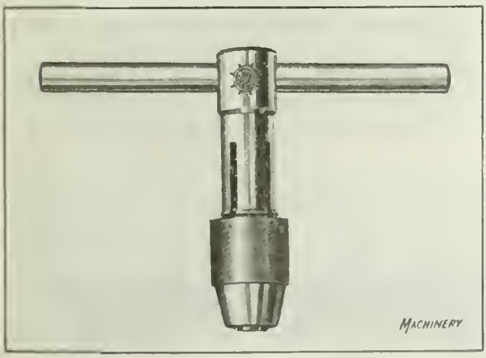
"Economy" 14-inch Geared-head Lathe recently developed by the Rockford Lathe & Drill Co.

parts. The tailstock spindle is locked by an improved clamp which is of such design that it does not require the barrel to be split.

The carriage has a bearing of 20¼ inches on the ways of the bed and is provided with self-oiling felt wipers for keeping the ways clean and lubricated. A thread-cutting indicator enables the operator to catch the thread on the work no matter what the pitch may be, thus eliminating the necessity of reversing the lathe. The quick-change gear-box furnishes thirty-two changes of threads and feeds, which are obtained through sliding gears and clutches controlled by two convenient handles. A 1½- or 2-horsepower motor of any standard make, using either direct or alternating current, and having a constant speed of not more than 1200 revolutions per minute, is suitable for driving the lathe. The motor is mounted on a detachable plate secured to the base and drives the machine by means of a belt 3 inches wide. The operation of the motor is controlled by a shifter-bar running the full length of the bed. This machine may be furnished with a bed 6, 8, or 10 feet in length, the maximum distance between centers on a 6-foot bed being 37 inches.

ADJUSTABLE TAP WRENCH

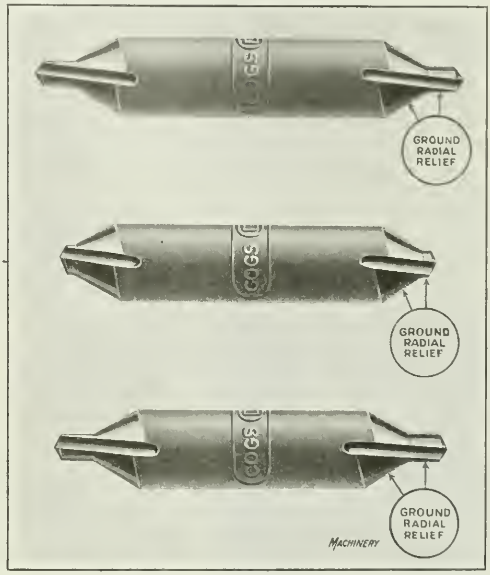
The accompanying illustration shows an adjustable wrench for taps, drills, reamers, and tools of a similar nature, which has recently been placed on the market by the Consolidated Tool Works, Inc., 296 Broadway, New York City. In addition to its use in connection with the tools mentioned, the wrench may also be employed for gripping wire when it is desired to point the ends. The wrench is made from solid bar steel, and is ground and polished.



Adjustable Wrench for Taps, Drills and Reamers, sold by the Consolidated Tool Works, Inc.

COGSDILL CENTER DRILL

The illustration shows a center drill so constructed as to permit it to be reground after the point has been worn out. This drill is made by the Cogsdill Mfg. Co., 5132 Grand River Ave., Detroit, Mich. It has deeply cut spiral-flute chip chutes which allow the chips to free themselves. The cutting portion of the drill is ground after being hardened, thus, it is claimed, eliminating the breakage commonly due to distortions produced in the hardening process.



Center Drill made by the Cogsdill Mfg. Co.

NEW MACHINERY AND TOOLS NOTES

Burning-in and Running-in Machine: Detroit Garage Equipment Co., 268 Jefferson Ave., Detroit, Mich. A machine intended for use in service stations, garages, and small motor plants in "burning-in" motor bearings to size and for "running-in" tests.

Bench Drill: Pullman Ventilator & Mfg. Co., York, Pa. A bench drill designed for high-speed work on small parts. This machine will take drills up to and including ⅜ inch in diameter, and the maximum distance from the spindle to the table is 9½ inches.

Cylinder Reboring Attachment: Barnes Drill Co., 814 Chestnut St., Rockford, Ill. A cylinder reboring attachment designed for use in connection with the sliding-extension gap lathe made by this company. The attachment will accommodate any size or type of cylinder.

Forging Furnace with Preheating Oven: Bellevue Industrial Furnace Co., Bellevue Ave., Detroit, Mich. A furnace intended for use in forging high-speed steel drills, reamers, etc. It is provided with a preheating chamber in which the work can be slowly heated before being inserted in the high-temperature chamber.

Truck Platform: Stuebing Truck Co., 312 E. Court St., Cincinnati, Ohio. A portable truck platform made of oak, bound with angle-irons and supported by steel legs with broad bearing surfaces so as not to injure floors. The platform is made in various sizes, and in box, sectional-bin, stake, table, and other types.

Spring Tool-holder: Miner-Fuller Co., Plainville, Conn. A tool-holder which is recessed in the front end to accommodate a section carrying the tool bit, this section being connected to the tool-holder by means of a U-shaped spring. This construction permits the tool to spring back and forth, but all side motion is prevented.

Cutter Grinding Machine: Bilgram Machine Works, 1231 Spring Garden St., Philadelphia, Pa. A machine for grinding the prismatic cutting tools used on Bilgram bevel-gear generators. An abrasive wheel is held on each end of the spindle, one being used for grinding the gear-generator tools, while the other is intended for general purposes.

Carburizing Compound Press: Hanna Engineering Works, 1769 Elston Ave., Chicago, Ill. A machine for pressing plastic carburizing compound about ring gears, the work being placed on the platen and the compound spread on the teeth. After the die is placed on top, the foot-treadle is operated, the result being that the compound becomes packed.

Boring-tool Set: Cascade Tool Co., 71 Washington Ave., Cohoes, N. Y. A line of boring-tool sets which consist of a holder, clamping bolt, two eccentric spring sleeves, and three boring-bars fitted with high-speed steel bits. The offset tool-holder may be swung around so as to enable the operator to turn surfaces which cannot be reached with ordinary tools.

Oil-pump and Agitator: Fruchey Machine Co., 454 E. Lafayette Ave., Detroit, Mich. A soluble-oil pump and agitator, of which the pump proper consists of a rotor running between two blades. The inlet is through five holes in the cover-plate, and the outlet is through a vertical pipe. The agitation is effected by recesses in the veins close to the hub of the rotor.

Annealing Furnace: Bellevue Industrial Furnace Co., 715-717 Bellevue Ave., Detroit, Mich. A semi-muffle type of furnace which can be heated by either oil or gas. It is equipped with a hand-operated chain mechanism for raising or lowering the door. Oil burners are ordinarily used for heating, and these are located at the front where they are easily accessible for adjustment.

Bench and Floor Grinders: Glow Electric Co., 219 Walnut St., Cincinnati, Ohio. A line of totally enclosed electric grinders and polishing stands. The bench grinder is intended for use in assembly rooms and where space is limited, being portable and readily installed. The pedestal grinder is suitable for general shop and tool-room use, while the polishing stand is for general polishing work.

Draw-in Chuck Adapter: Phoenix Tool Co., 2 Remer St., Bridgeport, Conn. A self-contained adapter by means of which spring or draw-in collets may be used in the spindle of any engine lathe or milling machine without employing a draw-bar or providing a through hole in the spindle. The adapter can be used in the dividing head of a milling machine without interfering with the angular setting of the head.

Drilling and Tapping Fixture: Waldon Tool & Metal Mfg. Co., 13 Ferry St., Norwich, Conn. A quick-acting fixture designed primarily for drilling and tapping operations, but which may also be used in hand milling. The jaws for holding the work are operated by a cam-plate so arranged as to give a rapid motion until the jaws are almost in contact with the work, and then to increase the gripping power so as to hold the work firmly.

Storage Battery Tractor: Elwell-Parker Electric Co., 4223 St. Clair Ave., Cleveland, Ohio. A four-wheeled storage battery tractor designed especially to meet the requirements if iron and steel plants. The normal draw-bar pull is rated at 400 pounds while the ultimate power before the wheels slip is given as 2400 pounds. The drive is from a direct-connected motor to a worm reduction on a full floating axle. The weight of the tractor is 4000 pounds.

Milling Machine: Rockford Milling Machine Co., Rockford, Ill. A No. 3 high-power all-geared milling machine on which several improvements have been added since the description presented in MACHINERY for March, 1920. The method of transmitting the feed to the saddle and table mechanism has been changed in such a way as to eliminate the telescopic feed-shaft and universal joints. The overarm and the feed and speed gear-change mechanism have also been redesigned.

Steam Drop-hammer: Massillon Foundry & Machine Co., Massillon, Ohio. A redesigned line of steam drop-hammers on which the cylinder is a semi-steel casting that connects the tops of the housings, eliminating the necessity of a tie-plate. A safety cylinder is provided to protect the hammer in case the piston-rod becomes broken. The ram guides may be adjusted into the side frames to permit the horizontal removal of the ram. The hammers are built in sizes ranging from 800 to 20,000 pounds capacity.

Wheel-truing Machine: Precision Truing Machine & Tool Co., Cincinnati, Ohio. A wheel truing and dressing machine which may be applied to any surface or tool grinder. A small hard grinding wheel is mounted on one end of the spindle. In use, the device is placed on the table of the grinding machine. Then by bringing the face of the truing wheel in contact with that of the grinding wheel, while the latter is rotating, the truing wheel is also made to revolve, and the action of the two wheels running together dresses the grinding wheel.

Automatic Drilling Machine: Langelier Mfg. Co., 67 Clifford St., Providence, R. I. An automatic machine, which is designed to drill six holes on a door-lock cylinder, but which may, by slight changes, also be adapted for other work. There are six individual spindle units located equidistantly around six-sevenths of a circle, and jigs for holding the work are bolted to a revolving table. There are seven jigs, so as to permit the work to be unloaded and loaded as each jig successively reaches the station above which there is no spindle.

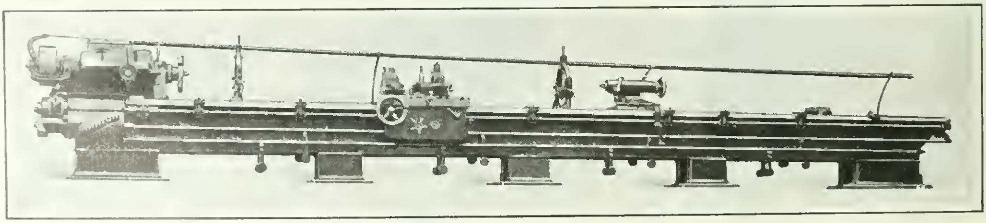
Inverted Multiple-spindle Drilling Machine: Defiance Machine Works, Defiance, Ohio. A line of inverted multiple-spindle drilling machines suitable for deep-hole drilling because of the chip clearance obtained when the drills are in an inverted position, and for drilling work which can be more conveniently held when placed on the face that is to be drilled. The spindle housing is stationary, while the work is mounted on a movable head which lowers the work on the drills. The drill spindles are equipped with collets which may be individually adjusted to compensate for uneven grinding of the drills in a set.

Vertical Lathe: Cadillac Tool Co., 268 Jefferson St., Detroit, Mich. A semi-automatic vertical lathe provided with two carriages, which has been developed to reduce the floor space generally occupied by lathes of the horizontal type. The two carriages are mounted on sliding bars that extend from the base through the tailstock. A carriage is fed by sliding its corresponding bar downward. The right-hand carriage is generally used for turning operations and the left-hand carriage for facing and grooving operations. However, both may be arranged for turning, and they may be fed in the same direction or in opposite directions. The machine is particularly adapted for machining pistons. It has a maximum distance between centers of 16 inches and a swing over each carriage of 9 inches.

* * *

HENDEY LATHE OF UNUSUAL SIZE

In the accompanying illustration there is shown a 24-inch geared-head lathe with a 30-foot bed, which was recently built in the shops of the Hendey Machine Co., Torrington, Conn. The point of especial interest in the construction of this machine is the fact that the bed was cast in one piece. Obviously this was a difficult foundry job, calling for the greatest care in molding and in pouring the metal, to produce a perfectly sound and straight casting of this length, where the width and depth are so much smaller.



Hendey 24-inch Geared-head Lathe with a 30-foot Bed that was cast in One Piece

NEW BOOK ON SOLUTION OF TRIANGLES

Solution of Triangles. By Erik Oberg. 100 pages, 6 by 9 inches; 44 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

This book is intended primarily for men in machine shops, tool-rooms, and drafting-rooms, requiring a condensed treatise covering the use of formulas and the solution of triangles. Problems involving right-angled triangles are so numerous, and a knowledge of their solution is of such value to the average man in the mechanical field, that a book dealing specifically with the more important problems of the kind mentioned, will doubtless be of direct assistance to a great many whose experience and training has been chiefly along practical lines.

The use of formulas is dealt with in the first chapter in view of the fact that many shopmen do not understand the value of formulas and have erroneous ideas regarding the difficulties of applying them to practical problems. In dealing with the solution of various problems involving right-angled and oblique-angled triangles, examples have been selected to cover cases likely to arise in connection with ordinary work. The presentation of complex trigonometrical problems has been avoided, since the primary object of this treatise is to give the student a good working knowledge of those branches of trigonometry which are the most frequently employed in everyday shop and drafting-room practice.

* * *

PERSONALS

Fred W. Cedarleaf, formerly chief engineer of the Sparks-Withington Co., Jackson, Mich., has joined the Zeigler Mfg. Co. of Alexandria, Ind., manufacturer of sheet-metal stampings and automatic screw machine products, in the capacity of works manager.

Frank C. Whitney has resigned as advertising manager for the Davis-Bournonville Co., Jersey City, N. J., after eleven years service with the company in the oxy-acetylene welding and cutting apparatus field. He was sales manager during the years 1914 to 1920.

C. F. Herington, who has been connected for the last five years with the Bonnot Co. as mechanical engineer and district sales manager in Chicago, Ill., became associated on May 1 with the Holbeck Engineering Co., Cleveland, Ohio, in the capacity of vice-president.

Victor T. Goggin, formerly New England sales manager of Fred T. Ley & Co., Inc., of Springfield, Boston, and New York, has associated himself as contracting engineer with Dwight P. Robinson & Co., Inc., of New York, Chicago, Dallas Youngstown, Los Angeles, and Montreal.

Arthur B. Sonneborn, formerly connected with the Detroit Electric Welder Co. and with the Federal Machine & Welder Co. as sales and service representative in the Detroit and Cleveland territories, is now identified as director of sales with the American Electric Fusion Corporation, 1906 N. Halsted St., Chicago, Ill.

L. F. Nielsen, formerly chief engineer of the Shaw-Enochs Tractor Co., has engaged in private practice in the field of machine and tool designing and production engineering, in partnership with W. C. Joubert under the name of Equitable Engineering Co. at 101-103 First Ave. N., Minneapolis, Minn. This firm is also manufacturing the Joubert water circulating pump for Ford cars.

Russell B. Reid who has been associated for several years with the Edward R. Ladew Co. as assistant sales manager, has been made manager of sales for the Sharon Pressed Steel Co. of Sharon, Pa., manufacturer of motor car frames, industrial trucks, and pressed steel automobile parts. Mr. Reid will direct the sales of the company from the New York office at 66 Broadway.

W. C. Peterson, who has been associated for the last twelve years with the Packard Motor Car Co., Detroit, Mich., has been placed in charge of the metallurgical department of the Atlas Crucible Steel Co., at Dunkirk, N. Y. During Mr. Peterson's term of service with the Packard Motor Car Co., he had charge of the metallurgical laboratories, heat-treating departments, and research work, and will now take up similar work in the Atlas plant.

Edmund J. Henke, who has been connected for a number of years with the electric welding industry in this country and abroad, recently serving as chief engineer of the Thomson Electric Welding Co., and also having been associated with the Federal Machine & Welder Co., has recently organized a new corporation known as the American Electric Fusion Corporation, located in Chicago, Ill. Mr. Henke is president and general manager of the new concern.

F. W. McIntyre has been appointed general sales manager of the Reed-Prentice Co., Becker Milling Machine Co., and the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., succeeding J. P. Ilsley who has become associated with the Taylor Steel Construction Co., of New York City. Direct sales offices of the three companies are maintained in New York, Detroit, Cleveland, Indianapolis, and Worcester. The Dale Machinery Co., has been appointed sales agent in the Chicago territory, and Normoyle & Lapp, 514 Liberty Bldg., Philadelphia, Pa., have been appointed sales agents in the Philadelphia territory. Improvements in the present product and in new lines are being developed.

* * *

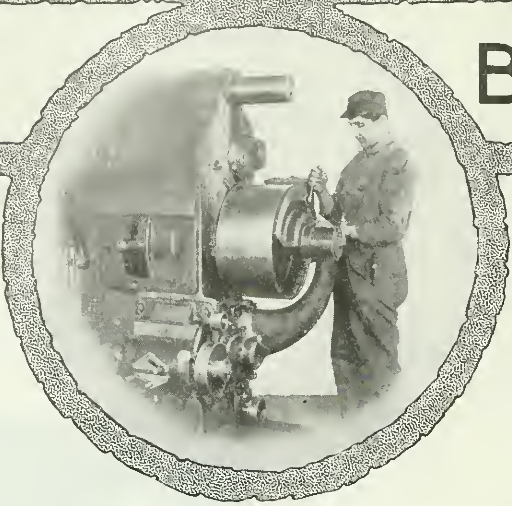
OBITUARIES

LESTER GRAY FRENCH

Lester Gray French, for thirteen years editor and assistant secretary of the American Society of Mechanical Engineers, and manager of the journal *Mechanical Engineering*, died on April 18 at the French Hospital in the city of New York from septic poisoning, following an operation. Mr. French was born in Keene, N. H., in April, 1869. He received his technical education at the Massachusetts Institute of Technology, from which he was graduated in 1891 with the degree of S. B. He served the year 1891-1892 with the Cranston Printing Press Co. as draftsman, and then became connected with the International Correspondence Schools, Scranton, Pa., as instructor in mechanical engineering. Leaving this institution in 1895 he went to Providence, R. I., where he entered the employment of the Builders Iron Foundry as assistant to the superintendent. In 1897 he became editor of Machinery, continuing in this position until 1906, when he resigned to take up the publication of technical books, among them being one of the earliest treatises on the steam turbine, of which he was the author. In 1908 he was made editor of the publications of the American Society of Mechanical Engineers, which organization he faithfully and ably served to the date of his death. With a rare combination of enterprise, vision, and dependability Mr. French developed the publications of the society to a very high standard. He had been a member of the American Society of Mechanical Engineers since 1899.

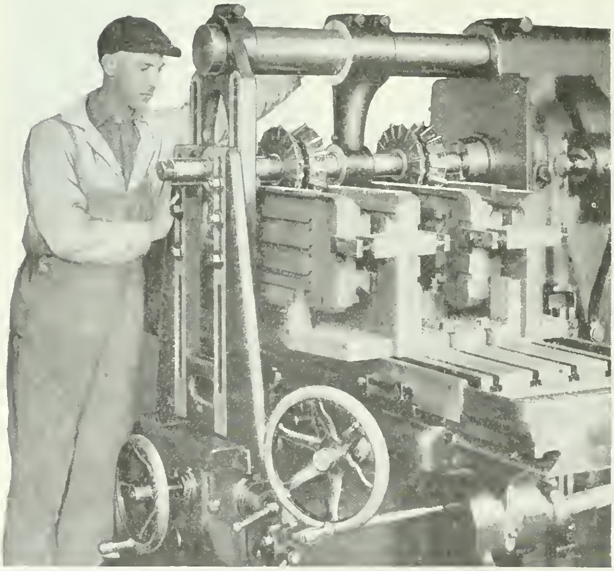
Robert Alexander Bole, vice-president, director, and district sales manager of Manning, Maxwell & Moore, Inc., New York City, died April 2 in the Schenley Hotel, Pittsburg, Pa., where he made his home. Mr. Bole was sixty-two years of age. He was widely known in iron, steel and railroad circles. Mr. Bole was born in Old Allegheny City and recived his education in the Pittsburg schools. In early life he became identified with the Westinghouse Machine Co., and rose from the ranks to secretary of the company. Following his long and faithful service with the Westinghouse interests, he became identified with the Niles-Bement-Pond Co., and later with Manning, Maxwell & Moore, Inc. At the time of his death he had been connected with the latter company for a period of twenty-six years. Mr. Bole had a wide circle of business and personal friends throughout the East, and his qualities of integrity, justness, and keen business judgment gave him great prominence in manufacturing and civic activities.

L. C. Blancke, president and general manager of the Blancke Twist Drill & Tool Co., Inc., and the L. C. Blancke Co., Inc., New York City, died on April 5.



BROWN & SHARPE

Power and For Heavy

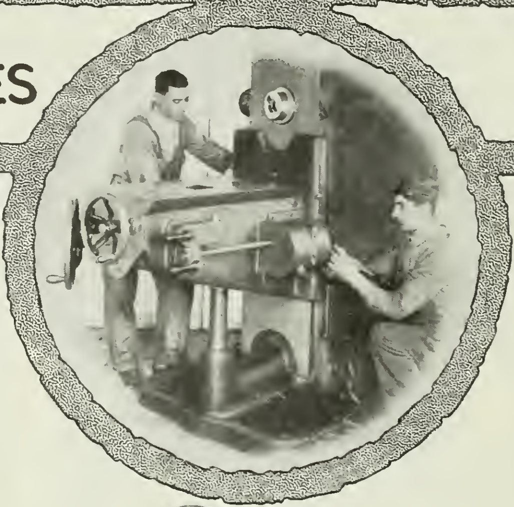


B. & S. Heavy Service Milling Machines possess the power and ruggedness demanded by modern milling practice.

Observe in the above illustration the massive proportions of the driving pulley and the extra wide face—one of the chief elements that provide for a powerful drive, enabling heavy cuts to be taken at high speeds and coarse feeds.

BROWN & SHARPE MFG. CO.,

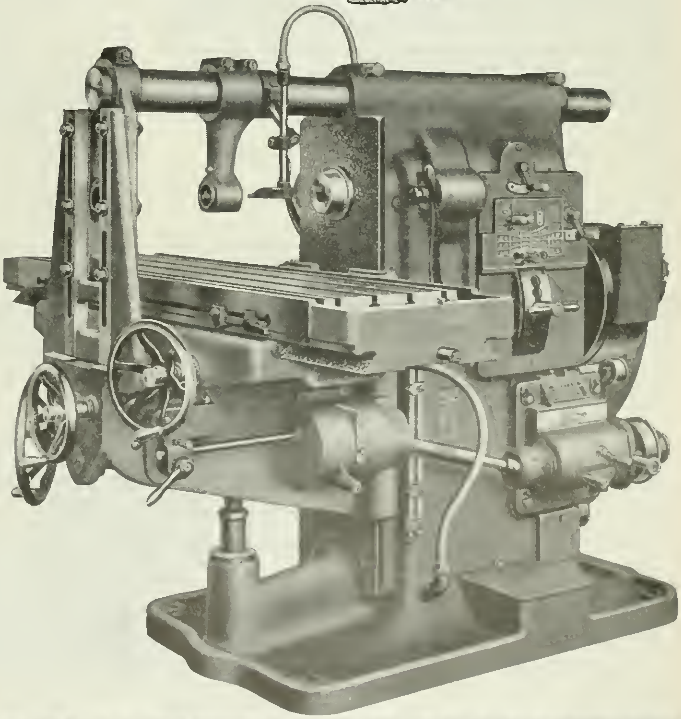
MILLING MACHINES



Rigidity
Service

Note in the illustration at the right the rigid design of the knee with its ample vertical depth and long bearing surfaces for both column and saddle, also the liberal extension at the top of knee—the point of greatest stress.

These are a few of the numerous features that enter into the construction of B. & S. Heavy Service Milling Machines. There are many others of equal interest described in our Milling Machine Book, a copy of which awaits your request.



PROVIDENCE, R. I.

HOOVER CONFERS WITH TRADE JOURNAL EDITORS

A conference was held at Washington, April 12, between Herbert C. Hoover, Secretary of the Department of Commerce, and a number of the editors of leading engineering and trade journals. At this conference, various topics relating to cooperation between the Department of Commerce and the trade press were discussed, and suggestions were offered as to means whereby the industries of the country could be best served by the Department. Further conferences will be held in the future, and it is believed that in this way the engineering and trade press may form a valuable connecting link between the Department of Commerce and the industries, and may be able to serve their industries better through this cooperation with the Department and especially with the Bureau of Foreign and Domestic Commerce. The object in view is to give whatever aid is possible to the Department of Commerce so that it thereby may be enabled to give to the industries such services as they require.

* * *

MACHINERY CLUB OF BUFFALO

The Machinery Club of Buffalo has been formed among the engineers and sales representatives of the machinery trade of that locality for the purpose of promoting a friendly feeling among the men of the trade. The officers are George T. Aitken, president; Floyd C. Lowell, vice-president; W. B. Joyner, secretary; and A. C. Towne, treasurer. Luncheons are given every week on Saturday at Weyand's Hall, which visiting men are cordially invited to attend.

* * *

NATIONAL MACHINE TOOL BUILDERS' CONVENTION CANCELLED

Announcement is made that the convention of the National Machine Tool Builders' Association, which was to be held in Atlantic City, May 19 and 20, has been cancelled. There will be no spring meeting of the association.

RUSSIAN CONDITIONS AND PROSPECTS

In a letter recently received by a well-known American machine tool builder from the company's former agent in Russia, the following impressions of Russian conditions and prospects are outlined.

"The condition in which Russia will find itself after the Bolshevik regime will be so bad that the re-establishing of the industry will be possible only by the investment of foreign capital to renew and rebuild everything. When the moment for usual trade possibilities will appear no one can tell at present. The first steps to be taken when Russia reopens will be to feed and dress the people, rehabilitate buildings damaged by the bursting of frozen water pipes, and procure stocks of coal and wood. Nearly all the wooden houses in Petrograd have been pulled down and used for fuel. The railroads are in a terrible state both as regards the permanent way and rolling stock. Well-informed Russians believe that it will take years merely to bring the country into a condition where life can be carried on in a normal way. Where the capital required will be found and who will risk the investment nobody can say. Very long credits will be unavoidable. I am at present on a business trip in Roumania. Here, as well as in other parts of eastern Europe which I have visited several times, everything is dull and the German competition keen, based on very low prices and favorable terms."

* * *

TITAN COLLET CHUCKS

In the description of the Titan quick-change collet chucks and sockets made by the Titan Tool Co., 26th and Holland Sts., Erie, Pa., in the April number of MACHINERY, page 811, an omission was made. It should have been stated that the straight-shank drill chucks are made in two sizes, the smaller having a capacity for drills up to and including 5/16 inch in diameter and the larger having a capacity for drills up to and including ½ inch in diameter. The taper-shank drill chucks are made in sufficient sizes to handle all sizes of taper-shank drills.

COMING EVENTS

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 9-11—Annual convention of the American Association of Engineers in Buffalo, N. Y. Headquarters of the association, 63 E. Adams St., Chicago, Ill.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel. Secretary, American Supply & Machinery Manufacturers' Association, F. D. Mitchell, 4106 Woolworth Bldg., New York City.

May 23-26—Spring meeting of the American Society of Mechanical Engineers in Chicago, Ill.; headquarters, Congress Hotel. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 24-28—Summer meeting of the Society of Automotive Engineers in West Baden, Ind.; headquarters of the society, 29 W. 39th St., New York City.

June 15-16—Annual convention of the American Railroad Association (Section III-Mechanical) at Chicago, Ill.; headquarters, Hotel Drake.

June 22-24—Annual joint convention of the American Drop Forge Association and the Drop Forge Supply Association in Chicago, Ill. Secretary, American Drop Forge Association, E. B. Horne, 1516 Helen Ave., Detroit, Mich.

September 14-16—Annual convention of the National Association of Cost Accountants in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary's address, 233 Woolworth Bldg., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

September 28-October 8—New York Electrical Exposition at the 71st Regiment Armory, Park Ave. and 34th St., New York City. For information relating to exhibits, apply to Norman Maul, the Electrical Show Co., 130 E. 15th St., New York City, Room 828.

The sectional meetings of the American Society of Mechanical Engineers for May are as follows: **May 9**—Hartford Branch at the City Club, Hartford, Conn.; **May 19**—San Francisco Section in San Francisco, Cal.; **May 20**—Philadelphia Section on the Hotel Adelphia roof, Philadelphia, Pa.; **May 21**—Atlanta Section in conjunction with the Atlanta section of the American Institute of Electrical Engineers in Atlanta, Ga.

NEW BOOKS AND PAMPHLETS

National Safety Code for the Protection of the Heads and Eyes of Industrial Workers. 64 pages, 5 by 7½ inches. Published by the Department of Commerce, Washington, D. C., as Bureau of Standards Handbook Series No. 2. Price, 10 cents.

This little booklet contains a set of rules designed to give mechanical and optical protection to the eyes of workers in occupations which involve eye hazard. The occupations requiring eye protection are classified; and requirements for each group, operating rules, and specifications for testing protectors are given.

The Modern Motor Truck. By Victor W. Page. 962 pages, 6 by 9 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $5.

This book treats of the design, construction, commercial application, operation, and repair of motor trucks. It outlines the principles on which trucks of various types operate, and covers the construction and operation of the leading types of gasoline and electric trucks. Explicit instructions are given for the repair and upkeep of every part, and for systematic inspection and lubrication. In addition, data on systematic maintenance and cost system are included. A large number of motor truck and trailer applications are illustrated. The material is written in a non-technical manner, and is offered as a compilation of practical information for truck owners, users, and drivers, rather than as an engineering treatise.

Mechanical World Electrical Pocket Book (1921). 376 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 2 shillings, net.

This is the 1921 edition of this well-known electrical pocket book, which contains a collection of electrical engineering notes, rules, tables, and data. Among the important improvements in the present edition is a lengthy section on motor starters and controllers, the previous matter on motor starters having been rewritten and the general treatment considerably extended. The section on transmission conductors and cables has been revised, and a new table of maximum currents introduced. The matter on wiring systems and methods has also been rewritten and extended. Substantial additions have been made to the section on electric heating and cooking, and the matter on electric elevators has been rewritten. A list of principal abbreviations has been included and a number of new illustrations are introduced.

Personnel Relations in Industry. By A. M. Simons. 341 pages, 6 by 9 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $3.

The author of this book is director of the Personnel Department of the Leffingwell-Ream Co., management engineers, and his deductions are the result of long study and actual personal contact with labor problems. He approaches the problem of industrial relations from an entirely new angle. Although he keeps the worker's point of view constantly in mind, he makes production the criterion of any plan and suggestion. He lays great stress on the influence of the instincts in industry, and gives especial attention to the forms of industrial democracy. Other points treated of are interviewing, mental and trade tests, training, promotions and discharges, welfare work, wage relation, labor turnover, and organization of the personnel department. Labor organization both in Great Britain and America is also discussed.

The minutes saved by the Cincinnati 24-inch Automatic Duplex on small lots will cut your cost per piece—

This job is milling the bosses and the body of these steel drop forgings back into and including the prongs.

The pieces are made in lots of 25 to 75.

Is the time saved by the Duplex worth while? Investigation of Automatic cost records shows a consistent saving on small lots.

In this case it amounts to nearly 60%.

The holding fixture is inexpensive and the "set up" is simple.

True, a piece which is milled on both sides is "made to order" for the Duplex. But haven't you got lots of just this sort of work?

The time saving features are—

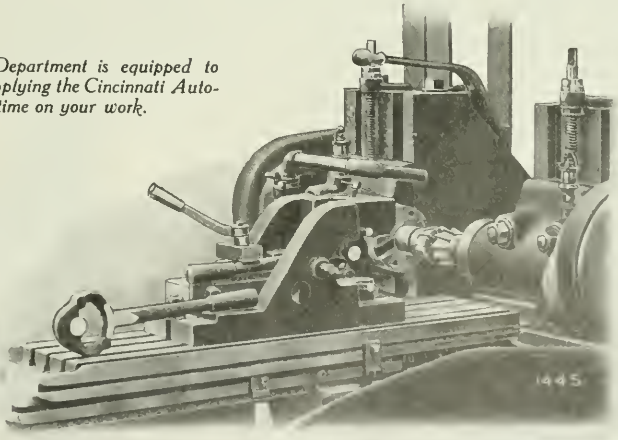
Only one setting of the piece for two cuts.

The operator engages the starting lever and—

The machine runs up to the point of cutting 100 in. per minute, trips into feed, reverses and comes back to the operator at 100 in. per minute without further attention. There is no hand operation, no danger of jamming the work into the cutters—the dogs automatically take care of that.

And finally, you get accurate results. The cutter pressures equalize each other and the work does not spring away as it would from a single cutter.

Our Service Department is equipped to assist you in applying the Cincinnati Automatics to save time on your work.



The Cincinnati Milling Machine Company

CINCINNATI, OHIO

Broaching Practice. By Edward K. Hammond. 122 pages, 6 by 9 inches; 100 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

For many years, broaching has been employed for cutting keyways and machining holes to a variety of shapes, but this method attracted comparatively little attention until extensive developments began to take place in the machine-building field, especially in connection with the manufacture of automobiles. This treatise covers the three important elements in broaching practice; namely, the broaching machines, the design of the broaches or cutting tools, and the application of the broaching process to commercial work. Examples of broaching were obtained from plants using broaching machines for conducting regular manufacturing operations. Since these examples include many classes of work and represent a great diversity of requirements in regard to size and shape, they not only indicate the possibilities of this process but show just how this efficient method of machining can be applied under different conditions.

Organic Chemistry for the Laboratory. By W. A. Noyes. 293 pages, 6 by 9 inches. Published by the Chemical Publishing Co., Easton, Pa. Price, $3.50.

The purpose of the author in writing this book, which is now in its fourth edition, has been to classify the most important of the laboratory processes of preparing pure compounds, and to illustrate them by concrete examples. Two distinct purposes have been kept in view: The first has been to give the beginner full and accurate directions, and clear theoretical explanations of processes which have been found successful in practical laboratory experience; the second object has been to furnish the more advanced student with a guide which will aid him in selecting processes that are likely to be successful for the preparation of compounds that he may desire to use. The number of preparations given is consequently considerably greater than it would be profitable for the average student to prepare. The discussion of special topics, such as crystallization, filtration, distillation, extraction, etc., has been given in connection with preparations, when their use is required.

Cam Design and Manufacture. By F. B. Jacobs. 121 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2

The subject of cam design and manufacture is of considerable interest in view of the fact that cam movements are among the most useful mechanisms that the machine designer has at his command, as it is by means of such mechanisms that many complicated motions can be laid out and constructed. Much of the material previously published on this subject has been presented from a theoretical rather than from a practical point of view. The present work explains some of the methods that are in actual use for laying out and cutting cams, and describes the types of machines used in cam cutting and grinding. Complicated mathematical formulas have been avoided so that the average man unversed in higher mathematics can readily understand the principles set forth. The material is divided into seven chapters under the following headings: Machine Cam Design; Gas Engine Cam Design; Cam Followers; Master Cams; Machine Work on Cams and Cam Cutters; Cam Cutting; and Cam Grinding.

Employe Training. By John Van Liew Morris. 311 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $3.

The need of adequate training for employes has been increasingly realized by manufacturers during recent years, and various systems of training have been developed in different lines of industry. The present book comprises a study of a number of the education and training departments that have been established by concerns in various lines. The study has been undertaken in order to determine to what extent the manufacturing industry can be relied upon to train its own workers. The investigation has been mainly an inquiry into the programs and organization machinery being utilized in industries along the line of employe training, which has expanded to cover a much wider scope than apprenticeship systems of the past. Thirty-five vocational programs are outlined. The book is divided into five sections as follows: Comprehensive Programs for Apprenticeship and Special Training; Programs Emphasizing Apprenticeship; Programs Emphasizing Special Training; Programs of Primarily Technical Instructions; and General Discussion of Apprentice Training, Training of Technical Men in the Industry, and Special Training.

Cylinder Boring, Reaming and Grinding. By Franklin D. Jones. 110 pages, 6 by 9 inches; 80 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

The object of this book is to deal comprehensively with the different methods, tools, fixtures, and machines used for cylinder work. As the most highly developed cylinder machining methods are found in automobile plants, the equipment and practice of these plants is a special feature of this treatise. In factories producing motors by the thousand, it has been necessary to do the work rapidly as well as accurately, which accounts for many of the interesting tools and machines which have been developed. The problem of tool designers, manufacturers of reamers or cylinder boring machines, and others concerned with efficient methods of finishing motor cylinders, has been to secure not only accurate work, but also maximum production. Since the machines and tools which have been developed for use in automobile plants are exceptionally interesting, this class of equipment and the important variations in practice are described completely. A few examples typical of steam, pump, and compressor cylinder work are included to illustrate the general procedure and some of the different types of tool equipment used.

Electric Welding. By Ethan Viall. 417 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $4.

This book discusses the process of electric welding and the uses and principles of construction of arc welding equipment, as well as its application to repair and to production work. It treats of the use of both the metallic and the carbon electrode processes. Attention is given to the physical properties and metallography of arc-fused steel, automatic arc welding, butt-welding and spot-welding. A large number of examples of actual welding jobs are given, and illustrations and descriptions are presented of the different types of commercial welding machines. The book contains seventeen chapters, and an idea of the scope will be obtained from the following chapter heads: Electric Welding—Historical; Arc Welding Equipment; Different Makes of Arc Welding Sets; Training Arc Welders; Carbon-electrode Arc Welding and Cutting; Arc Welding Procedure; Arc Welding Terms and Symbols; Examples of Arc Welding Jobs; Physical Properties of Arc-fused Steel; Metallography of Arc-fused Steel; Automatic Arc Welding; Butt-welding Machines and Work; Spot-welding Machines and Work; Welding Boiler Tubes by the Electric Resistance Process; Electric Welding of High-speed Steel and Stellite in Tool Manufacture; Electric Seam Welding; and Making Proper Rates for Electric Welding, and the Strength of Welds.

NEW CATALOGUES AND CIRCULARS

Blackmer Rotary Pump Co., Petoskey, Mich. Circular containing illustrations and specifications of Blackmer motor- and belt-driven rotary pumps.

Rockford Lathe & Drill Co., Rockford, Ill. Circular descriptive of the "Economy" 14-inch geared-head quick-change lathe arranged for motor drive.

American Emery Wheel Works, Providence, R. I. Circular containing a list of the machines on which American grinding wheels carried in stock can be used.

Ingersoll Milling Machine Co., Rockford, Ill. Circular showing the Ingersoll reciprocating type continuous milling machine, and typical examples of work for which it is adapted.

Northern Engineering Works, Detroit, Mich. Bulletin 543, illustrating different types of electric hoists, and installations of these hoists, showing their adaptability for a wide variety of service.

Roeper Crane & Hoist Works, Reading, Pa. Catalogue 50 of Roeper electric hoists, containing specifications and tables of capacities, lifts, weights, etc., of the hook suspension and trolley types.

Rupp-Moore Co., Inc., Philadelphia, Pa. Booklet of high-grade crucible tool and electric alloy steels, containing data on uses of the different brands, and heat-treating instructions for each case.

St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo. Circulars treating of Arcade molding machines, showing examples of patterns plated by the company, core-boxes, and match plates.

Electric Furnace Co., Alliance, Ohio. Booklet containing a collection of photographs of Baily electric furnaces installed in brass foundries and rolling mills in the United States as well as in foreign countries.

Celite Products Co., 11 Broadway, New York City. Bulletin B-4 descriptive of Celite high-temperature cements for use in setting, facing, and patching firebrick work for all types of furnace construction.

Lyon Metallic Mfg. Co., Aurora, Ill. Circular entitled "Everything in its Place," illustrating metallic factory and office equipment, including metallic shelving, steel bench legs, tool racks, blueprint cabinets, desks, etc.

Pawling & Harnischfeger Co., Milwaukee, Wis. Circular illustrating and describing a new Pawling & Harnischfeger crane cage equipped with front-lever-operated controllers and all-enclosed switchboard and control.

Crouse-Hinds Co., Syracuse, N. Y. Circular illustrating installations of safety switch "Condulets" and safety motor-starting switch "Condulets," as well as plug receptacle housings used in connection with these "Condulets."

Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. Booklet entitled "Reamers at Work," illustrating the Gisholt solid adjustable manufacturing reamer in use. The circular also gives prices and dimensions of the different sizes.

Rickert-Shafer Co., Erie, Pa. Bulletin 7, descriptive of the construction and principle of operation of Rickert-Shafer collapsible taps, which are made in sizes having capacity for cutting straight threads from 1 inch to 6½ inches in diameter.

High-speed Hammer Co., Inc., Rochester, N. Y. Circular showing the different sizes of high-speed riveting hammers made by this concern ranging from No. 1-AA, with a capacity of 1/64 to 1/16 inch, up to No. 6-B with a capacity of ⅝ inch to 1½ inches.

Hercules Electric Steel Corporation, 137 Lafayette St., New York City. Circular containing information relating to "Gladiator" high-speed steel tool-holder bits, which are carried in sizes of from 3/16 inch square by 1½ inches long, to 1 inch square by 7 inches long.

Manning Abrasive Co., Inc., Troy, N. Y., has published a series of booklets entitled "Reflections of 'Sandy,'" containing information on Manning "Speed-grits," including emery paper, metalite cloth, grinding disks, and other abrasive products, presented in story form.

E. Horton & Son Co., Windsor Locks, Conn. Circular containing price lists of the Ellison hardened body drill chucks formerly manufactured by the American Machine Co., of Hartford, Conn., and which have recently been acquired by the E. Horton & Son Co.

J. C. Glenzar Co., Detroit, Mich. Catalogue 4, entitled "Utility Tools," containing illustrations, dimensions, price lists, and other information relating to the line of interchangeable tools made by this company, which includes counterbores, spot facers, reamers, core drills, countersinks, bushings, sleeves, etc.

Detroit Stamping Co., 3445 W. Fort St., Detroit, Mich. Circular giving tables of dimensions of flat and concentric washers produced in combination dies, gang dies, and round dies. The "Universal" card-holders made by this company, which are carried in four styles are also illustrated in this pamphlet.

Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill. Catalogue 80, treating of Stewart porcelain enameling furnaces. Information is given on the characteristics of enamels, ingredients and properties, fluxes, enameling coloring compounds, application of enamel, and requirements and types of furnaces.

Collis Co., Clinton, Iowa. Bulletin descriptive of the "Wonder" quick-change drill chuck, which is provided with collets for holding various kinds of tools. The pamphlet contains price lists of the chucks, collets, and bushings; a list of equipment for use in connection with the "Wonder" chuck; and tables of tap sizes.

Simmons Economy Tool Corporation, 981 Broadway, Albany, N. Y. Circular descriptive of the "Hold-em-all" tool-holders, designed to hold different sizes and shapes of tool bits down to lengths as short as ½ inch in one tool-holder. Price lists and illustrations showing the different types of tools that can be held in one holder are included.

Yale & Towne Mfg. Co., Stamford, Conn. Circular entitled "Make Labor More Efficient," illustrating the use of Yale hoisting and conveying systems. Circular D-2163, containing dimensions and other data relating to Yale spur-geared chain blocks, which are built in seventeen sizes with capacities of from ¼ to 40 tons.

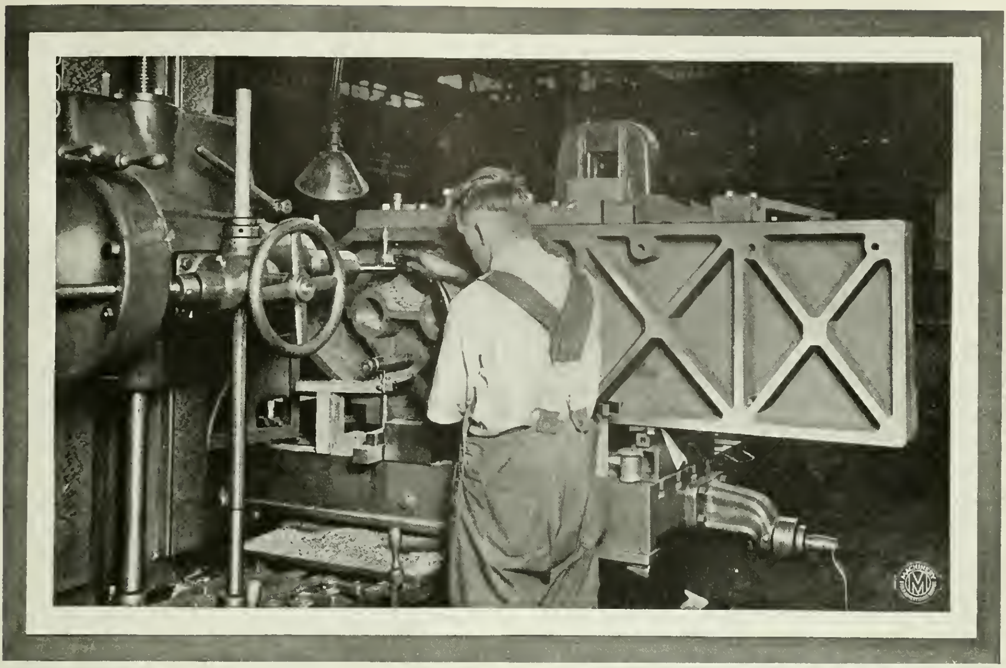
Expanded Metal Safety Guard Co., 14th St. and Vernon Ave., Long Island City, N. Y., is issuing a monthly publication known as the "Safety Guardian," which is descriptive of machine guard installations made by this concern for a variety of classes of machines. The bulletin also contains other information relating to safety.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 223, illustrating various types of burners suitable for the use of oil and gas fuels for industrial heating. Information is given on conditions governing the selection of burners, as well as methods of attaching burner plates, and prices of different sizes and types of burners are included.

Fulton Iron Works, St. Louis, Mo. Bulletin 801, treating of Fulton Diesel oil engines. A historical sketch of the development of the Diesel engine is given, which is followed by a description of the Diesel cycle of operations, charts showing fuel consumption curves, and information relating to fuel economy and fuel supply, lubrication, etc.

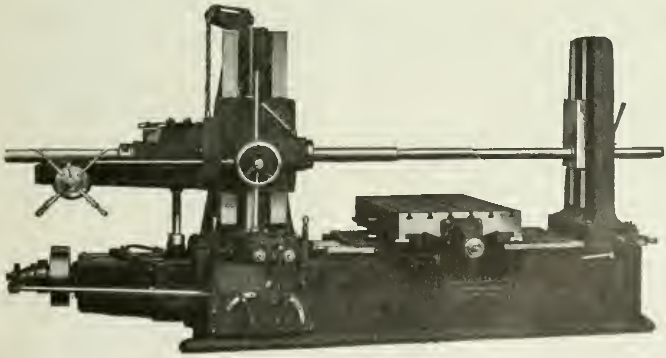
Wayne Machinery Co., Fort Wayne, Ind., manufacturer of woodworking machinery and machine shop and metal-working tools has published a booklet intended to give an idea of what may be seen on a trip through the plant of the company. The book contains photographs of the various departments as well as a description of the equipment, products, etc.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular illustrating Cleveland punching machines which are adapted for the use of



TWO LUCAS "PRECISION" BORING, MILLING AND DRILLING MACHINES

In the "Kempsmith" Tool and Fixture Department



The far-famed accuracy of Kempsmith Millers has its source in the "Kempsmith" Tool-room, where accuracy is built into tools, jigs, fixtures, etc., and duplicated in the machines they are used to produce. Of the two Lucas "Precision" Boring, Milling and Drilling Machines in this department, the first is three years old and its services sold the other.

Wherever holes must check up within 0.001" center to center, wherever tolerances are only a matter of tenths of thousandths—as in the jig here shown being machined—one or the other of these heavy duty "Precision" machines is sure to be assigned, their "excellent workmanship and permanency of alignment" being the reason given for their popularity.

Lucas "Precision" Boring, Milling and Drilling Machines are made in three sizes with 3", 3¾" and 4½" spindles. Details or salesman on request.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U. S. A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

seven standard interchangeable attachments, namely, punching attachment, angle shearing attachment, bar shearing attachment, plate shearing attachment, coping attachment, notching attachment, and fine hole punching attachment.

United States Steel Corporation, Bureau of Safety, Sanitation, and Welfare, 71 Broadway, New York City. Bulletin 8, showing examples of the safety and welfare work carried on in the plants of the United States Steel Corporation. The booklet is made up of photographs illustrating safety equipment, educational and recreation provisions, as well as homes constructed for the employes.

Vanadium-Alloys Steel Co., Latrobe, Pa. Booklet containing sixty-eight pages devoted to "Red-cut Superior" high-speed steel. In addition to the information given concerning heat-treatment, uses, etc., the pamphlet lists special sections, and gives tables of weights, and suggestions concerning the grinding of high-speed steel. Copies will be sent upon request to any user of high-speed steel.

Chicago Pneumatic Tool Co., 6 East 44th St., New York City. Bulletin 639, treating of the BQ-46 hammer drill, which is adapted primarily for demolition work, being of use to contractors in demolishing old buildings, concrete walls, and foundations, drilling anchor bolt holes, and work of a similar nature. The tool is also of use in steel mills and glass plants for removing slag from ladles and slag pockets, glass from furnaces, etc.

Simonds Mfg. Co., Fitchburg, Mass. Catalogue 121, entitled "Simonds Steel and Useful Reference Tables," descriptive of this company's facilities for making steel both for Simonds saws and for commercial purposes. In addition to material relating to heat-treatment, and data on the high-speed tool steel, and carbon and special alloy tool steels produced by the company, a large number of useful tables are included giving weights of steel, flash and fire tests of oils, melting points, decimal equivalents, heat colors, temperature conversion tables, etc.

Bacharach Industrial Instrument Co., Bennet St. and Murtland Ave., Pittsburg, Pa. Bulletin G, descriptive of manometers, for the determination of small pressures or pressure differences. These instruments have been recently added to the line of products which this company manufactures. The types shown in the circular are of a new design, and may be arranged either for pressure, draft, or differential pressure. Pamphlet M, descriptive of engine indicators of the Maihak type, which are furnished for revolutions up to 1500 per minute, for application to Diesel engines, automobile engines, airplane engines, etc.

National Acme Co., Cleveland, Ohio. Circular entitled "The Modern Mahomet," announcing moving pictures which have been made by the company in order to give those who do not have an opportunity to go to the National Acme plants, the privilege of actually inspecting their plants through these films. One of the films is entitled "The Spirit of Progress," and constitutes a trip through the screw products plant of the company, showing in detail the various operations involved in the making of a spring bolt. The other film, entitled "Building Gridley Automatics," represents features of the manufacture and assembly of Gridley automatic turret lathes and multiple-spindle screw machines. These films are shipped without charge to any company, society, or school desiring to exhibit them.

Bardons & Oliver, Cleveland, Ohio. Catalogue illustrating and describing a line of standard tools for the Bardons & Oliver turret lathes. The first part of the book gives data on turret and cut-off rest tools, including stop gages, chamfering tools, box-tools, die-holders, threading dies, die-heads, drill-holders, turning tools, tap-holders, recessing tools, hollow mills, knurling tools, cutting-off tool-holders, etc. The second part contains a detailed description of the automatic chuck mechanism used on Bardons & Oliver turret lathes; the third part contains illustrations and names of parts of the machines for use in ordering repairs; and the fourth section is made up of reference tables giving speeds of machines, screw thread data, weights and areas of round, square, and hexagon steel, etc.

TRADE NOTES

Victor Saw Works, Inc., announce the removal of their plant from Springfield, Mass. to Middletown, N. Y.

Michigan Tool Co. moved on April 25 to its new factory and office at 147 Jos. Campau, corner of Atwater St., Detroit, Mich.

Dodge Mfg. Co., Mishawaka, Ind., announces that it has obtained the exclusive agency for the distribution of Kenyon cotton rope in the United States and Canada.

Cadillac Tool Co., Detroit, Mich., announces the removal of the machine tool sales division of the company, together with the accounting department, to a new sales office and sales room at 38 Hendrie St.

Universal Crane Co. has removed its plant from Cleveland, Ohio, to its new factory at Elyria, Ohio. The company has greatly increased its capacity and production is now under way in the new plant.

U. S. Tool Co., Inc., 51-53 Lawrence St., Newark, N. J., will take additional shop space at 117 Mechanic St., where the company will manufacture the U. S sub-presses, and will do an extensive line of punch press work.

Norton Co., Worcester, Mass., manufacturer of grinding wheels and grinding machines announces that until further notice all refractory materials previously billed at list price, plus 10 per cent, will be billed at the straight list price.

Bernard E. Mohr, formerly manager of the machine tool department of the Fairbanks Co., St. Louis, Mo., has engaged in business for himself at 5407 Easton Ave., St. Louis, Mo., selling new and used machine tools and machine shop equipment.

Consolidated Tool Works, Inc., has moved from 261 Broadway into new quarters at 296 Broadway, New York City, where the general offices and the New York warehouse of the company will be located under one roof, which will greatly facilitate the handling of the business.

Mason, Fenwick & Lawrence, 220 Broadway, New York City, patent and trademark lawyers, announce that they have associated with them three late members of the examining corps of the United States Patent Office, namely, E. D. Sewall, C. R. Allen, and H. P. King.

Edward Valve & Mfg. Co., East Chicago, Ind., has moved its general offices from 72 W. Adams St., Chicago, to its factory at East Chicago, Ind., in order to centralize the control of the industry and better serve its customers. All correspondence should hereafter be addressed to East Chicago.

Pittsburg Stamp Co., Inc., has moved from Pennsylvania Ave., to larger quarters at 815-817 N. Canal St., North Side, Pittsburg, Pa. In the new location the company will have a modern completely equipped factory for turning out steel lettering dies, steel and brass stamps, nameplates, stencils, and similar work.

Sage Radiator Co., Inc., has been organized in Syracuse, N. Y., by Charles S. Sage, for twelve years chief engineer and superintendent of the Rome-Turney Radiator Co. of Rome, N. Y. The new company will manufacture radiators for trucks, tractors, and airplanes and will be located at 1050 S. Clinton St., Syracuse, beginning May 1.

E. Horton & Son Co., Windsor Locks, Conn., has taken over the Ellison drill chuck business, which has been carried on for the last few years by the American Machine Co., of Hartford, Conn. It is the aim of E. Horton & Son Co., to carry such a complete line of chucks that it will be in a position to supply a chuck for every possible need.

Victor Saw Works, Springfield, Mass., at a meeting of the board of directors, elected William F. Pollock, president of the company to succeed Frank M. Baldwin, resigned, and Guy W. Donahue, vice-president in place of William P. Jeffery. The board of directors was increased to five members by the addition of Mr. Pollock and Mr. Donahue.

Victor Tool Co., Inc., Waynesboro, Pa., has opened a branch office in New York City at 131 W 39th St. F W. Curtis is manager and Warren J. Boe is sales engineer. All matters from the New York territory pertaining to the company's line of collapsible taps, self-opening die-heads, and floating reamer-holders will be handled from this office.

Federal Engineering & Mfg. Co., Cleveland, Ohio, has reorganized for the purpose of expanding its business. The company is developing a special line of machine tools and parts, and will continue its regular lines under the name of the **Master Tool Co.**, at its present address 203 E. St. Clair Ave., Cleveland, Ohio. Charles F. Overly is vice-president and general manager.

Wheel Truing Tool Co., 2131 Penobscot Bldg., Detroit, Mich., importer of industrial diamonds, and manufacturer of diamond-pointed tools, announces the removal of its western office from the Wells Building, Milwaukee, Wis., to the company's branch office in the Great Northern Bldg., 20 Jackson Blvd , W., Chicago, Ill. W. J. Sansom will be in charge at the new location.

David A. Wright, Chicago, Ill., dealer in machine tools and appliances, has moved into new quarters at Jefferson and Monroe Sts. in the new machinery center in Chicago. The new offices have 5000 square feet of floor space and 150 feet of window space, and will be used exclusively for show rooms. Mr. Wright is also putting on the market a line of large lathes of his own manufacture.

Arrow Tool Co., 200 Cannon St., Bridgeport, Conn., announces that the company is now doing business under the name of **Arrow Tool & Mfg. Co.** There will be no change in the business aside from the addition of a fully equipped press department which will enable orders to be taken for light and medium sheet-metal stampings and light manufacturing. The company will continue to make tools and special machinery of all kinds

Modern Tool Co., 2nd and State Sts., Erie, Pa., has appointed the **E. L. Essley Machinery Co.**, 551 Washington Blvd., Chicago, Ill., as the exclusive selling agent in the Chicago territory for Modern plain and universal grinding machines. At the Essley headquarters expert services will be given to customers by experienced grinding machine men, and the Modern Tool Co. will also have its own grinding expert stationed there.

David A. Wright, Chicago, Ill., moved May 1 to a new location at the southwest corner of Jefferson and Monroe Sts. The new showroom will have approximately four times the space now occupied. In addition, the company has a warehouse and factory at Roosevelt Road and Washtenaw Ave., where a large stock of machinery is stored and rebuilt. This plant is equipped with machinery for rebuilding machine tools.

Atlas Crucible Steel Co., with plants at Dunkirk, N. Y. and Welland, Ontario, Canada, has moved its general offices, including general sales offices, to the Hanna Bldg., Cleveland, Ohio. The company has recently extended its facilities, and in addition to its regular production of tool steels is now in a position to furnish high-grade alloy steels. Frank P. Case will be in charge of the sale of tool steels, and Harry J. West in charge of the sale of alloy steels.

Austin Machinery Corporation, manufacturer of cranes, steam shovels, and other road-building machinery, announces that it will rebuild its plant at Winthrop Harbor, Ill., which was recently destroyed by fire. For the present business will be handled through its Muskegon plant or Toledo plant. The company has recently consolidated into its group, the plant of the **Fairmont Mining Machinery Co.**, at Fairmont, W. Va., and extensive improvements are planned there.

Ogden R. Adams, Central Ave. and St. Paul St., Rochester, N. Y., will hold a machinery demonstration and hand-hacksawing contest at his plant on the afternoon and evening of May 7. The hacksaw contest will consist of sawing through ten lengths of 1-inch pipe, and an award of $25 in cash will be made to the winner. Demonstrations of drilling, milling, internal and external grinding, and lathe and screw machine work will be made by experts from various machine tool manufacturers, showing latest methods of production.

Darwin & Milner, Inc., makers of crucible and electrically melted carbon and alloy steels, announce that the head offices and warehouses of the company are now centralized at 403 Long Ave., Cleveland, Ohio, to which address all general correspondence and orders should be sent. H. Reinhardt, 80 Rutland Road, Brooklyn, N. Y., will act as general district agent for New York and adjacent territories, and the Brooklyn Steel Treating Corporation, 8 Franklin St., Brooklyn, N. Y., will be special representative of the company for New York City.

American Electric Fusion Corporation was recently organized with a capital of $50,000 for the purpose of manufacturing electric welding machinery of the resistance type, that is, butt-welders, spot-welders and seam-welders. The officers of the corporation are as follows: President, Edmund J. Henke; vice-president, Edgar Littmann; secretary-treasurer, S. G. Taylor, Jr.; director of sales, Arthur B. Sonneborn. The works and offices of the new corporation are temporarily located at 1906 N. Halsted St., Chicago, Ill., pending the erection of a permanent home.

Reeves Pulley Co., Columbus, Ind., has transferred its New York agency from Patterson, Gottfried & Hunter, Inc., to the Standard Supply & Equipment Co., 71 Murray St., New York City. The new agency will carry complete stocks of the Reeves variable-speed transmission and wood split pulleys, as well as a full line of repair and replacement parts. William L. Garcis formerly head of the power transmission department of Patterson, Gottfried & Hunter, will continue to handle the Reeves lines, having now become associated with the Standard Supply & Equipment Co.

Fosdick Machine Tool Co., Cincinnati, Ohio, maker of heavy-duty radial drilling machines and upright drilling machines has taken over all patents, drawings, patterns, jigs, and fixtures covering the line of Pierle quick-change high-speed ball bearing sensitive drilling machines from the R. K. Le Blond Machine Tool Co. This acquisition will give the Fosdick Machine Tool Co. a complete line of drilling machinery consisting of heavy-duty radial drilling machines, heavy-duty upright and gang drilling machines, and high-speed sensitive single- and multiple-spindle drilling machines.

Air Reduction Sales Co., manufacturer of "Airco" oxygen, acetylene, and welding and cutting apparatus, announces that its executive offices were moved on May 1 from 120 Broadway and 160 Fifth Ave., to 342 Madison Ave , New York City. The New York district office was transferred on the same date to the "Airco" factory at 191 Pacific Ave., Jersey City, N. J. The company also announces that it has secured control of the National Carbide Corporation of Virginia, which has a new plant at Ivanhoe Va., and began May 1 to direct the policy and control the operation and sales of this corporation. The carbide produced at the new plant will be marketed as "Airco" carbide through the chain of "Airco" distributing stations.

VOLUME 27

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NUMBER 10

JUNE, 1921

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It is understood that all contributed articles pertaining to machine shop practice and machine design are submitted exclusively to Machinery; when accepted and published, payment is made at our regular space rates unless other terms have been agreed upon.

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The Editor's Monthly Talk

WHAT the technical journal offers its readers is, or aims to be, something other than entertainment; but the technical journal is in competition with all the professional and amateur entertainments which beset the modern man on every side. The range of attractions is wide, including the ever-present and ever-changing movies. The function of a journal like MACHINERY is to be useful rather than diverting, technical and practical rather than beguiling.

It speaks well for the men who operate our manifold industries that, notwithstanding the diversions on every hand which make so strong and constant an appeal for their time, money and attention, they continue to give not only splendid but ever-increasing support to the journal of serious and definite purpose. Trade and technical journalism never had so many readers—serious readers who mean to master all the technical details of the greatly diversified industries in which they are at work, and it is more than likely that the measure of success which comes to each journal in its special field is about equal to its merit, not as entertainment, but as practically useful, educational and reliable.

When Does Automatic Machinery Pay?

The question above is timely. Not all automatic machinery pays, however ingenious or efficient. It often happens that automatic machinery is designed for work which can be done just as well by relatively inexpensive hand-operated machinery. The natural tendency of the progressive machine designer is to develop machines and devices that will work automatically, but it often happens that the first cost of such a device may be out of proportion to the number of parts to be made. Where quantity production is required, the machine may pay for itself in a very short time, but where quantities are limited it may never pay for itself.

The article in June MACHINERY, "When Does Automatic Machinery Pay?" discusses the fundamental points which must be considered before any attempt is made to provide automatic machinery for machining operations: Can an automatic machine be designed which will turn out a thoroughly satisfactory product? How much will it cost? What production rate will it give? How much attention will it need to keep it in running order? These practical points are considered in detail, and the methods for reaching satisfactory conclusions with reference to each question are definitely outlined.

Accuracy in Drawings

In the article, "Common Causes of Errors in Machine Design," in June MACHINERY, the author emphasizes the great importance of making drawings absolutely accurate, in order to avoid misunderstandings likely to be very costly during production. By correct drawings the author means not merely technically correct—that is, that there should be no errors in dimensions, but accuracy in design and in the mechanical principles involved. The designer should not be too quick to discard an old design or too critical of some unfamiliar construction or shape of a part previously used. Very likely there are good reasons which were carefully thought out in the past, and it is as risky to discard the old without careful consideration as to reject improvements when not obviously advantageous.

The successful designer must be always on the alert; he must compare the old and the new, the results of past experience and the ideas for new developments. MACHINERY has published nothing more definitely useful than this series. Some of the points covered may appear elementary, but they are not elementary when considered in the broad manner in which the author handles his important subject.

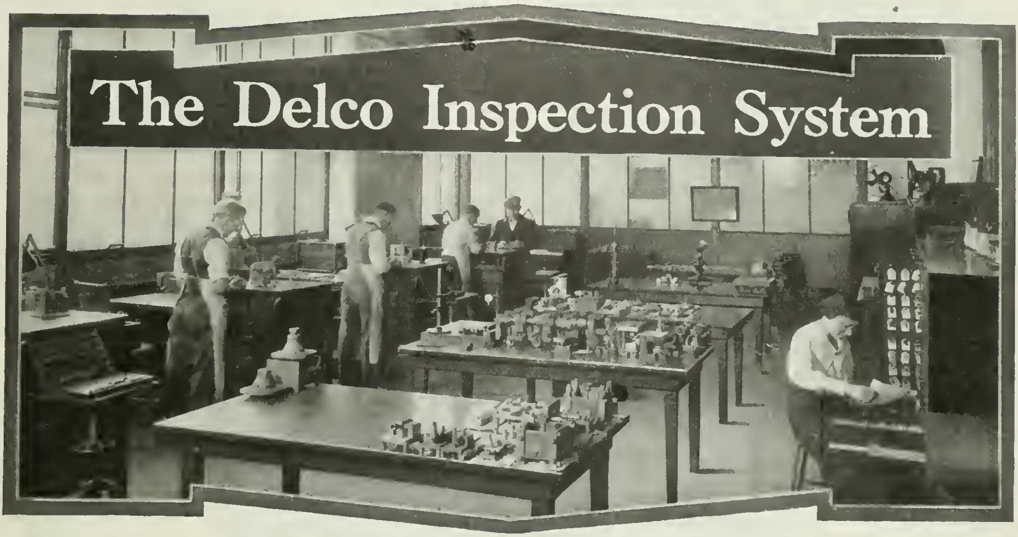
Dealing with Selling Problems

To make an article is one thing and to sell it is quite another. The basic principles of a successful selling organization are discussed in June MACHINERY by Howard W. Dunbar, sales manager of the grinding machine division of the Norton Co., Worcester, Mass. Mr. Dunbar is definite and specific. He discusses the work of the machine tool salesman, the duties of the selling force, policies in selling machine tools, suggestions made by the customer for modifying design and for special fixtures, the return of machines to the factory for repairs, credit allowances on returned parts and materials, and the salesman's attitude toward complaints.

This is the first of a series by Mr. Dunbar which will be read with a great deal of interest by men connected with the selling organizations, not only of machine tool firms, but of builders of machinery in general, as well as by dealers. The production department will find these articles of particular interest, because in any successful business, quality in production and efficiency in selling must go hand in hand.

Modern drop-forging practice will be covered in a series of articles beginning in July MACHINERY. This series will deal with the work in all its phases, beginning with the lay-out of a drop-forging plant and definitely outlining the equipment required. These articles will cover drop-forging methods, the making of drop-forging dies, heat-treatment of dies and various other operations and problems met with in drop-forge shop practice. In addition, July MACHINERY will contain thorough and up-to-date articles on railway shop practice, cold-swaging dies, the work efficiently performed on crank planers, and numerous brief articles on approved shop practice and machine design.

JUNE MACHINERY 1921



The Delco Inspection System

A Description of the Methods Used by the Dayton Engineering Laboratories Co., for the Inspection of Raw Materials, Purchased Parts, Tools, Equipment and Gages, and the Manufactured Product*

By LOUIS RUTHENBURG, Superintendent, and R. A. CRIST, Assistant to the Superintendent of the Dayton Engineering Laboratories Co., Dayton, Ohio

THE inspection system used by the Dayton Engineering Laboratories Co. is divided into three main groups: (1) Inspection of raw materials and purchased parts; (2) inspection of tools and equipment; and (3) inspection of the manufactured product. As organized, the inspection division of the Delco plant is divided into five specific groups, known as follows: (1) Tool inspection; (2) parts in process inspection; (3) final inspection; (4) road inspection; and (5) salvage department.

Of these the second division—parts in process inspection—is divided into three subdivisions: (a) Receiving inspection; (b) departmental inspection; and (c) service inspection. Because of the nature of the product manufactured by the Delco plant the final inspection is divided into two sections, the mechanical and the electrical. The duties of each of the different sections or departments and the methods employed will be dealt with in detail in the following.

The present article on the principle of the Delco inspection system is based on a paper prepared for a training course for executives by the executive training course committee of the Dayton Engineering Laboratories Co. This committee consists of Louis Ruthenburg, superintendent, R. A. Crist, assistant to the superintendent, W. E. Baker, employment manager, and O. T. Kreusser, educational head, working in cooperation with other executives of the Delco organization. The principles laid down, therefore, constitute the authoritative record of the best practice in inspection, as the highly developed and systematic methods of the Delco organization are well known throughout the whole engineering world.

Receiving Inspection

The first necessity for inspection arises in connection with raw materials and purchased parts. This inspection includes visual examination, both as to quantity and quality, and, when possible, also chemical, mechanical, and electrical tests. It includes the inspection of castings, both while in process in the foundry making them, and when finally received at the Delco plant.

The materials which pass through the receiving inspection department may be roughly classified as follows: (1) Raw materials; (2) semi-finished and finished parts; (3) shop equipment and supplies.

Inspection of Raw Materials

All raw materials, when received, are provided with a green tag, which indicates that the material must not pass to the production departments until this tag has been removed, the removal of the tag being an evidence that the material has been properly inspected. All material received that can be tested either by physical, chemical, or electrical tests has a sample removed from it, which is sent to the laboratory for testing purposes. In this manner the materials are tested to determine that they agree with the predetermined specifications, the purpose of which was explained in the preceding article dealing with principles of inspection. Thus, for example, all material, such as bar and sheet stock, is sent to the chemical laboratory for analysis and also for physical tests. At the same time the received material is checked to determine the quantity received, and when this has been done and while the analyses are still being made, the material is sent to the raw stock department, but the green "hold cards" placed on the stock prevent it from being released for the production departments until the chemical laboratory's report of approval has been received.

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Raw materials in the form of castings also pass through the receiving inspection department. The rough castings are first inspected as to quantity and weight. Then a hammer test is employed to detect cracks, and in some cases the castings are checked for warpage by a flat surface inspection. As most castings used by the company are annealed and sand-blasted before passing to the manufacturing departments, the castings are routed to the heat-treating department for this process, and then inspected before being machined. Defects often develop while annealing and sand-blasting, and a re-inspection of the castings before they are sent to the stock-room usually will bring to light such defects.

One inspector is in entire charge of the casting inspection. He visits the foundries making the castings twice a week, inspecting both the pattern-making work and the molding. He then inspects the castings after they have been received at the Delco plant, and he also follows them through the machining departments to ascertain that no difficulties are met with in machining them. It is obvious that there is a great advantage in having one man responsible for the inspection of the castings from the time that the patterns are made until the castings are machined. There is no divided responsibility, and hence much less likelihood of anything being overlooked that could be prevented in time. In order to place a double check on received material, the receiving department, which records the receipt of raw materials or parts, counts and weighs everything that comes into the plant, and the inspection department also counts and weighs the materials.

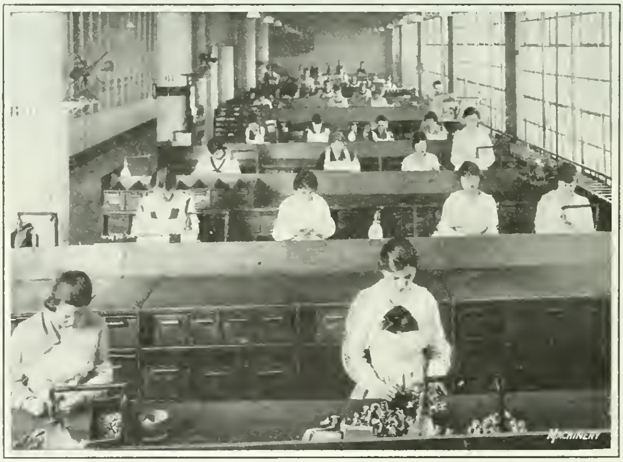


Fig. 1. Typical Inspection Department in the Dayton Engineering Laboratories Co.'s Plant

Inspection of Semi-finished and Finished Parts Purchased from Outside Plants

When orders for parts are placed with outside plants, samples of the finished material ready for shipment are sent by the outside plant to the Delco inspection department before shipment is made. These sample parts are then inspected, and if found satisfactory shipment will be requested and the parts received. Purchased parts which arrive in their finished shape are inspected in the receiving inspection department, and then passed to the stock-room. Ball and roller bearings are carefully inspected, as well as armatures, resistance units, and other parts that are purchased from outside concerns.

The receiving inspection department also counts and records the number of small tools, machine tools, and other equipment that is received. The inspectors attach to each a number, and notify the tool inspection department that such machine tools or small tools have been received, but before the tools or machines are released to the factory, they must be inspected by the tool inspection department, which is held responsible for the equipment.

Under the heading of general equipment and supplies, there are also all kinds of articles ranging from office desks to thumb-tacks which must be checked for quantity and quality. This is done by the receiving inspection department. If the purchased materials do not meet the specifications, "return goods orders" are issued and passed to the purchasing department, and the materials are returned to be replaced by those that will meet the specifications.

Tool Inspection

The tool inspection department, a view in which is shown in the heading illustration, is responsible for the checking of all tools, appliances, machinery, and machine tools. The work of inspection is roughly divided into six classes, as follows: Jigs and fixtures; dies and plug and snap gages; small tools; precision tools and gages; machine tools; and shop appliances. All tools, whether made within the plant or purchased from the outside, must be passed upon by the tool inspection department before being sent into the factory. Tools made in the plant are all checked to the drawing, and are given what is known as a 100 per cent inspection. The inspection department is also given the right to criticize the design and to suggest improvements. The inspectors are specialists, one man, for example, always inspecting dies; another, jigs and fixtures; another, plug and snap gages; while still another works exclusively on drills, taps, threading dies, and small tools purchased from outside manufacturers. When new jigs or fixtures are placed on the job and parts from them do not pass the parts-inspection department, the tool inspection department is held responsible, and is expected to locate the trouble as well as to suggest some means for remedying it.

Blanking and drawing dies are inspected by the tool inspection department for dimensions. They are then sent to the press department for trial. The first parts turned out by the dies are then sent back to the tool inspection department as a final check of the die. These parts are tagged and kept by the inspection department for reference. Lead proofs are made of all drop-forging dies, and these are also kept by the tool inspection department for future reference. The first actual forgings made by a drop-forging die are also sent to the tool inspection department in order to ascertain that they conform to the lead proof, and are kept for future reference.

In the inspection of taps and threading dies, an actual trial is made of a few taps and dies to see that they cut properly. The lead is inspected by an Alfred Herbert thread testing machine. The tool inspection department is also responsible for gages of all kinds used in the factory, and in order to maintain the quality of gages, a special method known as "night tool inspection" is used.

Night Tool Inspection

A tool inspector visits the various manufacturing departments after the closing hours and inspects all the gages used during the day. These gages are left out by the supply keeper so that the night inspector knows what gages have been used, and in that way is enabled to maintain the gage equipment in a first-class condition. Some departments are visited only every other night, while the grinding department is visited every night on account of the fact that the gages there usually have smaller tolerances and wear faster. This night inspection saves a great deal of poor work, and eliminates arguments with the men that their gages are incorrect; thus it not only increases production, but also creates a better spirit in the plant.

Every gage below size is returned to the tool department and replaced. By checking the gages in this manner, time is spent only on inspecting the gages that are actually in use, but these are checked frequently. Systems that include going over all gages at certain intervals involve a checking and rechecking of gages that may not have been in use at all, while those that are used daily are not inspected often enough to maintain the required accuracy. As one man inspects all the gages throughout the plant, there is no divided responsibility; and such gages as adjustable thread gages, etc., are sealed with sealing wax in order to protect both the inspector and the man who uses them.

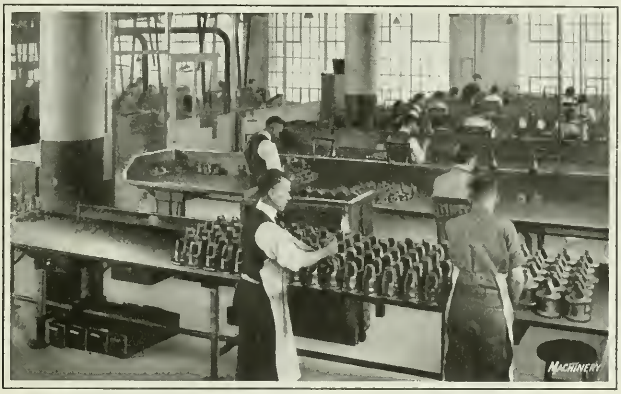


Fig. 2. An Inspection Department for Finished Parts

Equipment of the Tool Inspection Department

The tool inspection department is provided with the necessary equipment of Pratt & Whitney and Johansson precision blocks, Hirth minimeters, American amplifying gages, standard thread plugs and receivers, Alfred Herbert lead-testing machine, Hartness screw thread comparator, together with a full equipment of the more usual types of measuring instruments.

A number of sets of precision blocks are used. One set is kept as a master reference set. This set has been verified by the Bureau of Standards, and all new sets received are checked against it. The several sets of precision blocks in use in the plant are checked about once a month against this master set. If some of the blocks are found to have worn, the amount that they are below size is marked on the lid of the box in which they are kept, immediately above the block, so that by taking this figure into account the blocks can still be used for precision purposes. The best set next to the master set is kept in the tool inspection department, and as new sets are acquired, this set, with the wear marked upon each block, if wear has taken place, is passed on to the various other departments that use precision blocks.

All ground work is inspected by Hirth minimeters or American amplifying gages. Setting blocks of accurate dimensions are made in the tool-room for each part to be inspected by this type of gage. The tool inspection department works entirely to definite standards and limits which are arrived at in the application of the limit system. The tolerances are predetermined, and are specifically incorporated in the tool drawings or in the drawings for the parts to be made with the tools.

Under the high productive pressure system used in the Delco plant, the life of a gage is rather indefinite and is governed by many conditions. Therefore, unless the gages are always kept in a first-class condition there is always a possibility of spoiled work. For this reason the night inspector, in addition to returning such gages as are under size to the tool supply room, makes out a daily report covering the entire inspection, and in this way the limit system is rigidly maintained.

Inspection During Manufacture

The method of conducting the inspection of material as it moves through the shop varies greatly with the requirements in different plants. The detail of inspection and the accuracy necessary in producing electrical automobile equipment is, of necessity, much greater than it would be in the manufacture of, say, dredging machinery. There are in general use two principal methods of conducting inspection of parts during manufacture—traveling or floor inspection, and centralized inspection.

Comparison of Floor Inspection and Centralized Inspection

Under the first method—floor inspection—the inspector spends all his time on the shop or factory floor, moving from place to place as necessary. The initial parts are checked as they come from the machines, and the finished lots checked as regards both quality and quantity when they leave or arrive at each new operation or process.

In the centralized method of inspection, central inspection rooms are provided, and all work is returned to the proper room after each operation or after a definite number of operations. This method is of considerable advantage when the parts are small and the limits of accuracy close. If, however, the work is large and the parts heavy, it is obviously impractical. The extent to which one or the other or the combination of both of these systems should be used is a problem of management which often requires very good judgment. In general, if the parts are small, and the work of transferring them is not great, centralized inspection will be cheaper and more effective.

The experience which the Delco plant has had with floor inspection has proved that the placing of floor or traveling inspection in a department tends to relieve the foreman of the department of the responsibility for the quality of the work. Floor inspection does not necessarily insure quality. Quality product can only be obtained by the operator. The foreman of a department must assume the responsibility for the operator's turning out accurate parts.

Departmental Inspection Versus Centralized Inspection

Completely centralized inspection usually involves a considerable amount of extra handling. Then, too, under completely centralized inspection, without floor inspection, there is the added possibility of defective work in considerable quantity. For example, some of the Delco parts have as many as thirty operations conducted in a half dozen departments. If such parts were carried entirely through these operations without intermediate inspection, there would be a possibility of great financial loss. The operation on which such a piece was spoiled might be among the first, with the result that all succeeding operations would be performed on a defective part. Departmental inspection results in the inspection of the work after each department has finished its operations. In this manner, defective work is discovered before the cost of subsequent operations is added.

The department inspection is carried out in the manufacturing departments, each inspection department being under the charge of an inspection foreman or job foreman, responsible to the general inspection foreman, who, in turn, reports to the chief inspector. Two of the parts-inspection departments are shown in Figs. 1 and 2.

Parts in Process Inspection

The methods used in the various departments for inspecting parts in process differ with the nature of the parts being inspected. Small parts from automatic and hand screw machines, such as screws, nuts, and bushings, are generally inspected by picking up 10 per cent of the number of pieces from a lot and giving these a thorough inspection with thread, plug, and receiver gages. If any of these parts are found to be defective, the whole lot is inspected. The inspector is also held responsible for the accurate count of the pieces. If any parts are held to very close limits and there are a number of operations following, every part is inspected. After the inspection the parts pass on to the next operation.

The inspection of power press parts on which drawing and forming operations have been performed requires that every part be inspected, using special inspection fixtures. Blank parts are ordinarily inspected for the proper dimensions according to the specifications given on the blueprint, such items as diameter, location of holes, etc., being checked.

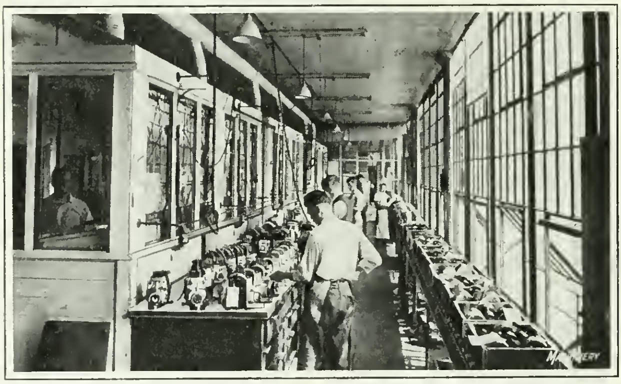


Fig. 3. A View in the Final Inspection Department, showing Soundproof Booths to the Left

Ground and hardened parts are given a much closer inspection. In addition to plug and snap gage inspection, indicator gages—especially amplifying gages—are used, and scleroscope and file tests are made. A number of special fixtures are also employed, some of which will be illustrated and described in a coming article in MACHINERY.

Molded insulation parts are given an electrical test, in addition to the visual inspection for molding defects. In the inspection of gears, the inspection department makes actual running tests from the first samples turned out, on a machine after it has been set up for quantity production. The approval of the inspection department must be secured before further gears are cut by the operator. After heat-treatment, all parts are tested to ascertain whether they have warped. The scleroscope is freely used for hardness tests. All plated and enameled parts are also inspected after heat-treatment. On all parts where concentricity is important or where for some other reason it is necessary to determine that the part will finish properly in a subsequent machining operation, such inspection is made. It is evident that this part of the inspection as well as inspection of locating points for subsequent operations is of great importance. Each inspector is held responsible for the finished dimensions in each operation. When the part is passed through its last operation and has been approved by the inspection department, it finally passes to the stock-room from which it is drawn by the assembly department.

The manufacturing departments in the Delco plant that are provided with parts-inspection departments are the drilling and milling departments, the hand screw machine department, the gear and lathe department, the automatic screw machine department, the plating department, the insulation department, and the armature department.

Sub-assembly Inspection

The apparatus made by the Delco plant is largely built on the unit plan, making possible sub-assemblies which can be returned to the stock-room and drawn from there for the final assembling work. After the sub-assembly has been completed, there is an inspection of the assembled unit to determine that the proper parts have been used in the assembly, that no damage has been done to the parts during the assembly work, and that the parts have been properly put together. Then the assembled unit goes back to the stock-room.

Final Inspection

In practically all industries a final examination is made of the finished product before shipment. These final inspections and tests are usually conducted in accordance with instructions furnished by the engineering department. The requirements of the final test are often set by the purchaser, and he or his representative may be present at the test. It is generally the practice, in highly specialized manufacturing plants having functionalized inspection, for the engineering department to prepare complete data sheets covering the final inspection and test. This practice is carried out in the plant of the Dayton Engineering Laboratories Co. The final inspection of the product in this organization may be divided into two definite phases—first, mechanical inspection, and second, electrical inspection.

Final Mechanical Inspection

The final mechanical inspection is performed as close to the assembly operation as possible, permitting defects to be taken care of immediately by the builder or the repairman. Inspectors must see that the parts are properly assembled, correct parts used—free from defects—and must also inspect for quality and workmanship.

Each piece of apparatus is numbered in series, the number being stamped on the apparatus. The assembler places a tag with a corresponding serial number on each motor or generator at the time the building operations are started. By this method the motor car companies keep a record of the serial number of the apparatus installed on each car. A space is provided on the tag for the inspector to place his check number when he has approved the inspection of the apparatus.

Preliminary electrical tests are made by the mechanical inspector before the apparatus is sent to final electrical inspection for final electrical test. Mechanical inspection is carried out through the various stages of assembling to insure quality product.

Final Electrical Inspection

The final electrical inspection of completed apparatus is made after the product has been passed by the mechanical inspectors. All motors and motor generators are subjected to a one-half hour running test as a motor for the purpose of thoroughly heating them. This test also serves to bring out "grounds" or "shorts," as well as faulty connections, and to properly seat the brushes. On this running test the motors are subject to inspection for the amount of current consumed. From this test they are transferred to a torque test, and the amount of "stalling torque" determined. Definite limits are established by the engineering branch when the product is designed, to meet the requirements of the customer.

Generators are taken from the running test, placed in soundproof booths, and tested for generating capacity, noise and electrical defects. A row of these booths is shown to the left in Fig. 3, and an inside view of a testing booth in Fig. 4. Here again the inspector is made responsible for the approval of the apparatus, by the recording of his check number on the serial tag. Incidentally, he also checks the stamped number on the apparatus against the serial number on the tag to see that they agree. To insure that no electrical defects have been overlooked during these two tests, and that no "grounds" are caused in fitting the covers, a third electrical inspection is made after the apparatus leaves the test booth. This test is made by the use of "test points" on a 110-volt line, after the "end and dust-cover fitting" operation.

The final electrical inspection of distributors is accomplished by the use of special test fixtures. Automatic spark advance, variation in degrees between sparks, strength of spark on each cam lobe, and the number of degrees of hand advance (to meet definite established limits), are among the salient features of the testing. A departmental foreman is in charge of each of the two phases of final inspection, and a general foreman is in charge of all final inspection functions. The general foreman is directly responsible to the chief inspector.

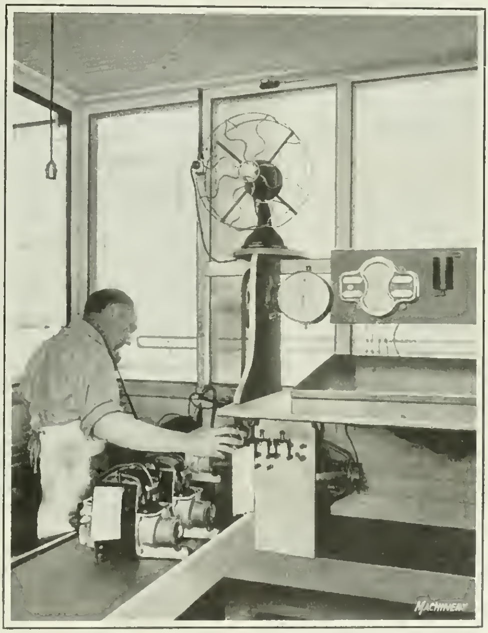


Fig. 4. Inside of a Soundproof Inspection Booth, where Apparatus is inspected for Silent Running

Road Inspection

It is the policy of the Delco organization to assign high-grade inspectors to the various automobile districts, and even, in some cases, directly to customer's plants, for the purpose of keeping the factory in close touch with any trouble that may develop after the shipment of the apparatus from the factory. In this way minor defects which may be overlooked in the factory are caught and remedied before the apparatus actually goes into service. This inspection service is of great importance. It produces a close contact between the manufacturer and his customer; it aids in having the apparatus built by the Delco plant properly used; and, as the Delco products are part of the customer's final products, it is of importance to the Delco organization that its product be placed properly in the ultimate product of the customer.

Service Inspection

The contact of the inspection organization with the product does not end here. As soon as a car is shipped from the automobile manufacturer's plant the question of service becomes paramount. The service division of the Delco organization is almost a complete unit in itself, operating under the general supervision of the sales department. All defective apparatus returned from service is handled by the service division. As soon as a piece of defective apparatus is returned, it is carefully inspected. At this point the service inspection department, which is a part of the inspection organization, begins to function.

Service inspection includes practically every type of inspection previously described. Every "ailment" known to electrical apparatus is eventually diagnosed by this department. This fact is of particular significance to the inspection organization as well as to the manufacturing organization. From the service records and from the inspection records of material returned from service, much information is gained which is of great importance in designing new apparatus, setting manufacturing limits, and arriving at proper standards of quality. This service inspection department is the final or connecting "arc" in the inspection "circle," forming a complete ring of responsibility, authority, and information.

The Salvage Department

Spoiled work and waste materials constitute one of the greatest leaks of direct financial loss in many manufacturing plants. Recently a great deal of attention has been paid to the matter of waste, and the results accomplished by a well-organized salvage department have been remarkable in a number of cases.

Spoiled work is not always a complete loss. Sometimes repairs may be made or the material reoperated. The function of the salvage inspection department, as will be described later, is to determine if spoiled work is subject to economical salvage. Material consigned as scrap is sent to the salvage department. The necessary records for material of this class are kept on what are known as scrap and reoperation tickets.

In many classes of work there is a certain amount of unavoidable scrap or waste, not from spoiled work, but resulting from the regular processes. For example, in metal-stamping operations, there will be quantities of blanking scrap left over; scrap in the form of turnings and borings is left from other classes of work, and so on. The amount of this scrap affects the cost of the work. When the scrap is high, the cost will naturally be higher. All such scrap is carefully collected and sold, as the scrap value bears an important relation to the total cost of manufacture.

All scrap and waste material must be sent to the salvage department. Here it is graded according to classification and held for sale. Common salvage, such as metal press scrap, turnings, borings, and similar material, is gathered and placed in separate containers and bins and shipped on sales contracts.

The salvage department is the "bone-yard" of the factory. Nothing in the way of waste material is overlooked. Files are recut; belting relaundered; screwdrivers, monkey-wrenches, hammers, pliers, and the like are repaired; milling cutters, reamers, and drills are salvaged by recutting or using the tool steel for other purposes; high-speed reamers, drills, and cutters are reduced to smaller sizes; lumber in the form of barrels, boxes, magnet wire spools, etc., is salvaged; obsolete machinery and tool supplies and machine appliances are sold. Salvage material is not permitted to leave the factory without the approval of the salvage department.

Salvage Inspection Department

The salvage inspection department and the salvage department are operated under separate heads, the first-named being responsible to the general inspection foreman of parts in process. The functions of the two departments are different; the salvage inspection department merely passes upon material rejected by the various departmental inspectors for the purpose of determining whether the material can be reoperated or will be scrapped. If scrapped, it is turned over to the salvage department which disposes of the material at its scrap value, as explained in the previous paragraphs.

The parts that must definitely be scrapped are passed on to the salvage department. For such parts the inspection department makes out a scrap ticket, which is signed by the foreman of the department whenever any material from his department is to be scrapped. This method gives the foreman information as to what material from his department has been found defective, and gives him an opportunity to remedy the defect immediately.

Central Inspection Office

In keeping with the functional plan in inspection, all clerical work in the inspection division is handled through the central inspection office. This plan enables the routine of the various inspection departments to be closely coordinated with the general inspection system.

* * *

CUTTING RATCHET TEETH ON A DRILLING MACHINE

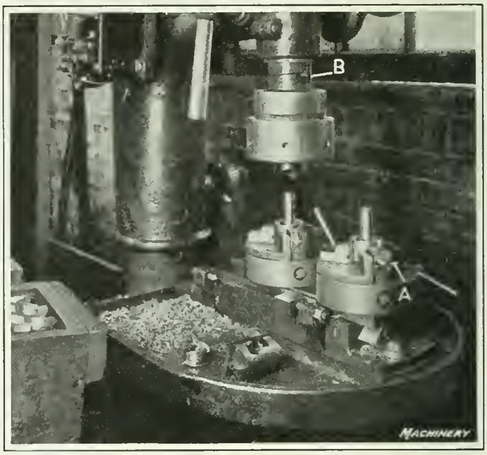
In the machine shop of the De Laval Separator Co. at Poughkeepsie, N. Y., a drilling machine is equipped for machining ratchet teeth in small steel collars, as shown in the illustration. These collars are first slotted to the depth of the teeth to form the front angle of the teeth and to provide a clearance space for the tool used in finishing the teeth on the drilling machine. A special tool of the counterbore type is used for this purpose, both ends being provided with cutting teeth, as may be seen by referring to the illustration, where one of the tools may be seen lying on the table of the machine.

The tool is held in the chuck by means of four set-screws which engage counterbored spots on opposite sides of the tool. Two spots on each side are machined in a direction nearly tangential to the circumference of the tool but in opposite directions, so that the screws in each pair operate against each other and make it impossible for the tool to become loosened during the severe service to which it is subjected.

The collars are clamped in a two-station fixture which is clamped to the table of the machine and which has a slide in the base, with suitable stops, in which a dovetail in the upper portion of the fixture operates. In this way, one piece is being removed and the station reloaded during the time required to machine the work held in the other station. It will be clearly seen that the chucks which clamp the work in place are provided with a pilot which engages the hole in the tool during the machining operation, thus holding the tool and the work in perfect alignment. It will further be observed that a pilot screw *A* is employed for the purpose of locating the work so that the cutting edges of the tool will be in the proper relation to the slots previously machined in the collars; the angle of the teeth must run into the slot at the correct depth.

The attachments provided for performing the work are as follows: A heavy coil spring is interposed on the top of the spindle between a collar and the top bearing. The spindle also carries two pairs of mating ratchet-teeth cams, which are made of hardened tool steel. One of these pairs of cams is located just above the machine spindle sleeve, and one just below it. The lower pair may be seen at *B*. but the upper pair and the recoil spring do not appear in the illustration. It will readily be understood that the action produced by this arrangement, when the feed is in engagement, is a jerky, intermittent motion, which is caused by the ratchet-cams gouging the cutter into the metal an amount determined by the rate of feed, and by the quick-return movement produced by the stiff coil spring at the top of the spindle.

Two sets of cams are employed, so that by placing them in a certain relation to each other, the harshness of the upward motion of the spindle will be lessened somewhat by breaking the force of impact between the engaging teeth of the cams. This is an unusual method of performing an operation of this kind, but nevertheless an effective one, for a high production rate is obtained by the use of the equipment described.



Drilling Machine with Special Provision for cutting Ratchet Teeth in Steel Collars

* * *

RIVET CUTTING RECORD

What is believed to be the record for cutting rivets in the dismembering of steel freight cars was recently established by an operator who cut out 1038 rivets in two hours and forty-six minutes. Of this number 683 were ⅝-inch rivets, 228 were ¾-inch rivets, and 127 were ⅞-inch rivets. The cutting was done on a standard Erie car under general yard conditions, the operator taking the rivets as they came, working inside, outside, and under the car. The car was one that had been retired from active service and that was in the car shop for repair, the rivets and plates being covered with heavy scale and rust, thereby rendering the cutting very difficult. It is said that the record applies not only to the number of rivets cut in the time mentioned, but also to the low consumption of gases used, the job taking only 384 cubic feet of oxygen and 83 cubic feet of acetylene. The operator used an "Oxweld" cutting blowpipe with a rivet-cutting nozzle.

Selling Machine Tools

First of a Series of Articles on the Work of the Machine Tool Salesman, Duties of the Selling Force, and Policies in Selling Machine Tools

By HOWARD W. DUNBAR, Sales Manager, Grinding Machine Division, Norton Co., Worcester, Mass.

FROM the rough casting to the production department of a customer's plant is a long journey beset with engineering, sales, transportation, and financial difficulties, which must be met and overcome by every successful builder of machine tools.

The salesman expects others to design, produce, and arrange for the transportation of the machines he sells; and he is not ordinarily expected to be the sole judge of the financial rating of the customer. However, there are certain sales policies that must be adopted by every organization and that must be carried out in a manner that will promote the greatest possible degree of harmony with other functions of the organization, in order to promote the interests of the company that the salesman represents.

Primary Duty of a Machine Tool Salesman

Salesmen of machine tools are expected to sell engineering principles first. When the prospective customer is properly impressed by the fundamental facts in connection with the value of the machines offered, it will be found that the selling price is not the main factor in which he is interested. There are a number of fundamental principles underlying the value of machine tools as a means for increased production, which vary according to the nature of the machines. In some machines these principles may relate to the feeds and speeds, in others to the accuracy with which they perform their work, and in still others to the extreme power and capacity for metal cutting that they possess. In all machine tools rigidity and properly distributed weight are essential features. The principles applying to each class of machine tools should be properly defined, and the diligent support of these principles is essential to the success of every salesman. Adherence to these principles and the education of the trade to appreciate them should be the primary sales policy of every machine tool builder.

Suggestions for Modified Design

Prospective customers of machine tools frequently indicate changes of design that they believe to be desirable for their particular needs. Except in comparatively rare instances these modifications are not based upon real necessity, and are often due to misconception of some fundamental principle relating to the best and proper use of machine tools. Every case of this kind should be made the occasion for a tactful lesson in the principles involved in the design and use of machine tools. The salesman has an opportunity to emphasize the use, the mechanical simplicity, and the indispensable character of each mechanism that has been incorporated in the machine that he sells through years of experience in the design of a certain line of machine tools.

Suggestions for Special Fixtures

Lathe and planer builders are not generally expected and rarely asked to make jigs or fixtures to hold the work on their machines, but buyers of turret lathes, milling machines, and grinding machines, for example, frequently require the manufacturer to design and build special holding devices. In some lines of machine tool building, the making of such holding devices becomes part of the equipment of the machine, and some manufacturers make a point of encouraging the ordering of equipment of this kind with their machines. As a rule, however, the building of such additional equipment is not profitable. The larger machine tool shops, especially, are equipped and tooled for the production of a definite line of machine tools. The building of special fixtures and attachments delays production and involves costs that always seem excessive to the customer. The salesmen of many machine organizations, therefore, encourage the customer to build his own fixtures. When he does, he usually views the cost on the basis of material and labor alone, and it is the opinion formed on that basis that makes the price asked by the machine tool manufacturer seem high to him, as, of course, the machine tool builder must always include overhead and a reasonable profit.

The question of special equipment must be dealt with individually by each machine tool builder. In some cases it becomes absolutely necessary that he equip his machine with the attachments or fixtures that will make it perform the work for which it is intended, at the most rapid rate. In other cases, it is obviously advantageous for the customers own tool department to design and make the required fixtures. A definite sales policy in this respect should be adopted by each manufacturer according to his own needs. Every manufacturer is always ready to suggest the methods that ought to be used and the general design of the holding device, and make sketches of special equipment for handling unusual shapes.

In order to facilitate the work of designing special fixtures on the part of the customer, machine tool builders should be prepared to furnish dimensioned drawings and cross-sections of tables, spindle noses, etc., to which the special equipment must be fitted. In many instances, the buyer of machine tools would probably find that he could obtain cheaper service in the case of special jigs and fixtures, from the tool job shops than he does from the machine tool builder; and the machine tool builder will also profit by having this trade taken over by a specialist, because the building of special equipment in a shop organized for regular production is generally a costly and unprofitable business.

Returning Machines to the Factory for Repairs

The practice of returning machines to the factory for repairs is not recommended. In fact, it has almost invariably been found cheaper to scrap the old and buy new. That this also holds true with attachments is indicated by experience. When an old machine is received for overhauling, a high-grade mechanic must be assigned to the work of tearing down and examining it in order to decide what parts need to be repaired, what replaced, and what retained without change. Add to this man's time the cost of repairs, replacements, and reassembly, and the reason for discouraging this practice becomes evident. Occasional exceptions to the above are sometimes necessary, and therefore due consideration must be given the facts of each case.

Credit Allowance on Returned Parts and Material

Customers frequently return parts of machines for repairs or credit. The returning of parts and mechanisms for credit should be firmly discouraged. Sometimes the parts returned are not worth repairing and should be replaced, or the parts returned for credit are either obsolete, in poor condition, or incomplete, and may require considerable expense to put them in salable condition. Under the general system now in use by most machine tool builders, of specifying equipment for machines, there will be fewer cases where it is necessary to return parts and mechanisms for credit; but even though they are more rare, there will always be occasions when a customer has parts or attachments which he wishes to return. A definite policy should therefore be adopted to cover all usual circumstances. These rules must be applied with judgment, and with regard for any special features in each individual case.

At inventory time, there is a tendency for customers to attempt to return material in order to effect a transfer of goods from their shelves to the manufacturer's. When it is evident that this is being done, machine tool manufacturers should not accept returned material, especially if the parts returned have been in the customer's plant for over, say, three months. A general rule, of course, would work an injustice in certain cases, and therefore it is not possible for any manufacturer to make a definite ruling, but, in general, a three month's restriction would relieve the machine tool builder of the responsibility of allowing credit for parts which, while ordered in good faith, should be charged by the customer to his own inventory rather than asking the machine tool builder to carry the burden.

The Making of Repairs

Every machine tool builder should have some kind of system for handling repairs on his customers' machines. A good plan is to have every job that comes for repairs inspected and a report made by the shop, estimating the time required and being accompanied by a list of new parts necessary for the repairs. The sales department could then decide whether it would be cheaper to repair or to replace, and could advise the customer as to the best method of procedure, stating approximate costs in each case. The good will obtained from the customer when he realizes that in each case a careful estimate is made as to which method will be cheapest for him is of great value.

Procedure in Allowing Credit for Returned Parts

Machine tool manufacturers should have a definite system for allowing credits on returned parts so that their salesmen may know definitely what to promise in each case. When parts are returned for credit, they should be inspected in the shop and a report made on the conditions of the parts, stating whether they are in condition to be returned directly to the stock-rooms, and if not, reporting in detail whether they are to be scrapped; or if repairs or painting are required, giving an estimate of the time and material necessary to put them in a salable condition. This information should be furnished to the sales department, which could then advise the customer as to the credit that will be allowed for the parts returned. Such a system is necessary in order that the customers will be dealt with alike in every case.

Each machine tool builder must, of course, determine for himself the basis for credit allowances. Generally speaking, a reasonable basis for such allowances would be as follows:

Material returned because of the builder's error should be credited at full selling price, and the builder should pay transportation charges.

Material returned because of customer's errors in ordering, new parts being ordered to replace those returned because of a change in his manufacturing plans and needs, should be credited at full selling price, the customer to pay transportation charges.

Material returned because of customer's error in ordering, no new parts being ordered to replace those returned, should be credited at a predetermined credit price, the customer to pay transportation charges.

When orders are changed before shipment, other parts of machines being substituted, full credit should be allowed on standard equipment. On special equipment credit should not be given, nor should special equipment be accepted if returned for credit.

When equipment is returned that requires labor or repairs, it should be credited at the current credit price less the actual cost for repairs. The credit price would naturally vary with different manufacturers. A fair credit price would probably be two-thirds the selling price.

Salesmen's Handling of Complaints

It is not unnatural for the sales force, hearing only one side of the question, to agree with the customer, particularly when complaints are presented. When a customer complains to a salesman of poor workmanship, the easy but fatal course to take is to admit faulty workmanship without investigation, or, by advancing an apologetic defense, to imply that such workmanship may be easily possible. There is no more certain way for a salesman to lose the good opinion that his customer has of him and the machines that he is selling than to allow the customer to think that the salesman believes it possible or probable that when the complaint is investigated it will be shown to be founded on serious defects.

A salesman representing a machine tool builder who is known to do his utmost to produce first-class machines and equipment need not take the position that it is likely that a defect is present. He can afford to act constructively by treating each criticism of the machines or policies of the organization that he represents as a reflection on an organization that is not permitting anything defective to pass out of its plant. If a salesman cannot have such faith in the organization that he represents, he will not make a good salesman. If he is to put his whole heart in his work, he must create within himself a loyalty to his company that will arise to rebut every criticism in the same way as he would spring to the defense of the character of a member of his family.

To achieve this attitude, the firm that the salesman represents must have established a reputation for not countenancing poor workmanship and for building machines that will produce as well as or better than any other machines on the market; but this reputation must be coupled with the knowledge that when a part is found actually defective, the builder wants to know it at once so that he may rectify an error as quickly as possible. When the salesman has impressed himself with these things he will become willing and fit to uphold them, and he will find in his customer's manner a new respect for his views.

Every machine tool builder should have a regular system by which complaints are handled, and should encourage salesmen to send in reports regarding every direct or indirect complaint that may be made against his machines. These complaints should be taken up at regular meetings of the executive members of the sales, designing, and shop departments. The men composing such a committee would be able to make authoritative decisions, and it could be expected that when a complaint has been submitted and acted upon, the decision would be accepted by all departments without reservation. Briefly stated, a salesman's duty should be to report every complaint which he hears, but his attitude toward the customer must indicate that he feels confident in his machine and that justifiable complaints are rare, but that, if the manufacturer has made a real error, he is anxious to rectify it.

* * *

There are now, according to *Safety Engineering*, 900 industrial plants in the United States employing a total of about 1500 physicians, either part or full time. It has been found that an efficient medical department insures a healthy force of workmen and results in increased production.

ODONTOGRAPH FOR LAYING OUT 20-DEGREE GEAR TEETH

By J. L. WILLIAMSON

The increasing demand for more compact electric motor units for railway service has resulted in the use of 20-degree involute gears for this class of work. The change from the commonly employed 14½-degree tooth to the 20-degree tooth makes it possible to reduce the center-to-center distance between the pinion and gear and still maintain the required strength. In order to show more clearly the advantages of the 20-degree tooth for this class of work, let it be assumed that a 14½-degree pinion-and-gear drive has been installed and that it must be replaced by new gearing, as the teeth have not proved strong enough to carry the load.

The usual method of overcoming a difficulty of this kind would be to decrease the diametral pitch of the new gears in order to provide coarser teeth, but as the speed ratio between the gears must be maintained, and the center distance between the pinion and gear cannot be increased, it becomes evident that greater strength can be obtained only by changing the form of the teeth. Thickening the tooth at its weak point by the employment of a greater pressure angle in laying out the tooth profile therefore becomes the best means of overcoming the difficulty.

Having had occasion to make several lay-outs for 20-degree teeth and being unable to obtain an odontograph similar to Grant's odontograph for 14½-degree teeth, the writer has calculated the constants given in the accompanying table, which may be of use to others confronted with a similar problem. For gears having more than 37 teeth the approximate radius of the arc forming the tooth profile can be obtained by the formula

$$\frac{20\pi N \cos 20 \text{ deg.}}{360P} = \frac{0.164N}{P}$$

in which N equals the number of teeth and P the diametral pitch. The following example will illustrate the use of the table: Let it be required to make a lay-out of the teeth for a gear and pinion having 71 teeth and 16 teeth, respectively, of 3 diametral pitch, with a pressure angle of 20 degrees. Referring to the accompanying diagram, the profile of the pinion tooth may be considered as two arcs generated by the face radius R and the flank radius r. The arc generated by radius R forms that part of the tooth outline lying between pitch circle C and the top of the tooth, while the arc generated by flank radius r forms that part of the tooth outline between the pitch circle C and the base circle E. These radii are obtained by dividing the constants in the table opposite 16 in the column headed No. of Teeth in Gear, by the diametral pitch, which in this case is 3. Therefore the face radius R of the pinion equals 3.726 divided by 3 or 1.242 inches, and the flank radius r is equal to 1.522 divided by 3 or 0.507 inch. These arcs are drawn about centers located on the base circle in such a position that either arc is a continuation of the other.

ODONTOGRAPH FOR 20-DEGREE INVOLUTE GEAR TEETH OF BROWN & SHARPE STANDARD PROPORTIONS

No. of Teeth in Gear	Face Radius R	Flank Radius r	No. of Teeth in Gear	Face Radius R	Flank Radius r
12	2.952	0.984	25	5.084	3.116
13	3.155	1.109	26	5.202	3.326
14	3.352	1.240	27	5.310	3.546
15	3.543	1.377	28	5.419	3.766
16	3.726	1.522	29	5.520	3.999
17	3.903	1.673	30	5.609	4.231
18	4.074	1.830	31	5.691	4.477
19	4.238	1.994	32	5.772	4.723
20	4.395	2.165	33	5.841	4.983
21	4.546	2.342	34	5.911	5.242
22	4.690	2.525	35	5.967	5.514
23	4.828	2.716	36	6.022	5.786
24	4.960	2.913	37	6.068	6.068

Machinery

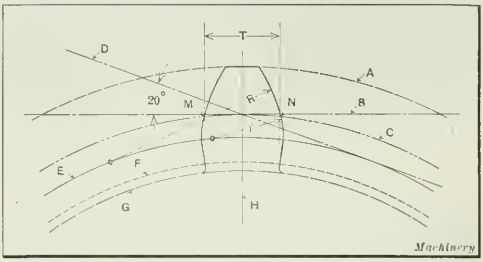
The profile of the 71-tooth gear may be considered as an arc of a circle, the radius of which is obtained by dividing 0.164 × 71 by 3 which equals 3.881. With a radius of 3.881 (3⅞ inches) draw the arc which forms the tooth profile about a center located on the base or generating circle.

Laying out Tooth Profile

The exact procedure in laying out the gear tooth profile for the 16-tooth pinion would be as follows: First calculate the pitch diameter, outside diameter, whole depth of tooth, clearance, and thickness of tooth on pitch circle C. To find the pitch diameter, divide the number of teeth by the diametral pitch. To find the outside diameter, add 2 to the number of teeth and divide the sum by the diametral pitch. The whole depth of tooth is found by dividing 2.151 by the diametral pitch. To find the clearance, divide 0.157 by the diametral pitch. The chordal thickness T of the tooth is obtained by the formula

$$T = \sin\frac{90}{N} \times \frac{N}{P}$$

in which N equals the number of teeth and P the diametral pitch.



Method of laying out 20-degree Gear Teeth

Now draw a vertical center line H, and with a compass set to a radius equal to half the pitch diameter draw pitch circle C about a center located on H. A section of this circle is shown in the accompanying diagram. Then from the same center and with a radius equal to one-half the outside diameter draw circle A. With a radius equal to the difference between the radius of circle A and the whole depth of tooth, draw circle G, also from the same center. Now with a radius equal to the radius of circle G plus the clearance draw circle F. Next at the point of intersection of center line H with the pitch circle draw line B at right angles to H. Line D is then drawn at an angle of 20 degrees with line B as shown. Now from the common center of circles A, C, F, and G, draw circle E tangent to D. This circle is known as the base or generating circle. Next draw two lines parallel with, and equally distant from line H, and a distance apart equal to T. These two lines intersect pitch circle C at points M and N. Now with N as a center and a radius equal to R strike an arc which intersects base circle E. From this point of intersection and with the same radius draw an arc from N to circle A as shown. Then with r as a radius, draw the arc which forms that section of the tooth profile lying between pitch circle C and base circle E. Complete the portion of the tooth profile lying between circles E and F by drawing a radial line from the common center of arcs A, C, and G. The small fillet or arc at the root of the tooth can then be drawn in, thus completing the tooth profile.

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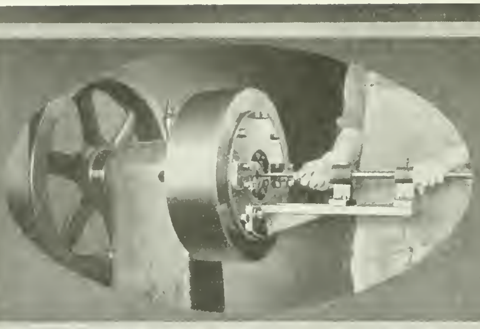
During 1920, 1325 airplanes from the Continent landed passengers and freight in Great Britain. They included 1079 British machines, 236 French planes, 9 Belgian and 1 Swiss.



Cold Swaging

Application of the Swaging Process and its Effect on the Quality of Metal—Based upon the Experience of the Torrington Co., Torrington, Conn.—First of Two Articles

By FRED R. DANIELS

THERE are certain mechanical operations that cannot be performed by any other method than swaging—the uniform rapid hammering of metal by means of a swaging machine for reducing the sectional area of the work. Swaging is used for work having a circular cross-sectional area, and metal cannot be swaged by a swaging machine into any other sectional shape. For that reason a great deal of the work usually produced by the swaging method consists of small wire parts, sewing needles, instruments, and instrument parts. Another application of the swaging process is in tapering and reducing the diameter of tubing.

While swaging is the only method that can be employed for a large variety of work, it should be understood that the swaging machine is not intended to compete with the automatic screw machine on such classes of work as can be economically produced on these machines. There is a large class of work that cannot be economically done by swaging, and it is as important to understand the limitations of the process as its broad applicability.

While it is true that there are decided limitations to the use of the swaging process, it has been found, on the other hand, that practically every known metal can be successfully swaged, including not only steel bars and wire, copper and brass, but also such materials as tungsten and monel metal. The latter material, which is composed mainly of nickel and copper, has caused, perhaps, the most difficulty of any in securing satisfactory results with this process.

The Swaging Machine and its Principle of Operation

The mechanical principles involved in the Dayton swaging machine, built by the Torrington Co., Torrington, Conn., are the same as those incorporated in other types of swaging machines, and there has been no material change in the principle governing its operation within recent years. Essentially the machine consists of a roll rack *A*, Fig. 1 in which a number of hardened steel rolls are free to rotate. The end of the machine spindle contains a diametral slot in which the dies *B* and the backers, the rounded end of one of which is shown at *C*, are carried. As the spindle revolves, these backers are brought into successive contact with the rolls, which results in closing the dies each time the two backers and a pair of rolls come into contact. The spindle revolves at a speed of from 200 to 600 revolutions per minute, depending upon the size of the machine; hence it will readily be seen that the spindle speed is multiplied by the number of rolls carried in the rack, in order to obtain the number of blows transmitted to the work per minute. In the case of the machine shown in Fig. 1, it will be seen that there would be an average of 3600 quick, short blows, or more correctly, applied pressures, delivered to the work each minute, assuming a spindle speed of 300 revolutions per minute. The machine spindle has a central hole passing through it, so that provision is made for stock to be fed from a coil in front through to a coil at the rear of the machine, if the nature of the work will permit this to be done. Since the roll rack is a floating member, it will

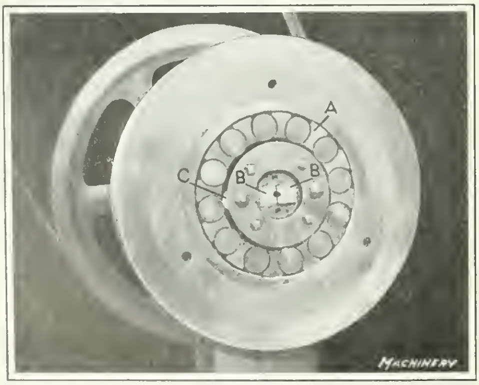


Fig. 1. Swaging Machine with Cover Plate removed, showing Dies, Backers, Rolls, and Roll Plate

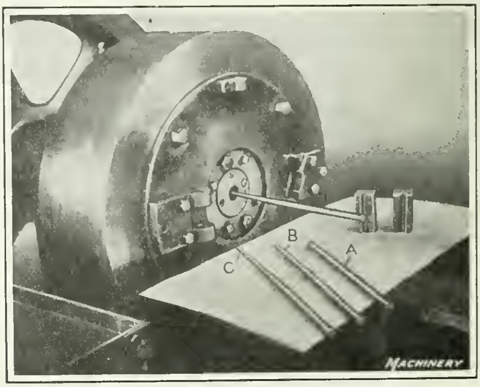


Fig. 2. Experimental Job performed on 7/16-inch Cold-drawn Stock, and Type of Dies used

be apparent that the revolving backers acting against the rolls will cause the rack also to revolve, but at a much slower rate than the spindle. This has the effect of distributing the pressure evenly on the work, increasing the degree of accuracy, and of so readjusting the molecules in the swaged material that it will be strengthened and its resilience retained.

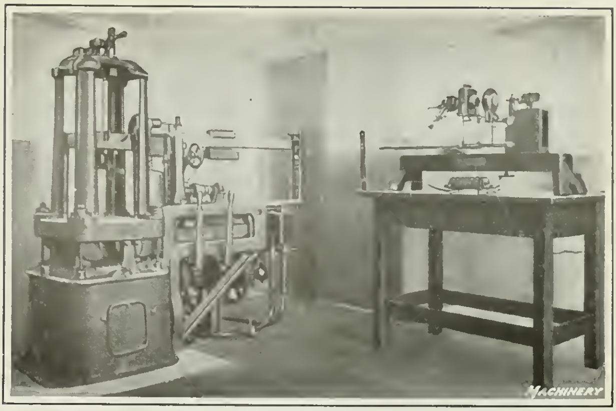


Fig. 3. View in Physical Laboratory, showing Tensile Testing Machine and Projector Apparatus

Effect of Swaging on the Physical Properties of the Metal

It has long been known that hammering metal improves its physical qualities; hence swaging increases the strength of the material. The effect of swaging upon metal has been conclusively shown in the tests which have been conducted in the physical laboratory of the Torrington Co. A section of the laboratory in which tests of swaged wire are conducted is illustrated in Fig. 3. The equipment employed is standard, selected with a view to obtaining accurate strength values, so that the tests made to determine the effect of swaging wire, the results of which are here presented in tabular form, may be considered as authoritative. The machine shown at the left in Fig. 3 is a 50,000 pound capacity wire-testing machine manufactured by the Tinius Olsen Testing Machine Co., Philadelphia, Pa. The Greenfield Tap & Die Corporation's lantern projector shown in this illustration is made use of in a rather novel way in connection with the manufacture and inspection of swaging dies, as will be explained in the next installment of this article.

TABLE SHOWING INCREASE IN TENSILE STRENGTH OF SWAGED COLD-DRAWN STEEL WIRE

Diameter of Wire, Inch	Breaking Load, Pounds	Ultimate Strength, Pounds per Square Inch	Reduced Diameter, Inch	Breaking Load of Reduced Diameter, Pounds	Ultimate Strength of Swaged Part, Pounds per Sq. Inch	Per Cent Gain in Tensile Strength
0.175	3480	144,700	0.156	2900	152,000	4.8
0.205	4785	144,900	0.175	3648	152,000	4.9
0.285	7900	123,800	0.225	5900	148,000	19.5
0.347	14500	153,300	0.274	9920	168,000	9.6
0.404	17440	136,000	0.324	12690	153,000	12.5
0.467	21720	126,700	0.371	15570	144,000	12.0

Machinery

The accompanying table gives the results of six tests performed on the testing machine, in which wires ranging in diameter from 0.175 to 0.467 inch were used. The outstanding result is a substantial gain in tensile strength in every instance. The table shows that the test pieces used varied in initial strength from 123,800 pounds per square inch to 153,300 pounds per square inch. A significant fact brought out in these tests is that the greatest gain in tensile strength occurred in the wire of the least strength before swaging, the gain being 19.5 per cent. The increased tensile strength for the strongest wire (0.347 inch diameter) is less than 10 per cent, and for the two small diameter wires less than 5 per cent. This lesser gain in strength may be due to the fact that the percentage of reduction in diameter was much less than it was in the case of the larger test pieces.

It may be thought that, though the repeated hammering to which wire is subjected in swaging increases its strength, the inherent characteristics of the process may be destructive to the structure of the metal, and that its resiliency and ductility may be sacrificed at the expense of increasing its tensile strength. It appears that this is not true, and many experiments have been conducted with samples to show that the quality of the metal has not been impaired by the rapid-fire hammering to which it has been subjected. Fig. 6 shows a collection of twisted and bent samples which serves to emphasize this statement.

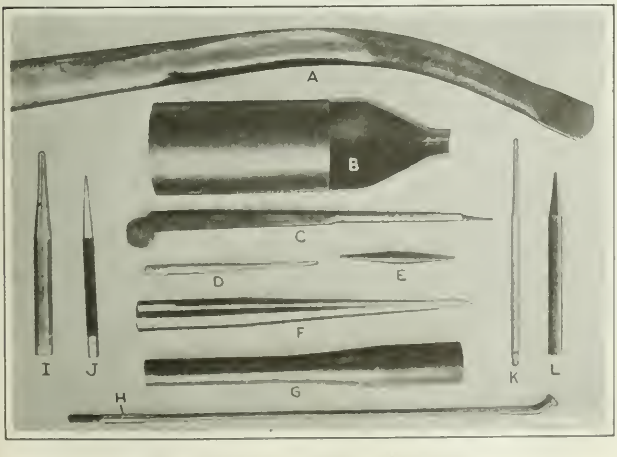


Fig. 4. Miscellaneous Collection of Swaged Work

It is stated that tungsten is the only material that is not improved in structure by the process of swaging, all other metals being materially increased in strength without impairing their ductility and resilience.

One of the important applications of the swaging process, as previously mentioned, is the reduction in diameter and the tapering of tubes. There is no other method by which these operations can be so well performed. Among the classes of tubular work that are satisfactorily handled in this way are firehose nozzles and bicycle frame parts, in the larger work; and metal pencil shells and lightning rod ends in the medium-sized work. On tube work, where the tube is to be tapered or reduced to a uniform inside diameter, it is usually the practice to use a mandrel in the tube in order to maintain a uniform size.

Swaging Gold-plated Materials

It is well known that solid silver, platinum, and gold-plated base metal wire used in jewelry work, especially in the manufacture

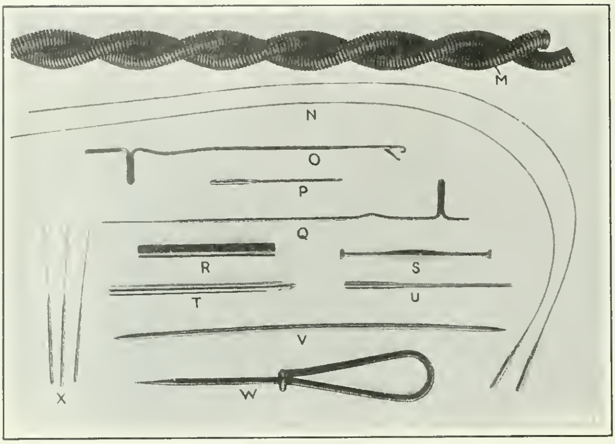


Fig. 5. Additional Examples of Cold-swaging

of spectacle bridges and bows, is produced by swaging. Perhaps it may not be so generally known that this is the only process by which a gold-plated base metal ingot may be reduced in diameter, from say, 1½ inches to the very small sizes extensively used in the optical and jewelry crafts, and at the same time produce a plated wire which will successfully withstand the acid test; yet it is stated that when a sample of this swaged wire is fractured and examined, the protective covering is so thin that there is no visible indication of an existing plate.

Although there appear to be no limitations to the amount of reduction that gold-plated bars will stand without destroying the plate, nothing can be done in the way of swaging casehardened steel. Gold-plated bars have a comparatively hard core and a soft plating which flows rapidly under the hammer; but casehardened steel has a hard exterior encasing the unhardened core. The hardened case will fracture and crumble under the battering-down effect of the swaging dies, and cannot be changed in sectional area by swaging until it has been properly annealed. In fact, where a number of passes through the dies are required to reduce a part, regardless of the kind of material, it is often necessary to anneal the material during the process of swaging in order to bring the metal to something like its original structural condition.

Producing Threads by Swaging

It may not be generally known that screw threads may be produced by swaging; but this is successfully and satisfactorily done from the coil, the wire passing through the dies and the hollow spindle of the swaging machine to a reel at the rear. The threaded wire thus produced, while not suitable for precision purposes, is extensively used for electrical and plumbers' supplies and for any purpose where merely a threaded rod is required. The characteristic of the swaged thread is its accuracy in lead rather than in thread form. The percussive action of the threading dies does not naturally lend itself to the production of threads of accurate form, while on the other hand, this method of producing a thread has the advantage of compensating for whatever inaccuracies might exist in the lead of any two successive threads of the die. The form of swaged threads is, however, not excessively irregular, nor does the action of the swaging dies destroy the ductility of the metal to any appreciable extent. The retention of ductility in swaged threads is shown in Fig. 5, in which at *M*, two threaded rods have been entwined without impairing the thread to any extent.

Amount of Diameter Reduction by Swaging

The amount of reduction in diameter that can be successfully effected by the swaging process is largely an empirical matter, depending on the size of the stock, its physical qualities, and a number of other factors. Small wire can be reduced the desired amount in one pass of the work through the dies, but on solid work which is large enough to withstand as great a reduction as 1/16 inch, a greater amount than this is not recommended in a single pass. This applies also to tubes if a mandrel is used; tubing swaged without a mandrel will stand a greater reduction however, than this. If, on the larger work, a greater reduction is attempted, the ends of the stock will become piped and have to be cropped off, causing a considerable loss of stock. This may be prevented by confining the amount of reduction effected at each pass to an amount not greater than that mentioned.

Examples of Swaging

In Fig. 2 are shown an experimental job and a pair of dies used for this work. A piece of cold-drawn stock *A*, 7/16 inch in diameter and 9½ inches long, was reduced about 2½ inches at one end in the first pass to 0.345 inch diameter, and was elongated thereby to 11 inches. This piece is shown at *B*. In the second reduction process the reduced diameter was further reduced to 0.253 inch and the over-all length increased to 12¼ inches, as shown by the sample *C*. These reductions were made under normal conditions, and give a fair idea of what may be expected on work of this size and nature.

Some difficulty may be experienced in swaging tapered parts, particularly if the taper is abrupt, by the ends of the stock splitting, and there appears to be no remedy for this except to employ a preliminary lathe operation to break down the ends of the work. After this has been done, the ends may be successfully tapered and will not pipe or split.

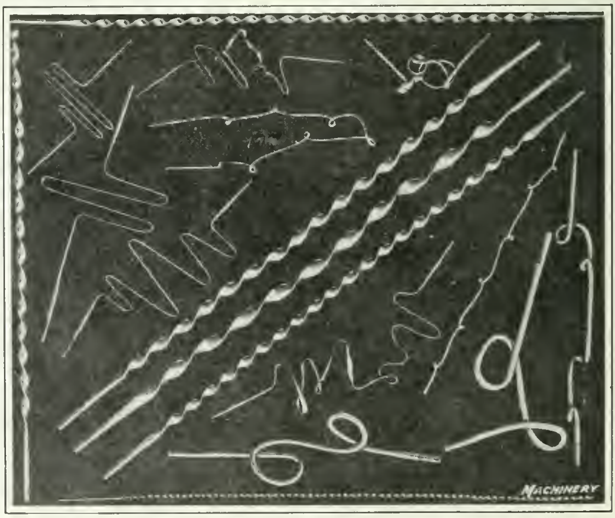


Fig. 6. Examples illustrating the Retention of Ductility in Swaged Work

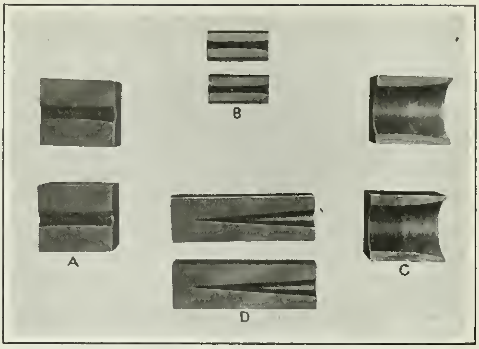


Fig. 8. Collection of Swaging Dies: (A) Straight Solid Stock; (B) Threaded Rods; (C) Tube Reduction; (D) Tapered Tubes

An inspection of sample *B*, Fig. 4, will make it apparent that, where such abrupt tapers are produced, whether the stock is solid or tubular, some form of positive feeding device must be employed to overcome the axial thrust produced by the revolving dies. The Dayton swaging machine makes use of a rack and pinion feed for work of this type.

A high degree of accuracy can be obtained by the swaging process. In fact, swaging is extensively used for sizing wire, in which work a diameter can be readily and uniformly held to within limits of plus or minus 0.001 inch, or even less for the smaller sizes. A corresponding degree of accuracy can be obtained when reducing the diameter by swaging, this accuracy increasing if anything, with the smaller diameters of work. One of the chief advantages claimed for the swaging process, as compared with machining, is the saving of stock effected. Besides saving stock and improving the physical qualities of the metal, many subsequent finishing operations, such as lapping and grinding, may be eliminated; also, the resiliency of the metal is retained, as previously stated, even though it is increased in hardness and tensile strength.

Swaging is especially economical where the stock is run from a coil through the dies and wound on a reel at the rear of the machine; that is, in straight wire reduction or threading. Usually for all other swaging work, preliminary operations, such as cutting-off the blanks, and often subsequent operations such as pointing or a second swaging operation, are required. These separate operations, of course, increase the cost of parts for which swaging is employed. This is especially true if the saving in stock and improvement in its physical qualities are not considered, or if the degree of finish produced directly by swaging is not necessary for the product.

Rates of Production

Any statement relative to production by swaging must be qualified, for this is another matter in which no hard and fast rule can be given. In general it may be stated that where the work is of such a nature that one particular end of a piece must be presented by the operator to the swaging dies, a production of from 600 to 800 pieces per hour can be reached on small work, produced in one pass through the dies. If it is immaterial as to which end is swaged, and if the swaged portion is not longer than ¾ inch, a production of 1300 pieces per hour can readily be obtained. Where the reduction produces straight cylindrical sections, the production time per pass is mainly governed by the length of the swaged section. A production of 500 pieces reduced in diameter per hour is a conservative estimate for conditions such as these, where the length of the swaged portion is not in excess of 2½ inches. For tapered work a much higher production can be obtained, because the work can be withdrawn from the dies quickly and independently of the action of the swaging dies. On the other hand, straight cylindrical work cannot be withdrawn any quicker than it is advanced into the dies in swaging, so that while the production figures given may aid in obtaining an estimate, the foregoing factors should always be taken into consideration.

Types of Swaging Work

The collection of parts shown in Figs. 4 and 5 illustrates the type of work for which swaging is suitable, and has been selected to cover a wide range of work. Specimen *A* is one leg of a bicycle fork, which is swaged to a taper in two operations and then flattened. It should be emphasized again, while referring to these samples of work, that swaging accomplishes nothing but the reduction in diameter and the tapering; all other work is performed by a separate process. Sample *B* is a seamless wrought-steel tube, 2 inches outside diameter, which is rather abruptly swaged to an 11/16-inch diameter neck, and has been cut away to show the thickening up of the wall at the neck section. The piece shown at *C* is a compass leg made of formed sheet steel and swaged at the point. The piece shown at *D* is a flat drill for drilling wood, used with a combination kit. A brass tube is shown at *E*, which has been tapered at both ends so that they are practically closed. The diameter of the tube is 5/16 inch, and the length of taper 1 1/16 inches at each end.

Sample *F* is a lightning rod end made of 11/16-inch copper tubing and swaged to a point. The length of taper is 5¼ inches, and the over-all length 7½ inches. The dies used in the production of this piece are shown at *D*, Fig. 8. The extra heavy brass tube shown at *G* has been swaged from 0.940 inch in diameter to 0.620 inch for a straight length of about 3 inches. The production of wheel spokes such as used for bicycles and automobile wheels is commonly accomplished by swaging. Such a spoke is shown at *H*, being reduced at its central portion from 0.206 inch diameter to 0.174 inch.

The samples shown at *I* and *J* are nail sets, in the partially and fully completed condition. It is in work such as this, where solid stock is rather sharply tapered, that

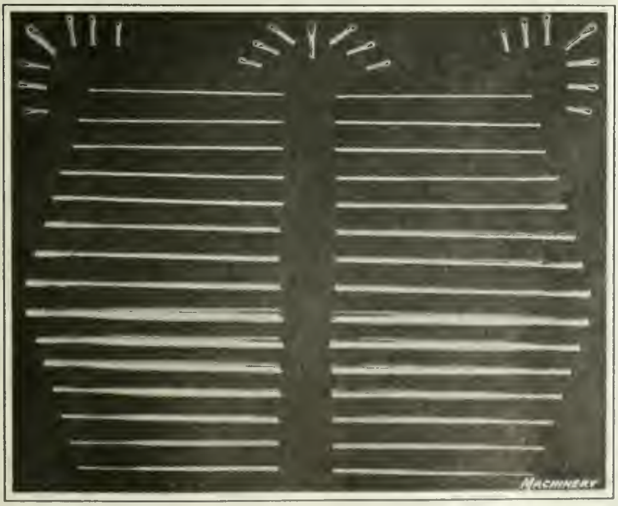


Fig. 7. Airplane Tie-rods reduced in Diameter between the Ends by Swaging

difficulty is likely to arise by the metal piping or splitting at the ends, necessitating the preliminary breaking down of the stock at the end in a lathe. On the size of nail set shown at *I*, the stock is reduced from ⅜ inch to 0.150 inch on the straight portion with a taper 1½ inches long, requiring two operations. The sample *J* is a smaller size, the original diameter of stock being ¼ inch and the length of taper 1 7/16 inches, produced in two operations.

At *K* is shown a crochet hook, 3/16 inch in diameter, which has a ⅜-inch abrupt taper to 0.127 inch, and from there on a gradual taper to 0.110 inch. The length of this gradual taper is 1⅜ inches. A brass shell such as used for metal pencils is shown at *L*. The outside diameter is 5/16 inch, swaged to a blunt point, approximately 0.066 inch in diameter, with a length of taper of 15/16 inch. This brass shell was first drawn with a closed end and then swaged to the shape shown.

In Fig. 5 the appearance of swaged threads is shown at *M*. These two brass rods are ¼ inch in diameter, and have standard threads 24 per inch. At *N*, *S* and *V*, are shown samples of gold-plated wire reduction work. The first of these is a pair of spectacle bows of 0.07 inch plated base metal wire, reduced to 0.021 inch, while *S* is a spectacle bridge piece tapered at both ends and flattened subsequently as shown. The piece of gold-plated wire *V* is 4¼ inches long and 0.065 inch in diameter, pointed at both ends for a distance of ⅜ inch.

At *O* and *Q* are shown a latch needle and a knitting needle blank, respectively, the swaging work on which consists merely of reducing the diameter at the end. Two other needles are shown at *P* and *T*, the first being a sewing machine needle and the latter a hook needle used on shoe machinery. There is nothing remarkable about the swaging operations on needles, except that swaging is the only method used to produce the points before they are finally sharpened by grinding.

The brass tube at *R* shows the result of the first operation in reducing the diameter from 0.165 to the finished diameter of 0.102 inch; the first reduction produces a straight section 0.150 inch long. This tube is used on player pianos. Another needle blank is shown at *U*, swaged from 0.105 to 0.038 inch in diameter, the straight section being 1 3/16 inches long. The amount of reduction in diameter of this sample and the abruptness of the taper between the two cylindrical sections demands that two passes of the work be employed to obtain the desired reduction. At *W* is shown an embroidery punch made from 0.086 inch diameter steel wire, swaged for a length of 7/16 inch at the end to a point. The three small specimens at *X* are steel points used for drafting machines. These are made from 0.45 inch diameter steel wire, and are reduced to a straight section 13/16 inch long and 0.010 inch in diameter. Among the large variety of small work produced by swaging may be mentioned dental instruments, instrument points of various kinds, balance pins for speedometers, etc.

While these parts are intended to be representative of the scope of swaging, it should be mentioned that large work such as fire-hose nozzles, for example, is taken care of by the capacity of the machine, it being possible to handle solid work up to a diameter of 2 inches and tubing up to 2¼ inches in diameter with standard capacity machines.

Swaging has become closely identified with the manufacture of airplanes in the production of tie-rods and streamline rods used in the construction and support of the wings. Fig. 7 shows a display board with sections of the rods used on the DeHaviland-4 airplane. These range in diameter from about ⅛ to ½ inch, and are threaded on the ends and reduced at the central diameter by swaging. The over-all length of the longest of these rods is about 20 feet. It is evident that any other method of machining would not produce a rod which would compare favorably with the swaged rod. It will be understood that the work performed by swaging is simply that of reducing the circular sectional area between the ends, and that those rods that are of oval section are flattened in a separate operation.

In a subsequent article the steel used for swaging dies and the methods employed in making these dies will be dealt with. The heat-treatment of the steel for swaging dies will be explained, and reference will be made to the use of the projectograph for swaging-die inspection.

* * *

SIMPLIFIED GEAR CALCULATION

By G. T. JOHNSON

The formula and table of constants here given have been worked out by the writer to eliminate the trial method of obtaining the number of teeth in a gear and also the number of teeth in its mating pinion when the pinion and gear are required to operate at a given center distance and speed ratio.

The problem is to find the number of teeth in the pinion and the number of teeth in the gear when the center distance, the diametral pitch, and the speed ratio are given.

TABLE OF CONSTANTS FOR SIMPLIFIED GEAR CALCULATION

R	S	R	S	R	S	R	S
1.0	1.00	3.0	2.00	5.0	3.00	7.0	4.00
1.1	1.05	3.1	2.05	5.1	3.05	7.1	4.05
1.2	1.10	3.2	2.10	5.2	3.10	7.2	4.10
1.3	1.15	3.3	2.15	5.3	3.15	7.3	4.15
1.4	1.20	3.4	2.20	5.4	3.20	7.4	4.20
1.5	1.25	3.5	2.25	5.5	3.25	7.5	4.25
1.6	1.30	3.6	2.30	5.6	3.30	7.6	4.30
1.7	1.35	3.7	2.35	5.7	3.35	7.7	4.35
1.8	1.40	3.8	2.40	5.8	3.40	7.8	4.40
1.9	1.45	3.9	2.45	5.9	3.45	7.9	4.45
2.0	1.50	4.0	2.50	6.0	3.50	8.0	4.50
2.1	1.55	4.1	2.55	6.1	3.55	8.1	4.55
2.2	1.60	4.2	2.60	6.2	3.60	8.2	4.60
2.3	1.65	4.3	2.65	6.3	3.65	8.3	4.65
2.4	1.70	4.4	2.70	6.4	3.70	8.4	4.70
2.5	1.75	4.5	2.75	6.5	3.75	8.5	4.75
2.6	1.80	4.6	2.80	6.6	3.80	8.6	4.80
2.7	1.85	4.7	2.85	6.7	3.85	8.7	4.85
2.8	1.90	4.8	2.90	6.8	3.90	8.8	4.90
2.9	1.95	4.9	2.95	6.9	3.95	8.9	4.95

Machinery

The speed ratio *R* of the pinion and gear is found by the formula:

$$R = \frac{\text{Revolutions per minute of pinion}}{\text{Revolutions per minute of gear}}$$

The formula for the number of teeth *t* in the pinion is:

$$t = \frac{C \times D}{\frac{R+1}{2}}$$

The number of teeth *T* in the gear is found by the formula:

$$T = t \times R$$

In these formulas

R = speed ratio of pinion and gear;
C = center distance between the gear shafts; and
D = diametral pitch.

Thus for either diametral or circular pitch gears, the formula for obtaining the number of teeth *t* in the pinion is

$$t = \frac{\frac{1}{2}(t+T)}{\frac{R+1}{2}}$$

To use the accompanying table of constants, simply substitute the value given in column *S* (opposite the required speed ratio *R*) for the expression $\frac{R+1}{2}$ in the formula.

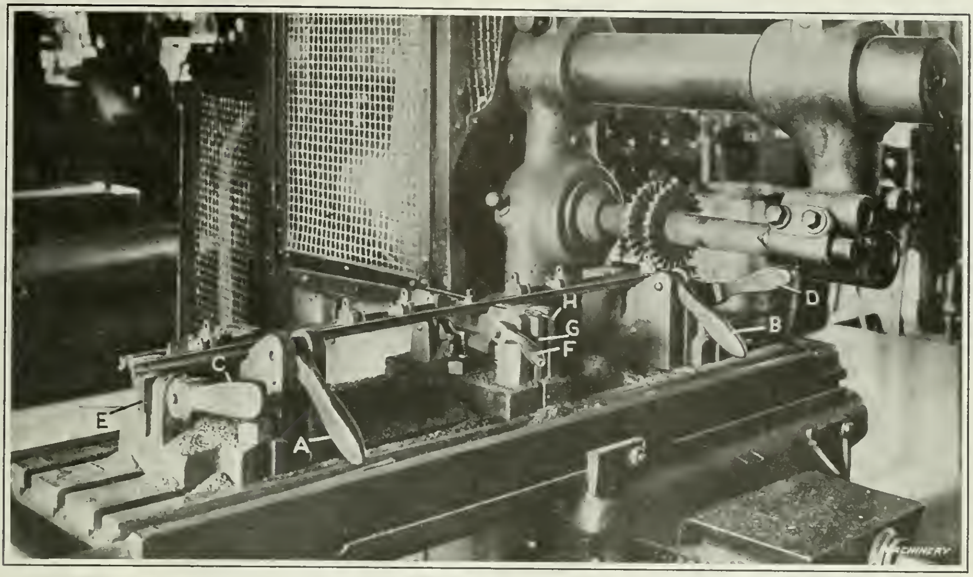


Fig. 1. Milling One Side of a Long Cast-iron Bed Rail for the Monarch Typewriter

Milling Slender Castings

Fixtures Used at the Smith Premier Works of the Remington Typewriter Co. for Holding Slender Parts without Springing

By FRANKLIN D. JONES

THE manufacture of typewriters involves many difficult problems relating to the design of special fixtures, tools, and machines. Large numbers of duplicate parts must be produced accurately and rapidly, and the manufacturing problem is further complicated by the fact that a modern typewriter requires numerous parts differing greatly in size and shape. Many of these pieces are also slender, and for this reason must be held for different machining operations in fixtures especially designed to prevent distortion due to the pressure of clamping devices. At the Smith Premier Works of the Remington Typewriter Co., in Syracuse, N. Y., difficulties formerly encountered in milling slender pieces, such as the bed and carriage rails of the typewriter, were overcome by the application of two important principles, one relating to the design of the milling fixtures, and the other to the method of milling. The fixtures will be considered first, and then the effect of the milling operation itself on the accuracy of the product will be taken up.

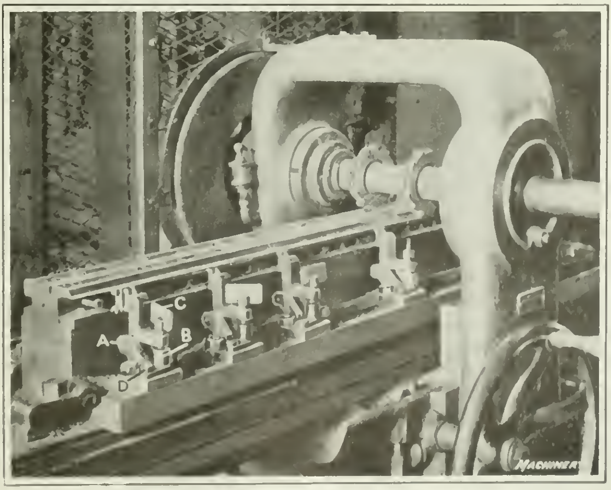


Fig. 2. Milling V-shaped Ball Races along Edges of Two Bed Rails held on Opposite Sides of Fixture

One of the parts that is easily distorted if not held and milled properly is the cast-iron bed rail. This slender casting is sometimes required in lengths up to 42 inches when used on typewriters having special carriages that are much longer than the standard size. These castings have milled surfaces on the sides, and a V-groove is cut along each edge to form a ball race or track. In order to secure an easy, free movement of the carriage, these ball races must be straight. The milling fixtures used for the bed rails have been very carefully designed to prevent any springing of the casting, and at the same time hold it securely enough for the milling operation.

Fig. 1 shows the first milling operation on a bed rail casting. The particular bed rail shown in this illustration is intended for one of the long carriages. As will be seen, three separate fixtures are mounted on the table of the machine. The fixtures at the ends grip the casting, while the one in the center supports it firmly but without subjecting the casting to vertical or lateral pressure sufficient to spring it even slightly. Each of the eccentric levers *A* and *B* of the end fixtures bears against a pivoted clamp, which is forced inward for gripping the side of the casting. The eccentric levers *C* and *D* clamp the outer ends of spring levers *E*, after the latter, with their small contact pins, have been pushed lightly upward against the under side of the casting by small springs. The lever *F* of the central fixture binds two spring-controlled equalizing supports *G* and *H*. When exceptionally long castings are to be milled, two of these central supporting fixtures are used.

Milling Fixtures for Supporting Typewriter Bed Rails

The design of these fixtures is shown more clearly in Fig. 3, which illustrates the same general type as shown in Fig. 1. The outline of the bed rail is indicated by dot-and-dash lines in both the side elevations and plan views. The end view at the left shows the arrangement for gripping the casting. Lever *A*, which has an eccentric surface, bears against clamp *J* which is pivoted at *K*. This clamp has a V-shaped jaw, and there is a similar jaw on the other side of the casting. The supporting levers *E* for the ends are pivoted at *L*, and are held lightly in contact with the under side of the work by springs *M*; levers *E* are then firmly held in this position by levers *C* and *D*.

A detailed view of one of the central supporting fixtures is shown in Fig. 4. This fixture is of the same general type as the one in use in Fig. 1. The position of the work relative to this fixture is indicated by the cross-section at *X*. The equalizing supports *H* and *G* are pivoted at *P* and *Q* to links which are free to swing about the lower pivot *T*. An extension *U* at the lower end of each link has beneath it a spring *V*, and attached to extensions *W* on the equalizing supports are additional springs *X*. A compression spring is used for support *H* and a tension spring for support *G*, as shown. Both of the springs *X* are tension springs. The support *H* has a V-shaped jaw that comes in contact with the left-hand side of the casting, as shown in the illustration, and a clearance space on the opposite side. This order is reversed in the case of support *G*. Clearance holes are provided in the supports at *Y*, and the bolt of clamp lever *F* passes through these holes. With this arrangement these supports are free to move laterally and vertically, so that they automatically come in contact with the sides and bottom surface of the casting when the latter is placed in the fixture, but the springs *V* and *X* which hold them in engagement with the work are not strong enough to spring the casting out of shape. A partial turn of lever *F* securely locks members *H* and *G*, so the work is firmly supported.

After the flat surfaces have been milled on one side of the casting by the use of the equipment illustrated in Fig. 1, the work is ready for milling the V-shaped grooves or ball races along each edge. One fixture used for this operation is shown in Fig. 2. This fixture holds two castings at a time, one being clamped along each side. The surfaces which were previously milled come in contact with locating surfaces on the fixture. The clamps used on this fixture have pivoted equalizing jaws and an ingenious arrangement to permit rapid insertion and removal of the work. The L-shaped member to which the clamping jaw is attached is pivoted at *A*, and has a support *B* against which the clamping screw *C* bears. When a finished casting is to be removed, screw *C* is loosened by a partial turn, and then support *B*, which is pivoted at *D*, is swung out of the way, thus allowing the L-shaped clamping member to drop down clear of the work.

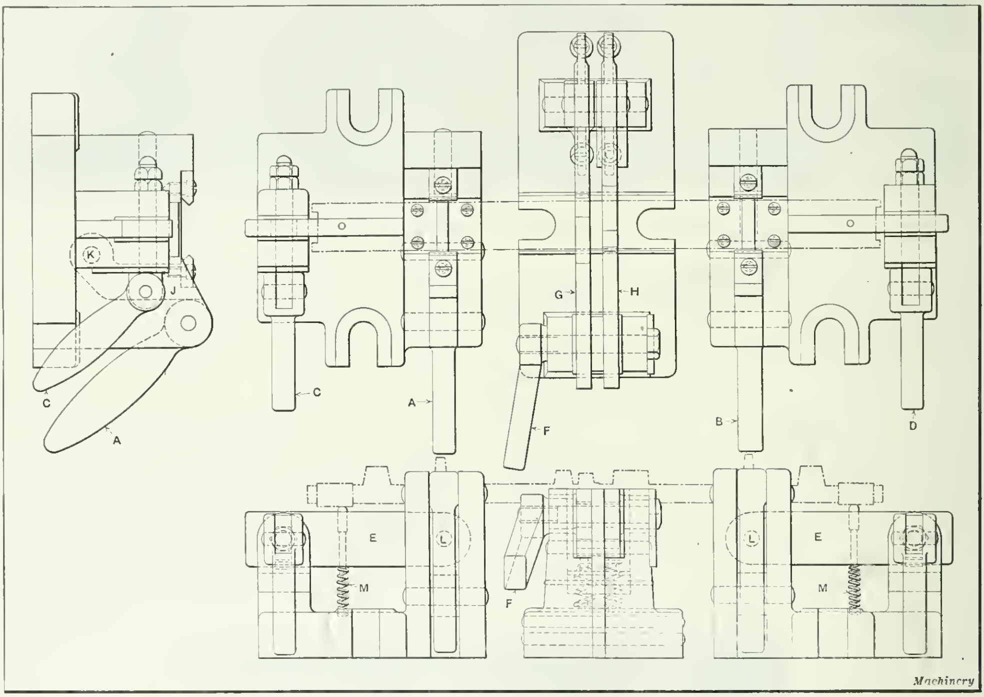


Fig. 3. Elevations and Plan Views of Fixtures designed for holding Slender Parts without Distortion

Fixture Used in Milling Ball Races in Typewriter Carriage Rails

Another delicate milling operation is illustrated in Fig. 5. The work in this case is the lower carriage rail. It is formed of sheet steel, 3/32 inch thick, and the operation is that of milling a 90-degree ball race. This race, which is formed by rolling and is approximately straight for milling, must be trued by removing a very small amount from the surface of the V-groove, and an exceptionally good support without the slightest tendency to spring the work is necessary. The fixtures used are similar in principle to those already described, but differ slightly in regard to the arrangement. At each end there is a clamping jaw *A* which is normally held upward to permit insertion of the work by spring *B*, and is forced downward for clamping by lever *C*, having an eccentric end surface. Two supporting bars *D* and *E* are placed between the end-clamping fixtures. These bars have V-shaped grooves to fit the lower side of the carriage rail, and they are of the spring-supported equalizing type, operating on the same general principle as the fixture illustrated in Fig. 3.

Effect of Rate of Feed on Distortion of Work

Notwithstanding the precautions taken in designing fixtures for holding these slender parts, excessive distortion would still occur if the milling were not done properly. By studying cause and effect, it was found that the rate of feed used for milling has a decided influence on the distortion of such slender parts as the bed and carriage rails. When a fine feed is used, there is considerable distortion, but when the feed is coarse, the distortion is not great enough to cause trouble. This fact has been proved by milling the parts under exactly the same conditions except for the rate of feed.

Why should a fine feed cause distortion of the work? Here is an explanation. The uniformly spaced marks seen on milled surfaces are revolution marks, caused by some irregularity of the cutter, such as a tooth which differs slightly from the others and leaves a mark every revolution. Now, as this irregular tooth comes around, it strikes the work with greater force than the others and exerts what might be defined as a peening action. The irregularity of the cutter is, of course, very slight in any case, but, nevertheless, the effect on the work may be pronounced when the feed is too fine, because the peening action due to the irregularity in the cutter is greater, or occurs oftener, in a given length with a fine feed than with a coarser feed; consequently, there is greater distortion, and the amount of distortion from this cause is surprising when the work is long and slender and easily sprung out of shape. The discovery of this relation between the rate of feed and the straightness of milled parts eliminated a great deal of trouble and expense at the Smith Premier Works.

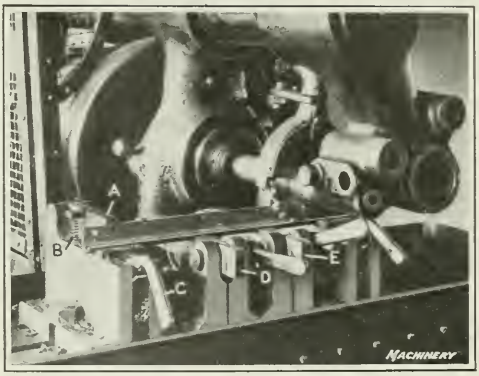


Fig. 5. Milling Ball Groove along Steel Carriage Rail

* * *

RAILROAD SHOP EFFICIENCY

The following example of the extremes to which the labor unions have gone in their sub-division of the labor to be done by different crafts in railroad shops has been furnished by railway officials in order to inform the Railway Board as to the actual conditions with which it has to deal in deciding upon the abrogation of some of the rules at present in force and the steps to be taken for increasing the efficiency of labor in the railroad shops.

In order to change a nozzle tip in the front end of a locomotive it is necessary:

1. To call a boilermaker and his helper to open the door, because that is boilermaker's work.
2. To call a pipeman and his helper to remove the blower pipe, because that is pipeman's work.
3. To call a machinist and his helper to remove the tip, because that is machinist's work.

The same three forces must be employed to put in the new tip. Before federal control a machinist's helper or any handyman put in nozzle tips alone. Similarly, railroads are required to employ members of three crafts—machinists, sheet metal workers, and electricians and their helpers—to make a repair to a locomotive headlight, which was formerly handled by one or two men. Under such restrictions it is impossible for railroad shops to be conducted efficiently.

* * *

In Joseph Roe's book on "English and American Tool Builders," it is mentioned that in 1832, M. W. Baldwin, the founder of the Baldwin Locomotive Co., built an engine for the Philadelphia and Germantown Railroad which was placed on the road in January, 1833. An advertisement of that time says: "The locomotive engine built by Mr. M. W. Baldwin of this city will depart daily, when the weather is fair, with a train of passenger cars. On rainy days horses will be attached in the place of the locomotive."

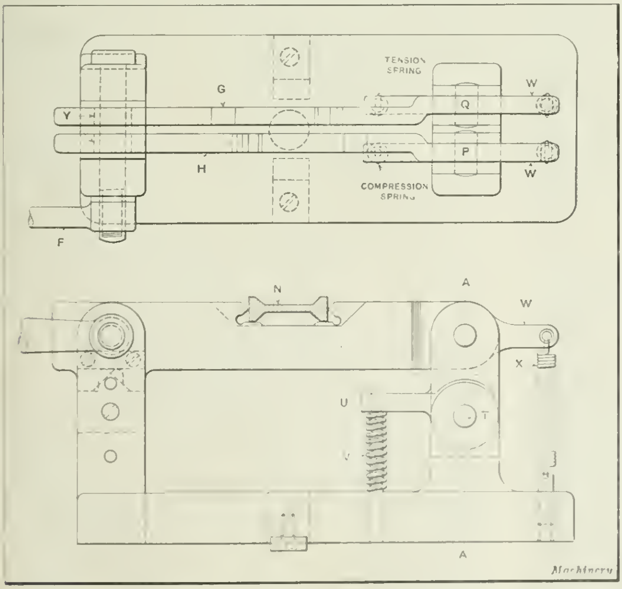


Fig. 4. Supporting Fixture used in Conjunction with Clamping Fixtures when milling Slender Parts

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PREPARE FOR BUSINESS NOW

Many of our manufacturers are preparing for the volume of business we all expect before long. Steel mills have been particularly busy in rehabilitating their plants, making necessary repairs and even installing some new equipment. Paper mills are enlarging their facilities; and although they are now running short time, some are installing machinery ordered last year so that when the demand again becomes normal they will be prepared to meet it. The textile industry also sees the turn ahead and is putting its plants in order.

It requires courage and vision to spend money on repairs or stock when there are no orders in sight, although everyone knows that more material and labor can be obtained per dollar under present conditions than after business revives. Plants can be rearranged and changes made now without interrupting production that will result in economies when the plant is again operating. It is true economy to prepare for business now.

The late F. E. Reed of Worcester, one of the ablest men in the machine tool industry, made no small portion of his great fortune by building lathes when business was slack, and he was always ready with a large stock of carefully made tools when demand reappeared. Business is as certain to revive now as it was in Mr. Reed's time, and his policy is a safe one to follow.

* * *

MACHINE TOOL STATISTICS NEEDED

There is almost no statistical information available to guide the individual machine tool manufacturer in shaping his manufacturing and selling policy. He must base his estimate of possible sales on his orders and on fragmentary information concerning the business of possible users of his machines. It is becoming more and more apparent that reliable and comprehensive statistics covering production and sales in any industry are of great value to all engaged in it; and the individual manufacturer, in furnishing such details about his own business confidentially to a central bureau or organization, should receive far more information than he gives, by obtaining the current statistics of the industry. Because manufacturers generally are reluctant to give out information of this character, they are obliged to apply the old cut-and-try methods to the commercial end of their business.

The National Machine Tool Builders' Association is now endeavoring to compile production statistics, which should be of great value to all members if they are only nearly complete. Suppose that a shaper manufacturer, planning to increase his stock, knew the total number of shapers unsold in the hands of manufacturers and dealers, and the approximate capacity of the market; would not that information be a great help in determining his manufacturing policy? Suppose that comprehensive statistics were available covering five or ten years past, showing the total domestic and export consumption of the different classes of machine tools, together with adequate information of the present total capacity of the machine tool plants in the country; would not such information be a real help in deciding policies for the future?

If statistics covering production, orders booked, shipments, and the total amount of orders on hand were given out each month, of course mentioning no names, but giving the total figures of all manufacturers for different lines of machine tools, each manufacturer could form a reasonably accurate opinion of present conditions and of the immediate future. Now they can only guess. It is admitted by manufacturers that if such statistics had been available a year ago all would have been better off today, because provision could have been made for the decline in business much sooner than was done.

The collection of such information is one of the greatest services that the National Machine Tool Builders' Association can at the present time render its members and the industry. If there are any details in connection with this work to which individual manufacturers object, it is surely possible by cooperation to overcome them, so that this important service may become operative.

* * *

PUBLICITY THAT PAYS

The value of a circular or catalogue of machine tools and accessories is materially increased by being truly descriptive of the product advertised. Many circulars and catalogues contain too little of the definite information which the ultimate users in the shop—the superintendent, the foreman and the shop men in general—are looking for. Vague and general phrases are too common. The descriptions of the machines or devices often consist of generalities which, if analyzed, would be just as applicable to a similar machine built by a competitor.

The prospective purchaser can form no intelligent opinion as to the comparative merits of two machines if the information furnished to him is given in the vague terms often found in printed descriptions. Such expressions as "The best materials are used in its construction throughout," "The bed is designed so as to insure maximum rigidity," mean little or nothing, because such statements are often as true of one machine as of another in the particular class referred to. Advertising literature should describe the distinctive features of the machine—the particular points wherein it differs from competing machines and is superior to them. The advantages gained by the user from these distinctive features should be clearly explained.

One object of advanced mechanical advertising is to visualize on paper the kind of work for which a machine is particularly adapted. This is an important point, because with the great variety of somewhat special types of machine tools and attachments now on the market it is not always apparent that the machine or device in question would be especially applicable to the prospective customer's work.

In the preparation of circulars and catalogues, close cooperation is desirable between the engineering staff, who are conversant with the technical points to be described, and the advertising and sales staff, whose training qualifies them to present such descriptive matter in convincing form.

The Center of the Machine Tool Industry

According to the 1920 census, the "center of population" is now located in the southwestern part of Indiana, having moved westward about eight miles during the last decade. The "center of the machine tool industry" has also been moving westward during the past fifty years, somewhat slowly during the seventies, then quite rapidly during the eighties and nineties, and again more slowly during the past twenty years. A brief review of this westward movement will probably interest those now connected with the industry.

In the middle of the last century the building of machinery of all kinds was concentrated on the Atlantic Coast. Fifty years ago, practically all the machine tool building shops in the United States were located in New England, New Jersey and eastern Pennsylvania. The important machine tool building centers at that time were Providence; Hartford; Worcester; Fitchburg; Windsor, Vt.; Philadelphia; and Newark, N. J.

TABLE 1. CITIES AND TOWNS BUILDING OVER 98 PER CENT OF THE MACHINE TOOLS IN THE UNITED STATES

Based Upon Number of Men Employed in Machine Tool Shops Not Including Small Tools—at the Time of the Armistice, 1918. Percentages given show Comparison with Entire Machine Tool Industry of the United States

City or Town	Per Cent	City or Town	Per Cent	City or Town	Per Cent	City or Town	Per Cent
Cincinnati, Ohio	11.8	Torrington, Conn. ...	1.12	Springfield, Ohio	0.28	Kenton, Ohio	0.13
Cleveland, Ohio	8.1	Pawtucket, R. I.	0.94	Nashua, N. H.	0.28	New Haven, Conn....	0.13
Providence, R. I.	7.3	Springfield, Mass. ...	0.88	Baltimore, Md.	0.27	Danbury, Conn.	0.12
Hartford, Conn.	5.3	South Bend, Ind. ...	0.74	Tiffin, Ohio	0.26	Freeport, Ill.	0.11
Worcester, Mass.	4.6	Moline, Ill.	0.69	Waltham, Mass.	0.26	New Castle, Ind.	0.11
New York City	3.6	Sidney, Ohio	0.68	Ridgway, Pa.	0.25	Waterbury, Conn. ...	0.11
Philadelphia, Pa.	3.3	Covington, Ky.	0.65	Kokomo, Ind.	0.24	Bay City, Mich.	0.11
Hamilton, Ohio	2.8	Grand Rapids, Mich..	0.65	Greenfield, Mass.	0.21	Louisville, Ky.	0.11
Bridgeport, Conn. ...	2.7	Pittsburg, Pa.	0.59	Dubuque, Iowa	0.20	Glendale, N. Y.	0.11
Rockford, Ill.	2.6	Syracuse, N. Y.	0.55	Winchendon, Mass...	0.20	Yonkers, N. Y.	0.11
Rochester, N. Y.	2.4	Saginaw, Mich.	0.54	St. Mary's, Ohio	0.19	Defiance, Ohio	0.10
New Britain, Conn...	1.93	Elkhart, Ind.	0.52	Mt. Gilead, Ohio	0.19	Portland, Maine	0.10
Fitchburg, Mass.	1.87	Chambersburg, Pa....	0.52	Racine, Wis.	0.19	Bristol, Conn.	0.10
Chicago, Ill.	1.85	Jackson, Mich.	0.50	St. Louis, Mo.	0.19	Brazil, Ind.	0.10
Madison, Wis.	1.85	New London, Conn...	0.46	Massillon, Ohio	0.18	Westboro, Mass.	0.09
Waynesboro, Pa.	1.71	Fond du Lac, Wis....	0.44	Beloit, Wis.	0.18	Minster, Ohio	0.09
Boston, Mass.*	1.70	Indianapolis, Ind. ...	0.43	Bridgeton, N. J.	0.17	Barre, Mass.	0.09
Buffalo, N. Y.	1.67	Dexter, Maine	0.43	Detroit, Mich.	0.16	Aurora, Ind.	0.08
Newark, N. J.	1.63	Wilmington, Del.	0.42	Royersford, Pa.	0.16	Peru, Ind.	0.07
Milwaukee, Wis.	1.58	Hudson, Mass.	0.41	Braddock, Pa.	0.15	New Bremen, Ohio...	0.07
Toledo, Ohio	1.57	Franklin, Pa.	0.36	Salem, Ohio	0.15	Edwardsville, Ill. ...	0.07
Springfield, Vt.	1.54	Davenport, Iowa	0.35	Holland, Mich.	0.15	Meadville, Pa.	0.07
Plainfield, N. J.	1.27	Hastings, Mich.	0.34	Canton, Ohio	0.14	Conneaut, Ohio	0.06
Windsor, Vt.	1.15	Richmond, Ind.	0.33	Paterson, N. J.	0.13	La Salle, Ill.	0.06
Erie, Pa.	1.13	Seneca Falls, N. Y...	0.31	Muskegon, Mich.	0.13	Xenia, Ohio	0.06

Machinery

*Includes Cambridge, Mass.

Comparisons by Sections

No statistics of the machine tool industry are available before 1899, showing either the number of plants in existence or the value of the product. By that time the Ohio machine tool builders had become well established; and as the accompanying tabulation shows, the proportion of product between the New England and the Ohio manufacturers has remained practically unchanged since then. The relative importance of New York, New Jersey and Pennsylvania as machine tool building states has decreased, while that of Illinois, Indiana, Michigan and Wisconsin has increased.

In 1899 the total value of the metal-working machinery built in the United States was about $25,000,000, of which machine tools represented $18,000,000. The statistics for 1899 do not show separately for each state the value of the machine tools built, but include all metal-working machinery. The New England states were responsible for 32 per cent of the total; New York, New Jersey and Pennsylvania, 26 per cent; Ohio, 30 per cent; and Illinois, Indiana, Michigan and Wisconsin, practically the entire remainder—12 per cent.

In 1904 the depression in the machine tool industry affected the Ohio manufacturers more than those in New England, so that of the total production of metal-working machinery in that year, the New England states were responsible for 35 per cent; New York, New Jersey and Pennsylvania, 24 per cent; Ohio, 25 per cent; while Illinois, Indiana, Michigan and Wisconsin had increased their quota to about 16 per cent. The total production of metal-working machinery in 1904 was valued at $32,000,000, of which $18,000,000 represented machine tools. These figures show that there was no increase in the value of the machine tools produced in 1904 as compared with 1899; due doubtless to the depression in the latter year.

Census of Manufactures for 1914

Unfortunately, the census of the machine tool industry has been taken in years when this industry was subjected to a depression. The next census after 1904 was that of 1914 when for the first time machine tools were classified entirely by themselves. According to this census, the total value of the machine tools produced in that year was $31,500,000. Of this total New England was responsible for 35 per cent; New York, New Jersey and Pennsylvania, 18 per cent; Ohio, 29 per cent; and Illinois, Indiana, Michigan and Wisconsin, about 18 per cent. These figures show that New York, New Jersey and Pennsylvania lost in relative importance as machine tool producing states as compared with 1899 and 1904, while Illinois, Indiana, Michigan and Wisconsin gained. The balance between New England and Ohio remained practically the same as in 1899.

The Machine Tool Industry in 1918

The great development that took place in the machine tool industry from 1914 to 1918 did not materially affect the proportion between New England and the middle-western states that has been maintained with comparatively small changes for the past twenty years. Census figures are not available showing the total value of the products of the machine tool manufacturers in 1918, but an estimate may be based upon the total number of men employed in the industry in 1918 (77,000), from which it may be assumed that the total value of the machine tools built in that year was between $300,000,000 and $400,000,000.

A tabulation of the number of men employed in the machine tool industry in 1918 was made by the Machine Tool Section of the War Industries Board. According to these figures, New England in 1918 employed 34.6 per cent of the workers in the industry; Ohio, 27.9 per cent; New York, New Jersey and Pennsylvania, 20.5 per cent; while Illinois, Indiana, Michigan and Wisconsin employed 15.3 per cent, the remaining 1.7 per cent being scattered over a number of the other states where machine tools were built. In the Ohio figures those for Kentucky are included, as practically all the machine tool building in Kentucky is located in Covington, across the river from Cincinnati.

The Center of the Machine Tool Industry

The figures given indicate that New England and Ohio up to the present time are practically holding the same proportionate places in the machine tool industry as they held in 1899. The percentage loss of New York, New Jersey and Pennsylvania is made up for by the increases in Illinois, Indiana, Michigan and Wisconsin, showing that the actual center of the machine tool building industry is gradually, if slowly, moving westward.

TABLE 2. DISTRIBUTION OF THE MACHINE TOOL INDUSTRY IN THE UNITED STATES

Based upon Number of Men Employed in Machine Tool Shops—Not Including Small Tools—at the Time of the Armistice, 1918

State	Per Cent	State	Per Cent	State	Per Cent
Ohio	27.1	New Jersey	3.2	New Hampshire	0.29
Connecticut	12.1	Vermont	2.9	Maryland	0.27
Massachusetts	10.5	Indiana	2.8	Virginia	0.20
New York	8.9	Michigan	2.7	Missouri	0.18
Pennsylvania	8.4	Kentucky	0.76	California	0.04
Rhode Island	8.3	Iowa	0.58	Tennessee	0.02
Illinois	5.4	Maine	0.53		
Wisconsin	4.4	Delaware	0.43	Total	100.00

Machinery

An attempt to determine the center of the machine tool industry in the United States in the same way as the center of population is determined, would locate it approximately on a line passing north and south, just east of Rochester, N. Y. As the tables in this article show, about 55 per cent of the machine tools in the United States are built in New England, New York, New Jersey and Pennsylvania; and 45 per cent are built in Ohio and in the states west of Ohio.

* * *

BELGIAN STANDARDIZATION ASSOCIATION

The Association Belge de Standardization is a Belgian organization, formed to study the question of standardization from the commercial and technical points of view in all branches of industry. It consists of important industrial and technical associations in Belgium. A general committee has been chosen to direct the activities of the association, to examine any proposals presented, and to keep in touch with similar organizations in foreign countries, in order that the members of the association may profit from results obtained elsewhere, or may, if required, assist in the establishment of international standardization. In each case where the committee decides to attempt standardization, it will appoint a technical committee of experts, who will report, and if necessary consult producers and consumers.

SPRING MEETING OF THE A. S. M. E.

A program that met with the requirements of mechanical engineers engaged in many different activities was arranged for the spring meeting of the American Society of Mechanical Engineers held in Chicago, May 23 to 26, with headquarters at the Congress Hotel. There was an unusually large attendance, and a strong professional program made attendance well worth while. The Western Society of Engineers cooperated wholeheartedly with the American Society of Mechanical Engineers in a session devoted to the subject of "Problems of Chicago as a Midwestern Rail-Water Gateway."

The papers read before the meeting were segregated into a number of different sessions, dealing specifically with fuel, machine shop practice, management, power test codes, railroads, materials handling, forest products, and power. The machine shop session was devoted to four papers dealing, respectively, with the effect of the automotive industry on gear-cutting practice, power press design, lathe design, and interchangeable manufacture. These papers were presented, respectively, by H. J. Eberhardt, H. J. Hinde, R. E. Flanders, and C. B. Lord. The subjects dealt with at the management session were industrial waste and graphics in management.

Excursions were arranged to the International Harvester Co.; Sears, Roebuck & Co.; and the Western Electric Co. At the close of the meeting, an excursion was arranged to the Rock Island Arsenal, which was limited to citizens of the United States not engaged in the manufacture of munitions for a foreign government. This excursion took place May 27 and 28. Friday morning was devoted to the inspection of the arsenal, and the afternoon was given over to a session of the Ordnance Division, at which a paper was presented relating to the needs for munitions preparedness.

* * *

TIME TO BUY COAL FOR INDUSTRIAL PURPOSES

All the authorities on the coal situation agree that unless industrial establishments begin to lay in coal for the coming season at this time, there is likely to be a coal shortage next winter. If no one is putting in any stock now, many industries will find themselves decidedly short in the fall, and all will order at once. If that happens, coal prices will rise again, due to excessive demand. Prices of bituminous coal are reasonable at the present time, and advantage should be taken of the present price level. Furthermore, by ordering coal now, the mines are enabled to work on a steady output, and the demand at no time will rise to a point where excessive prices will be exacted. It is doubtful if there would have been a coal shortage at any time if consumers had laid in a sufficient stock a reasonable time ahead of the actual requirements. Generally, however, the procedure is the reverse. There is a delay in ordering until there is the prospect of shortage, and then everybody orders at once, way ahead of actual requirements—a condition which naturally produces both a shortage and excessive prices.

Automatic Pin Drilling Jig

In the December number of Machinery, an illustrated description was published of an automatic sensitive drilling machine which had just been placed upon the market at that time by the Kingsbury Mfg. Co., of Keene, N. H. To adapt machines of this type for the efficient drilling of cross-holes through pins, an interesting type of jig has been developed, and this equipment is here illustrated and described. When the operator pushes the pin to be drilled into place in a V-block, the jig provides for releasing the spindle from its locked upper position, clamping the work in place for drilling, delivering a steady stream of cooling fluid to the point of the drill while the operation is in progress, unclamping the work, ejecting the drilled pin, and relocking the spindle at the top of its stroke until such a time as the next sequence of operations is started.

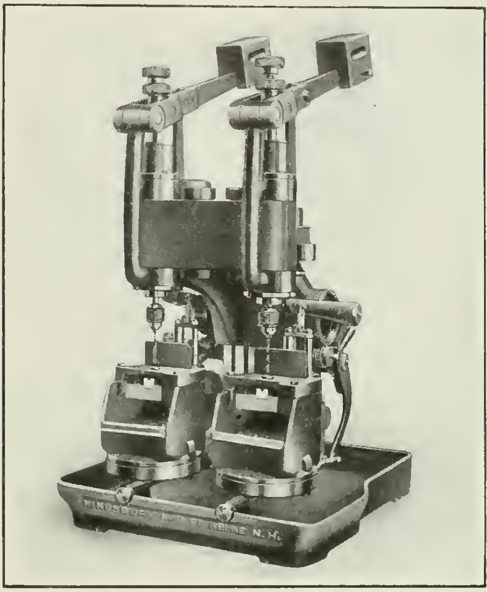


Fig. 1. Machine equipped with Automatic Pin Drilling Jigs

The way in which these results are accomplished is as follows: The pin to be drilled is held in a V-block *A*, Fig. 2, and when pushed into place in this block, it strikes the end of a screw *B* that is carried at the forward end of a slide *C*. The rear end of this slide rests under a latch *D* that provides for holding the drilling spindle in its upper position until a piece of work is pushed into place. This latch and other auxiliary parts of the mechanism are carried by a plunger *E*, which descends with the spindle. As the drilling spindle starts downward, an eccentric clamping roller *F* comes into action and provides for binding the pin

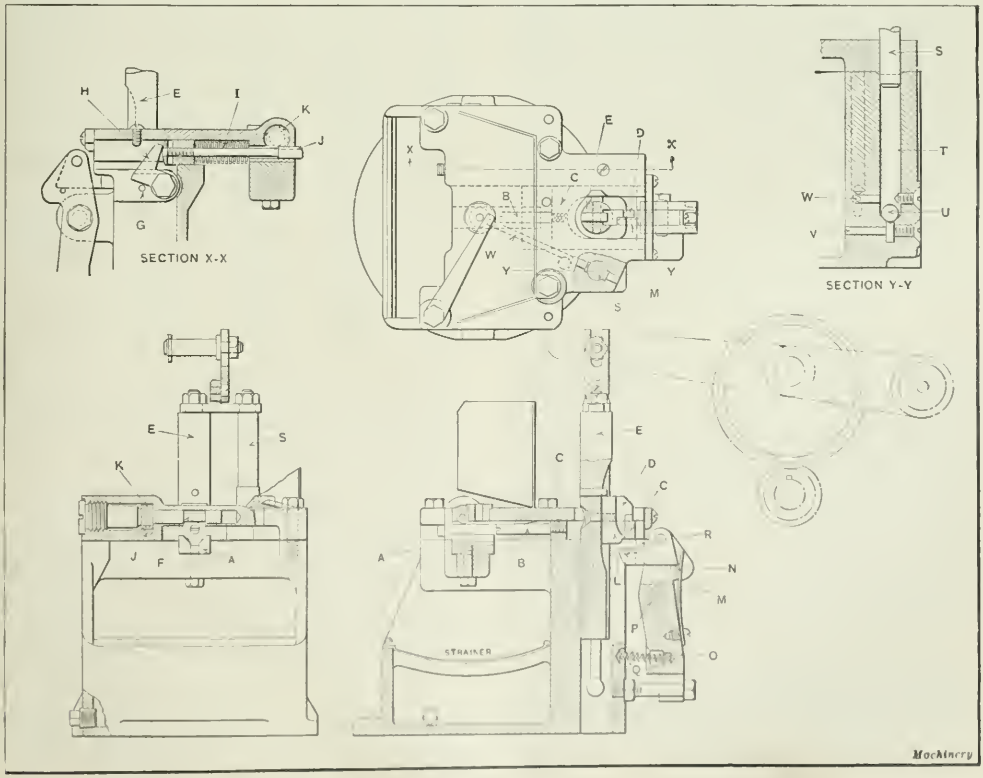


Fig. 2. Details of Design of Mechanism of the Automatic Pin Drilling Jigs shown on Machine in Fig. 1

down in the V-block. This is accomplished in the following manner: A pin *G* carried by plunger *E* drops from beneath a small bellcrank *H*, with the result that compression spring *I* is able to push forward on a plunger secured to the forward end of a rack *J*. This rack meshes with a pinion *K*, carried at the left-hand end of the binding roller *F*, and owing to the eccentricity of this roller, it is able to clamp the work down in place in the V-block *A*.

How the Drilled Pin is Ejected from the Jig

As plunger *E* moves down with the drill spindle, latch *L* strikes the point of a pivoted latch *M*, which swings out of the way to allow *L* to pass. After the drilling operation has been completed and the spindle starts back to its top position, latch *L* engages the under side of *M*, but is unable to pass because latch *M* is prevented from swinging on its pivotal support in the opposite direction through the action of a pin *N*. As a result, the lever *O* swings about its pivotal support *P* against the compression of a coil spring *Q*. This swinging of lever *O* progresses until latch *L* is able to slip past latch *M;* and at that point a shoulder *R* on latch *M* engages the rear end of slide *C*.

Coincident with the return movement of the mechanism, pin *G*, carried by plunger *E*, engages the under side of bellcrank *H* and moves rack *J* backward against the compression of spring *I*. This movement of the rack turns pinion *K* that meshes with it, and by turning the eccentric binding roller *F*, releases the work from the V-block *A*. When this releasing of the work clamp has been accomplished, the compression of spring *Q* swings lever *O* toward the right about its pivotal support *P*, and the shoulder *R* of latch *M* that is then in contact with slide *C* pushes this slide forward so that screw *B* is able to eject the drilled pin from the V-block *A*. At the same time, slide *C* moves into position under latch *D* and locks the spindle at the top of its stroke until such a time as a new pin is pushed into place in the fixture ready to be drilled. It should be noted that the regular automatic cycle of movements of the machine carries the spindle up to a position where latch *D* is slightly above slide *C*, as shown in Fig. 2. Then the spindle starts down, and its movement is stopped by the engagement of latch *D* and the top of slide *C*.

Coupled to the plunger *E* there is a plunger *S* that reciprocates in vertical cylinder *T*, at the bottom of which there is a ball valve *U*. Pipe *V* connects with a reservoir in the base of the machine that contains a supply of coolant. As plunger *S* rises, the suction draws the coolant from the reservoir into cylinder *T*, where it is held by ball valve *U;* and on the next downward stroke, plunger *S* forces the coolant from the cylinder through an outlet pipe *W* which leads to the point of the drill, thus delivering the coolant during the time when the drilling operation is in progress.

Owing to the automatic control of this fixture, one operator is able to attend to a battery of machines that are so equipped, with the result that a very high rate of output can be attained. The actual rate at which pins can be drilled will naturally vary according to the diameter of the pins and the size of the hole to be drilled through them. In drilling holes ⅛ inch in diameter through steel pins ¼ inch in diameter, the rate of production is 1500 pins per hour, which any experienced user of drilling machines will concede to be very satisfactory, taking into account the fact that this production can be easily maintained all day with practically no drill breakage. Fixtures of this type are adapted for use in drilling cross-holes in pins, rivets, screws, etc. It is merely required to push the work into place in the fixture, and so unskilled labor can be utilized.

* * *

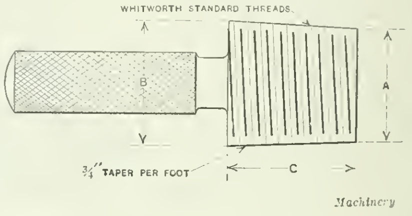
A consular report from India calls attention to the requirements for marking goods exported to India. The principal requirement is that all goods must be marked with the name of the country of origin in letters which are fully as large as any contained in the trademark or description of the goods.

BRITISH STANDARD PIPE THREAD GAGES

By CHARLES HENRICHS
Superintendent, Hollande Mfg. Co., Erie, Pa.

The tables published by the British Engineering Standards Committee on British standard pipe threads do not give sufficient information to enable pipe thread gages to be made with any assurance of accuracy in the dimensions. The tables available in handbooks are directly reproduced from the tables published by the Engineering Standards Committee, and therefore also lack the necessary data for the manufacturer who is called upon to make British pipe thread gages. The writer found it necessary to obtain the necessary information by correspondence with the British Engineering Standards Committee and British firms; and on the basis of the information obtained, prepared the table presented herewith, which will enable anyone to make British pipe thread gages that will meet the requirements.

BRITISH STANDARD PIPE THREAD GAGE DIMENSIONS



Size Inches	A Inches	B Inches	C Inches	Number of Turns in Fitting, by Hand
⅛	0.3730	0.3964	0.375	4 1/3
¼	0.5060	0.5294	0.375	3½
⅜	0.6404	0.6716	0.500	4¾
½	0.8090	0.8480	0.625	3½
¾	1.0180	1.0640	0.750	5¼
1	1.2860	1.3406	0.875	4⅛
1¼	1.6190	1.6815	1.000	5½
1½	1.8510	1.9135	1.000	5½
2	2.3080	2.3783	1.125	6⅞
2½	2.9170	2.9950	1.250	7½
3	3.4090	3.4949	1.375	8 9/10
3½	3.8950	3.9880	1.500	9 6/10
4	4.3870	4.4880	1.625	11
4½	4.8810	4.9885	1.625	11
5	5.3800	5.4890	1.750	12¼
6	6.3640	6.4890	2.000	15⅛
7	7.3650	7.4970	2.125	15⅛
8	8.3560	8.4960	2.250	16½

To the writer's knowledge this is the first table of this kind that has ever been published in the United States, and it is offered because of the need for such a table in mechanical literature.

* * *

A PERMANENT WORLD'S FAIR IN PARIS

The plans for a kind of permanent world's fair at Paris have now come to a point where it seems probable that they will become a reality. The fair, which is to be known as Marché du Monde, will be housed in a building of ten stories with a tower comprising thirty-five floors. The tower will be about 65 feet square and nearly 500 feet high, and will be devoted to offices of those merchants and agencies who do not wish to display their products. It is intended to use the building as a permanent exhibition of the products of the whole world's industries. Further particulars may be had from Milton L. Schmitt, Director American Division, Paris Marché du Monde, Paris, France.

Industry and the Department of Commerce

MR. HOOVER is working out definite plans for making the Department of Commerce of real value to the industries. There is no reason why the Department should not bear the same definite relation and give the same specific service to industry that the Department of Agriculture gives to the farmer.

It is Mr. Hoover's aim to avail himself of all the advice and assistance that he can get directly from the industries. As an entering wedge he is holding monthly conferences with the editors of the leading engineering and trade journals at Washington—the latest was held on May 9—in order to obtain, through this channel, suggestions as to the service which the Department can best render the industries in the respective fields represented by the trade and engineering journals.

Mr. Hoover should have the active assistance and wholehearted cooperation of manufacturers in this work. He has asked Congress for an appropriation of $618,000 in order to establish better service for the industries. The work the Department can do under proper guidance is so important that a sum much larger would be well spent. The amount asked for about equals the cost of a single battalion of our Army. Surely that much should be spent on aiding the industries from which, after all, the great bulk of the income of the Government is drawn.

How can the Department of Commerce be Made a Real Aid to Business?

As the government departments in Washington are now organized many of the functions that belong distinctly in the Department of Commerce are scattered over a number of other departments. A thorough reorganization is necessary if we are ever to have an efficient Government and a Department of Commerce that can serve the industries as they should be served.

The Bureau of Patents, for example, should be under the authority of the Department of Commerce. What could be more important than that such a function as the granting of patents, so directly affecting the industrial progress of the country, should be in the hands of the department directly interested in the welfare of the industries? At present, the Bureau of Patents is far behind in its work, due to faulty organization and insufficient appropriations. The scope of its work should be broadened and new functions added to it. One of these is foreign relations in patent matters. If the Bureau of Patents were part of the Department of Commerce these matters could receive adequate attention.

The Bureau of Patents is but one example of the need for an entire reorganization of the government departments in the interest of economy and efficiency. Everybody complains of the inefficiency of the Government, but few people give any aid to the men who have tried to reorganize the Government on a business basis. Now we have an administration in Washington that is ready and willing to do things on a business basis, and to apply business principles to government. Every man in the industries who believes in a business administration should write his representatives in Congress that there is a demand for better service to the industries, and that such service can only be rendered by a thorough departmental reorganization.

Plan and Purpose of Reorganization

In planning a reorganization, all functions of the Government should be placed in the various departments according to their *use* and *purpose*. The theoretical efficiency engineer is prone to divide an organization according to the *method* that is employed in performing certain work. Thus, for example, someone has proposed that all the engineering work done by the Government should be placed in a single department. This method of subdivision is erroneous. It subordinates the use and purpose of the work to the method by which the work is to be performed, and in so doing would stifle initiative and hamper the service. This applies particularly to the Department of Commerce. If the purpose and use of its service is subordinated to the methods by which the work is done, the entire purpose of the Department for serving the needs of commerce and industry is forgotten.

Functions of a Real Department of Commerce

A Department of Commerce organized to give real service to the industries should comprise every bureau and function at present included as a proper governmental activity that relates to industry, trade, and transportation—domestic or foreign; but it should not include the regulatory functions of the Government, because it must gain the unqualified confidence of the industries, and to do so it should have no regulatory or judicial powers. It should be simply a department of assistance to the industries.

If so organized, it would be possible to build up an intimate contact between the Department and the industries of the country. The Department could obtain and distribute, for the benefit of the industries, statistical data and information relating to problems in the manufacturing field. It could give greater constructive aid in the elimination of waste. It could learn from the industries, through the leaders in the field, what particular service the Department could render that would be of the greatest assistance. It could aid in standardization work whenever the industries indicated to the Department that such work would be desirable. It could publish, without delay, accurate information on conditions in the industrial field with a view to presenting a barometer of business in which the industry could place complete confidence. Such a barometer of business conditions would contain statistics as to production, stocks, percentage of industrial activity, and prices. With able men at the head of the Department and sufficient appropriations to carry on the work, such statistics could be published a few days after the end of each month.

Barometer of Business Conditions

One of the first services that should be established by the Department of Commerce under its present leadership should be an index of the condition of business in general throughout the country. Such an index would be a stabilizing influence. In times of prosperity it would have a tendency to prevent over-expansion and over-speculation. In times of depression it would aid in restoring confidence. It is safe to say that had adequate statistics of this kind been available a year ago, we would not have had the severe depression that followed, and it is equally safe to say that if business knew the percentage of activity that is now going on in the country, in spite of the severe depression in certain industries, the future outlook would be very reassuring. Lacking such a comprehensive barometer of business conditions, we depend haphazardly upon our own opinion and the judgments of some few statistical experts who, in a private way, have undertaken to do for industry what it should do for itself through the disinterested service of a reorganized Department of Commerce.

Let us all get behind Hoover!

New French Tariff on Machine Tools

From MACHINERY'S Special Correspondent

Paris, May 12

BUSINESS in France seems to have improved slightly, but on account of the large stocks on hand, manufacturers find it difficult to dispose of their products, and so the various industries continue quiet. In the iron and steel field, especially, business has begun to improve, and the sales made indicate an end to price cutting. The same may be said concerning machine tools and automobiles. The solution of the German question will certainly stimulate business in general. No appreciable change has been noted in the number of plants shut down.

Changes in Duties on Imports

One thing of moment which has recently occurred was the passing of a law on March 28 increasing the duties on imports. The *Official Journal* published under date of April 3 contains the following modifications in the tariff which will interest the machine tool manufacturers of various countries. The duties are imposed according to the weight of machines and parts, and in order that comparisons may be readily made, it will be remembered that 1000 kilograms are equivalent to 2205 pounds.

Machine tools:	
25,000 kg. and up	40 francs per 100 kg., instead of 15 francs
5,000 to 25,000 kg.	48 francs per 100 kg., instead of 18 francs
1,000 to 5,000 kg.	64 francs per 100 kg., instead of 24 francs
250 to 1000 kg.	96 francs per 100 kg., instead of 36 francs
Less than 250 kg.	200 francs per 100 kg., instead of 75 francs
Non-classified machines	40 francs per 100 kg., instead of 15 francs
Iron and steel parts of machines:	
Rough parts	32 to 56 francs per 100 kg., instead of 12 to 30 francs, according to weight
Finished parts	52 to 100 francs per 100 kg., instead of 20 to 60 francs, according to weight
Tools:	
Circular and band saws	140 francs per 100 kg., instead of 53 francs
Hand saws	100 francs per 100 kg., instead of 38 francs
Files and rasps (finished and rough):	
From 35 cm. in length and up	120 francs per 100 kg., instead of 45 francs
Less than 35 cm. in length	160 francs per 100 kg., instead of 60 francs
Vises and die stocks	60 to 180 francs per 100 kg., according to weight
Drills, taps, dies, reamers, milling cutters, etc.	40 per cent ad valorem, instead of 15 per cent
Calipers, graduated rules, gages and other precision instruments	1200 francs per 450 kg.

All the duties given in the foregoing must be multiplied by the general "tariff coefficient" which at the present time is 3. For example, a lathe weighing 900 kilograms will be taxed at the rate of 3 × 96 or 288 francs per 100 kilograms, or a total of 2592 francs. Through the new tariff, prices of machines in France can be readjusted to compare favorably with prices of German machines. For example, a German concern formerly listed a punch and shear having a cast-steel base and weighing 3500 kilograms (7720 pounds) at 30,000 francs ($2514, present exchange), approximately 8.57 francs per kilogram (32.6 cents per pound). This price included a duty of 2520 francs. Under the new tariff the duty becomes 6720 francs, a total increase of 4200 francs ($352), or an increase of 1.20 francs per kilogram, so that the price of the German machine will now be 9.77 francs per kilogram. One French firm quotes 8.10 francs per kilogram for a machine of this type, and another, 11 francs.

Prices of Machine Tools

The value of the stock of machine tools on hand in France, based upon information obtained from the principal dealers, is a billion francs ($83,800,000, present exchange). The highest priced machine tool in stock is a boring and turning mill which is listed at 411,184 francs (about $34,500) F. O. B. warehouse. A lathe, also of American manufacture, having a 15-inch swing and a distance between centers of 4 feet, costs about 12,000 francs ($1000), which amounts to about 13.3 francs per kilogram (50.5 cents per pound). Good French lathes having swings of from 190 to 250 millimeters (approximately 15 to 20 inches) cost about 4.5 francs per kilogram (17 cents per pound) for the largest sizes, and 6 francs per kilogram (22.8 cents per pound) for the smallest.

One German concern has reduced prices to meet the increase in duties on imports. On a small precision machine weighing 120 kilograms and listed at 5000 francs they originally paid a duty of 270 francs. As soon as the new French tariff law was passed, the German firm announced that it would reduce the price of the machine to 4000 francs. Including the new duty, the total cost will now be 4720 francs instead of 5270 francs, which it would cost if the price had not been reduced.

Prices of Raw Materials, Wages, and Living Costs

Metals have undergone another considerable cut in price, the permission to sell coal and coke for other than blast furnaces being largely responsible for this. Pig iron is listed at from 270 to 280 francs per metric ton ($20.37 to $21.11 per English ton, present exchange). Steel bars sell at from 65 to 70 francs per 100 kilograms ($49.05 to $52.83 per English ton). The protection given by the customs department in raising the duty on steel bars and sheet steel will tend to stabilize prices in France; prices are now stable in Belgium.

The cost of living has decreased materially due to governmental action, the reduction since the beginning of the year amounting to from 25 to 30 per cent; and it is believed that a still further reduction will occur during the next few months. Wages have been reduced proportionately; in the iron ore mines at Longwy an earlier reduction of a franc per day (8.38 cents), has just been followed by an additional reduction of 1.5 francs per day. At Rheims all working people have had their wages reduced from 10 to 20 per cent.

Union of Two Steel Concerns

Les Forges et Acieries du Nord et de l'Est has just united with the steel works of Basse-Loire and this combination constitutes one of the most important of the French iron and steel companies. The plants which it comprises are spread over the north, east, and west of France. The mining properties which it controls include an estimated reserve of more than 350,000,000 metric tons of mineral.

Railway Machine Shop Practice

Methods Employed in Machining and Assembling Bronze Bearings for Locomotive Driving-rods and Side-rods—Third of a Series of Articles

IT is a matter of general mechanical knowledge that the practice of bushing bearings with a bronze alloy is followed in the construction of driving-rods and side-rods for use on locomotives. There is a fundamental difference in the design of these bearing boxes, namely, the outside of the driving-rod box is of rectangular shape, while the side-rod box is of cylindrical form. The usual method of procedure in machining both of these types of brasses is to first finish the outside, after which they are assembled in the rod and then set up on a suitable form of boring machine to provide for finishing the inside diameter.

Planing the Outside of a Driving-rod Brass on the Slotter

In Fig. 1 there is illustrated a slotting machine built at the Niles Tool Works of the Niles-Bement-Pond Co., in Hamilton, Ohio, which is shown in operation in the Chicago, Rock Island & Pacific Railway Shops at Silvis, Ill., engaged in planing the outside of a bearing brass for a locomotive driving-rod. Conforming with usual practice, this brass is flanged, so that the strap which holds it in place on the end of the driving-rod fits into channels that preclude the possibility of the brass slipping out of place. In performing the required planing operations on this slotter, the edges and inner sides of the two flanges can be planed, as well as the outside walls of the brass.

One advantage of a slotter for work of this kind is that the swiveling table makes it possible to finish four sides of the brass at two settings. After all surfaces on one side of the brass have been planed, the table is indexed through 180 degrees, after which the same work is done on the opposite side. Then the brass must be removed from the table and reset to provide for planing the corresponding surfaces on the two remaining sides. To afford clearance between the under side of the work and the slotter table, so that the tool can cut down to the bottom of the work, a practice is made of setting the job up on blocks *A* which raise it sufficiently to give the desired working conditions.

Planing the Outside of a Small Driving-rod Brass on a Shaper

In Fig. 2 there is illustrated a 24-inch shaper built by Gould & Eberhardt, Newark, N. J., which is equipped with an indexing fixture to provide for planing the side walls and the flanges of various sized driving-rod brasses. This method is used in the Chicago & Northwestern Railway Co.'s shops in Chicago, Ill. For work that comes within its range, such an equipment possesses an advantage over the use of a slotter tooled up as shown in Fig. 1 in that the whole job can be completed at a single setting. So far as the actual planing operation is concerned, it is of an extremely simple character, consisting merely of the planing of straight, horizontal, and vertical surfaces on the flanges and on the side walls of the bearing brass.

However, the fixture is of sufficient interest to call for a brief description. As will be seen, there is a faceplate *A* pivoted to the body *B* of the fixture; and extending through the flange of the fixture body into the back of the faceplate, there is an index pin *C*. This pin enters one of several holes that are provided in the back of the faceplate for securing the work in various positions in which it must be held for performing planing operations on different sides of the bearing brass. Faceplate *A* is pivoted to the body *B* of the fixture by means of bolt *D*; and after the index-pin *C* has entered the hole

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In railroad shops engaged on work connected with the maintenance of locomotives, the machining of bearing brasses for driving- and side-rods is one of the most common operations. This article describes methods used in three well-known railroad shops for the execution of work required in refinishing used brasses or machining new castings—the Chicago, Rock Island & Pacific Railway, the Chicago & Northwestern Railway, and the Illinois Central Railroad.

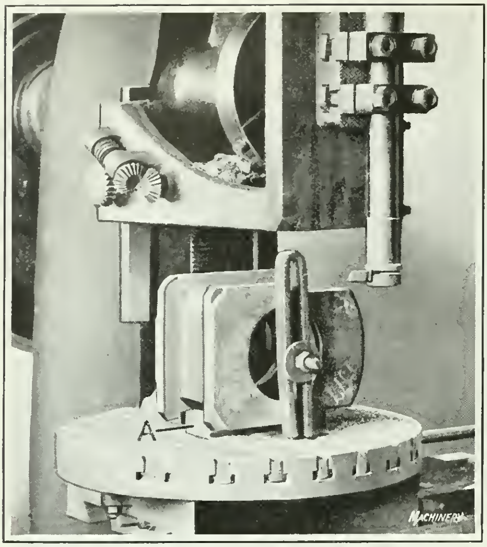

Fig. 1. Slotter equipped for performing Planing Operations on a Driving-rod Brass

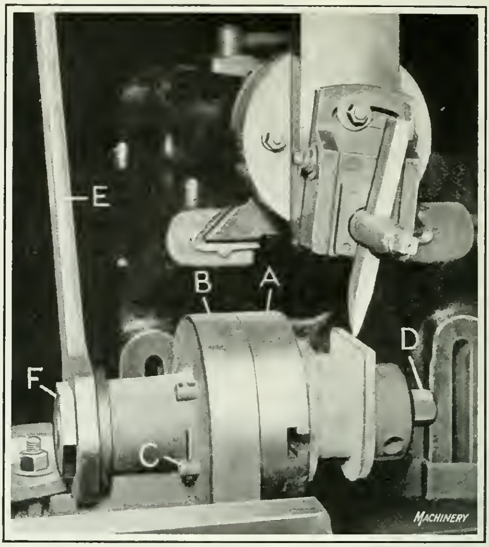

Fig. 2. Shaper equipped for performing Planing Operations on a Driving-rod Brass

to give the required location, a long handled wrench *E* is utilized to tighten the nut *F* on the end of the bolt *D*, which secures the work firmly in place.

Boring the Inside Diameter of a Driving-rod Brass

Previous mention has been made of flanges furnished on the outside of the driving-rod brasses, to enable a strap to secure the brass firmly in place on the rod. In the Chicago & Northwestern Railway Co.'s shops, a practice is made of utilizing this driving-rod strap as a jig, in which the brass is held while performing a boring operation on the inside diameter. In Fig. 3 there is shown a vertical boring machine built in the Niles Tool Works of the Niles-Bement-Pond Co., which is engaged upon the performance of this operation. So far as the boring operation is concerned, it is perfectly simple, consisting of the use of a boring-bar *A* for taking a cut over the inside diameter, and a tool *B* on the second turret face, that is utilized for facing the side of the brass. In order to provide the necessary clearance between the under side of the work and the boring machine table to allow the tool to cut down to the bottom of the brass, it will be seen that the work is set up on parallel strips *C* and that it is held down on the boring mill table by means of straps *D*.

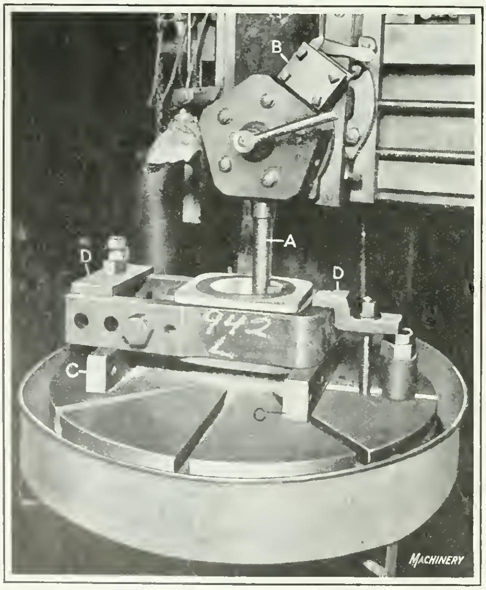

Fig. 3. Use of a Driving-rod Strap to hold the Bearing Brass while performing a Boring Operation

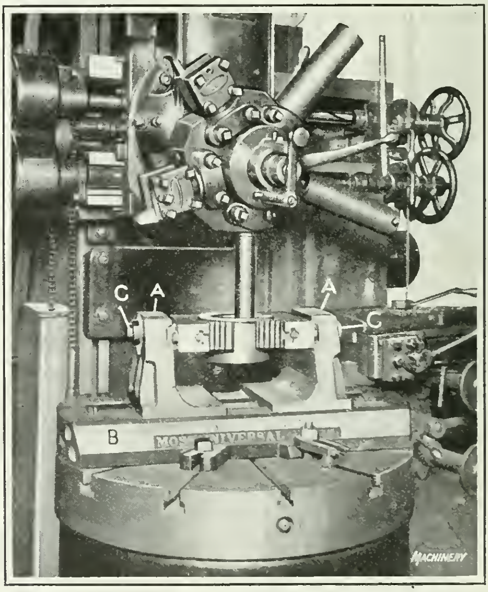

Fig. 4. Application of a Universal Chuck on a Vertical Turret Lathe that bores Various Sizes of Bearing Brasses

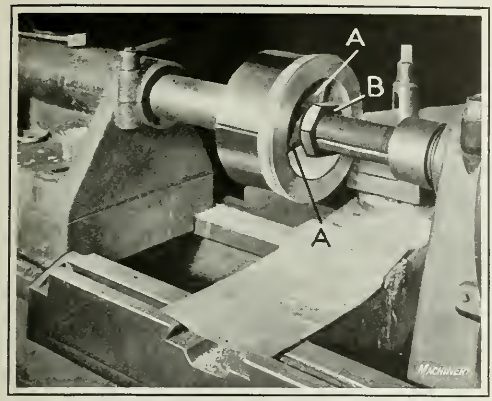

Fig. 5. Screw-operated Expanding Mandrel for holding Side-rod Bearing Brasses for turning

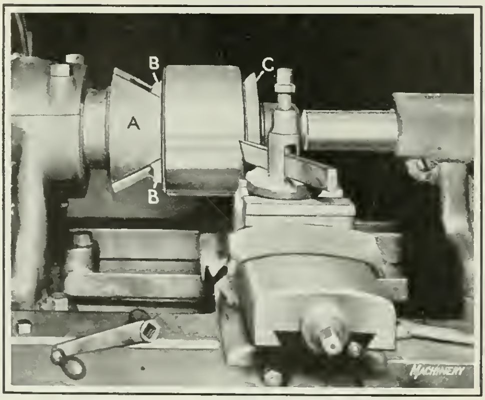

Fig. 6. Special Centers for holding Side-rod Bearing Brasses during the Turning Operation

Boring Side-rod Brasses

Previous mention has been made of the fact that it is quite general practice in the machining of side-rod brasses to first finish the outside, and after pressing the brass into place in the rod, to set the work up on a boring machine to provide for finishing the inside diameter of the bearing. In Fig. 4 there is illustrated a method used in the Burnside shops of the Illinois Central Railroad Co. in Chicago, Ill., which represents a departure from this procedure. It will be seen that a vertical turret lathe built by the Bullard Machine Tool Co., of Bridgeport, Conn., is furnished with a Moss universal chuck in which the previously turned bearing brass is held during the performance of the boring operation.

Bearing in mind that the two ends of the brass have to be faced, in addition to turning the inside diameter, it will be apparent that this universal chuck which is mounted on pivotal supports so that the work may be turned over, provides a convenient means of enabling the entire job to be completed at a single setting. On this machine, the turret carries the usual sequence of tools used for the performance of successive boring and facing operations; and it will be evident that the two chuck jaws are carried by supports *A* which slide on a bed *B*, adjustment of the opening between the jaws being accomplished by sliding the supports on the bed by means of a screw. As shown, the jaws are pivoted at *C*, so that they may be swung over to bring the lower side of the work into the operating position.

Arbor for Holding Side-rod Brasses while Turning

Fig. 5 illustrates a special threaded mandrel used in the shops of the Chicago, Rock Island & Pacific Railway at Silvis, Ill., for holding side-rod brasses while turning the outside diameter. From the illustration it will be seen that there are three jaws, two of which are shown at *A*, which grip the inside of the work. These jaws are parallel to the axis of the mandrel on their outer edges, but the inner edges are tapered and slide in inclined grooves cut in the threaded mandrel for that purpose. After the work has been slipped over the jaws, nut *B* is turned toward the left, causing the tapered inner edges of the jaws to ride upward on the inclined grooves in which they are carried, thus expanding the jaws and causing them to secure a firm grip on the inside of the work. There is nothing unusual about the actual turning operation performed on the outside of the bearing brass.

Special Chuck for Holding Side-rod Brasses while Turning the Outside Diameter

In Fig. 6 there is illustrated another means of holding side-rod bearing brasses while turning the outside diameter. This consists of a special pair of centers or, more properly, of a special chuck and an outboard center, between which the work is held. It will be seen that in the live spindle of the engine lathe there is mounted a chuck or driving center *A* in which there are three jaws (two of which are shown at *B*). These jaws are stepped to enter different sizes of bearing brasses. In this illustration, the brass is in place on the top step of the jaws *B*. On their inner edges, the jaws are tapered and engage inclined grooves cut in the chuck body. After the bearing brass has been put into place over the jaws, the outboard center *C* is tightened up against the work, thus causing the three jaws *B* to ride upward on the tapered grooves in the chuck body, and secure a firm grip on the inside of the casting. This chuck is used in the shops of the Chicago & Northwestern Railway Co. in Chicago.

Setting up Side-rod Brasses for Boring

The usual practice in handling work of this kind in the shops of the Chicago & Northwestern Railway Co. is to turn

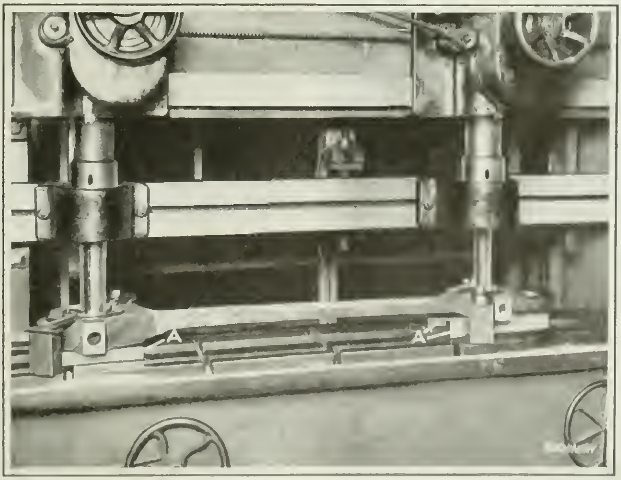

Fig. 7. Duplex Boring Mill for boring Side-rod Bearing Brasses after they are pressed into Place

the outside of the side-rod bearing brasses, then to use a hydraulic press to force them into place in holes bored in the rod for their reception, and finally to send the assembled rod to a boring machine to provide for finishing the inside diameter of the bearings. Fig. 7 illustrates a duplex boring mill built at the Bement-Miles works of the Niles-Bement-Pond Co., in Philadelphia, Pa., which enables both bearing brasses to be bored simultaneously. It will be seen that the work is set up on two parallel bars *A* at each end of the rod, which raise the lower end of the brasses sufficiently to provide clearance for the boring tools between the table and the work. The rough-boring tools consist of arbors set in the spindles of the machine and carrying fly cutters with which the preliminary cuts are taken, after which intermediate and finishing cuts are taken with tools of suitable forms. It is the method of setting up work and the provision made for boring both bearings at the same time that are of interest, rather than the actual procedure in performing the boring operations.

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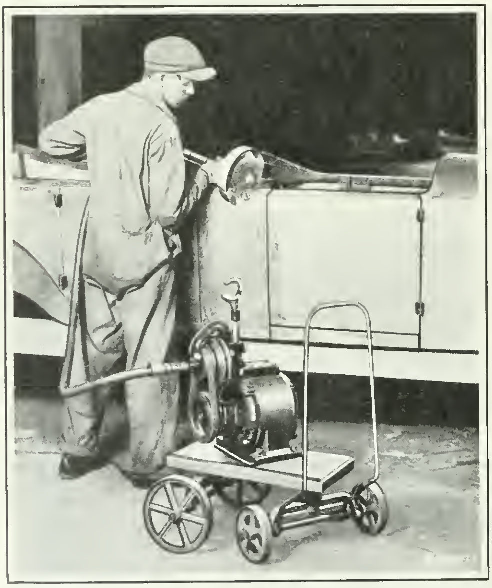
PREPARING AUTOMOBILE BODIES FOR PAINTING

In the accompanying illustration, there is shown a Type H-7 portable, electrically driven equipment built by the R. G. Haskins Co., 27 S. Desplaines St., Chicago, Ill. It is illustrated in use in an automobile body building plant, where this machine is used to drive a stiff wire scratch-brush that is employed to slightly roughen the aluminum surface, so that the paint will adhere tightly to the metal.



Use of Electrically Driven Scratch-brush for preparing Motor Car Bodies to receive their First Coat of Paint

It will be noticed that the whole outfit is mounted on a truck which facilitates moving from one job to another. The equipment consists of a 1 horsepower motor with a three-speed countershaft that gives spindle speeds of 900, 1800, and 3600 revolutions per minute. Six feet of flexible shafting connects the scratch-brush with the driving motor.

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A noticeable development of German activity in China is being recorded. Considerable quantities of German manufactured goods, including electrical machinery, and iron and steel products, are becoming factors in the China market.

SOURCES OF INDUSTRIAL POWER

In considering the world's future supply of power for industrial and other purposes, there are three main resources that are of importance—the water power in the world's rivers and the fuel supply in the form of coal and oil. Investigations have been made to determine exactly what the world's inventory is in these means of power supply. A review of the water power resources of the world has been prepared for publication by the United States Geological Survey. It shows that only about one-twentieth of the possible water power of the world's rivers has been utilized. One-half of the utilized water power is in North America and one-third in Europe. In water power resources as yet undeveloped, however, Africa ranks first, having over 40 per cent of the world's supply. Second place is taken by Asia; third by North America; fourth by South America; and fifth by Europe.

The coal resources of the world are very unevenly distributed between the various continents. Of these resources, especially when the better grades of coal are considered, North America has more than one-half; Asia about 25 per cent; and Europe about 17 per cent. Very little coal, comparatively speaking, is found in Australia, Africa, and South America. Estimates have also been made of the world's probable supply of petroleum oils, upon which we depend for our supply of gasoline, kerosene, and numerous other similar products. There are greater oil resources in North America than in any other one continent. Asia has also large oil supplies, with South America, Europe, Australia, and Africa following in the order mentioned. In each of these continents the oil is found in a comparatively small area, so that it is estimated that about 4 per cent of the earth's surface contains about 60 per cent of the world's total oil supply.

If we take fifty million horsepower as the average figure for the water power of the United States, susceptible of development without storage of water, we find that with the average power requirements of today, our rivers and streams, if fully developed and used, would just about meet the country's present needs and would supply that amount of power for all time to come. Moreover, with proper storage of water and improved load factor, the country's water supply would provide a considerably increased output of energy to meet a growing demand. If, on the other hand, the whole burden were placed upon the coal mines, and the water power already developed were not used, it has been estimated that by adopting the best steam practice of today, the present power requirements of the country could be met by available coal resources for 57,000 years.

This figure becomes all the more striking and has considerable instructive value when we turn our attention to the available oil resources of the United States. Were all the power of the country derived from the use of fuel oil, by adopting the best possible practice known today for the economical use of fuel oil in the production of steam, we would find that the known oil resources of the United States would last only nine years and three months. A comparison of the total resources available in coal and oil, therefore, makes it possible to appreciate the general truth of Eckel's statement in his recent book "Coal, Iron and War," in which he says: "We have just as much real chance of replacing coal by oil as we have of finding enough gold to use in place of steel."

The figures given also indicate that unless a check is placed upon the increase in the consumption of oil, the available oil resources will soon be exhausted. The resources of natural gas have already, in many instances, been depleted, and the same process is now being applied to the oil resources. A more extensive use of water power is to be expected within the near future. Water power development, of course, requires large investments, but when this investment has once been made, the power output continues for generations.

PREMIUM AND PIECE-WORK SYSTEMS

By I. O. PERCIFIELD

Judging from the various opinions that are expressed on the subjects of "premium" and "piece-work," there is apparently no general or uniform understanding of the merits of these systems. To understand the advantages obtained from premium or piece-work systems, it is necessary to analyze the reasons why they are used and to consider with an unprejudiced mind the objections given for not wanting to work under them.

The Object of Premium and Piece-work Systems

First, it must be understood that the main object of premium or piece-work systems is to increase the efficiency of a plant. A higher rate of efficiency necessarily means increased production, lower operating costs, and a reduction in the amount of material and labor used. It is not necessary to explain in detail the effect premium or piece-work has upon the efficiency of a plant. However, it is well to remember that a properly controlled system automatically regulates the discipline of the employes, and functions in a manner that will produce the results mentioned. Where a premium or piece-work system is properly installed, there is no time allowance on defective work, and no operations are done on parts made defective by previous operations until the defective work has been salvaged and O. K'd by the inspector. All work should be inspected and counted after each operation, allowing premium time for those parts passed by the inspector.

It will be understood from the foregoing why premium and piece-work systems are used, but why do a great many employes object to working under these systems, and what reasons do they give? Are these reasons based on facts or imagination? Can the causes of these objections be eliminated successfully without lowering the efficiency of the system? These questions have been asked and answered in different ways by managers and efficiency engineers who have made a study of the subject while endeavoring to work out a general plan involving certain principles that could be used successfully in the majority of manufacturing plants.

Methods of Creating Interest on the Part of Employes

It has been shown in many instances that the primary cause of the employe's objections to working under premium or piece-work systems is lack of interest. Since lack of interest is the primary cause, the first thing to do is to build up a system that will create interest. There are several ways by which interest can be created. Some methods are better adapted for use in one shop than in another, and it remains for the individual manager or engineer to find the one best adapted to his own needs.

One plan that has been used successfully is the offering of a prize at the end of certain periods to the operator having the best record in each department. The prizes may consist of money or something else. Under this plan the records of all employes are posted at the end of each period in the form of bulletins in the departments in which they are employed. This acts as an incentive to the naturally industrious workmen and a spur to the indifferent. The bulletins give the punctuality, defective work, attendance, and production record of each operator in the department for the period just passed.

Gaining the Employe's Confidence

Another of the principal objections to working under the premium and piece-work systems is the idea that the operator is giving a greater value to the employer than he is rewarded for—in other words, there is a lack of confidence. The idea that the "hire and fire" method is the best way to get results from employes has been proved to be erroneous. A mutual understanding between employer and employe that any grievance shall be quickly and openly adjusted, according to written rules or instructions, tends to create confidence, which is essential to the efficiency of any organization.

One of the best ways to produce results quickly is through the department foreman. He must be capable and thorough, and command the respect and confidence of his men. His influence will prove of great value if properly exerted. He should be able to teach his men better methods and show them how to improve. By this means, the men through their foreman, will gain confidence in the firm.

The practice of lowering rates arbitrarily has been the cause of more unrest and mistrust among employes of premium-operated factories than any other factor. By using a systematic method of regulating rates that is understood by both employer and employe to be fair, there will not be any complaints. The method used should automatically adjust any over-rated or under-rated operation. The establishing of cooperation between employer and employe by this method will insure satisfactory results to both.

Need for Instructing Employes Concerning Underlying Principle of Premium and Piece-work Systems

The writer had occasion to ask an operator in one of the large factories of the Middle West if he was working piece-work. The operator replied very emphatically that he was not, and wouldn't work piece-work for any firm, adding "I do more work now than what I get paid for." This operator was not speaking from any definite knowledge he had attained in working under a piece-work system. His reply only expressed the sentiment of thousands of other employes, who, like him, had never analyzed their positions with sufficient care to know whether piece or premium work would be to their advantage or not.

In fact, this operator was working under the principle of premium work and did not realize it. Everybody who works for wages or salary necessarily works for a premium. All must produce some result, either by manual labor or by the application of personal knowledge that is of value, before any reward is received. We are paid for something given. Upon how much or what we give depends the value of the reward. Suppose some of us do not produce the results for which we are paid—should we expect to receive the reward just the same as those who do? The majority of factory employes are honest and want to be fair in their dealings with their employers, but the practice of cutting rates arbitrarily, and ignorance of the real value of the premium and piece-work system to the employe, has caused a great many to become prejudiced against these systems. By proper instruction, this prejudice can be overcome and interest created that will eventually make premium and piece-work just as popular with all employes as it is now with a few.

* * *

AN EXAMPLE OF DECREASED PRODUCTION

The Boston Chamber of Commerce, having investigated the building situation, found that in 1898 a bricklayer and his helper laid 1500 bricks in an eight-hour day at a cost of 35 cents a hundred bricks. Last summer the rate was 500 bricks a day, at a cost of $2.72 a hundred bricks, or nearly eight times as much. It is of little consequence how many dollars and cents is a day's wage, but it matters a great deal what the product of labor is in any one day. No more can be bought and enjoyed than is produced, and low production means a low standard of living for labor, even though wages may be advanced tremendously. Russia has shown the truth of this statement. The reason why the standard of living in the United States has always been higher than elsewhere is because labor has always produced more per day in the United States than elsewhere. If the rate of production is decreased, the real rate of wages, as measured by their purchasing power, cannot possibly increase

American Gear Manufacturers' Convention

THE fifth annual meeting of the American Gear Manufacturers' Association, held in Cincinnati, April 27 to 30, was characterized by the intensive application to business and the accomplishment of results that has always been the keynote of the conventions of this association. The program laid down for the four days of activity was a comprehensive one, including several valuable addresses, a number of standardization reports, and discussions dealing with gear manufacturing practice. The association, which was founded only a little over four years ago, has now 92 member companies, with in all 109 executive members and 55 associate members. At the Cincinnati meeting, the Baush Machine Tool Co., Springfield, Mass.; the Cincinnati Gear Cutting Machine Co., Cincinnati, Ohio; and the Medart Patent Pulley Co., St. Louis, Mo., were elected members. Ever since the foundation of the association, F. W. Sinram, of the Van Dorn & Dutton Co., Cleveland, Ohio, has been president; H. E. Eberhardt, of the Newark Gear Cutting Machine Co., Newark, N. J., vice-president; and Frank D. Hamlin of the Earle Gear & Machine Co., Philadelphia, Pa., secretary. B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., has acted as chairman of the standardization committee.

Importance of Organization in Industry

In his opening address, Mr. Sinram, the president, pointed out the necessity for organization in industry, saying that "without organization you have no industry," and pointing out that this statement was perhaps more true today than ever before, because never before had cooperation between those engaged in the same field of endeavor been so important as it is today. He emphasized that we are now returning to a normal industrial condition, but the normal of tomorrow will not be the normal of yesterday. We are facing vastly changed conditions; quoting Forbes, Mr. Sinram said that "good times for all can only be had by the product of good work by all." It is the collective effort that counts. As a sequence to the times that have passed, there has arisen on every hand—and rightly so—a demand for better products. One of the means toward a better product in the gear industry is to be found in the standardization efforts of the association—technical, commercial, and cost accounting. The latter item, particularly, is important at this time, as it is only by the solution of the problem of how to avoid destructive competition that real progress can be made in the industry. Mr. Sinram also referred to the importance of production statistics and said that the industry ought to have such statistics in order that the individual members might be guided thereby.

Standardization Work of the Association

The standardization of the work of the association at the present time includes efforts toward arriving at specific standards for spur gears for industrial gearing; for regular and spiral bevel gears; for herringbone gears; for hardening and heat-treating, including classes of steels to be used in gear-making practice; for inspection of gearing; for keyways; and for sprockets. A number of other standardization committees are also working on definite standardization problems, and will submit reports of their findings at future meetings. The association also works in conjunction with the American Engineering Standards Committee in an effort to establish national standards.

Part of the recommendations made by the committee for the standardization of spur gearing were referred back to the committee for further consideration, but the following items relating to the standardization for industrial spur gearing were adopted as recommended practice:

The width of face for industrial spur gearing shall be 10 divided by the diametral pitch. It is recommended that the following table be used for convenience, as closely adhering to this formula:

Diametral Pitch	Face, Inches	Diametral Pitch	Face, Inches	Diametral Pitch	Face, Inches
1	10	2¾	3¾	8	1¼
1¼	8	3	3½	10	1
1½	7	3½	3	12	¾
1¾	6	4	2½	14	¾
2	5	5	2	16	⅝
2¼	4½	6	1¾	18	½
2½	4	7	1½	20	½

Machinery

The thickness of rim for spoked spur gears for industrial work is recommended to follow the formula: Rim thickness = 4 ÷ diametral pitch (or = 1.3 × circular pitch). The diameter of hub for spoked spur gears for industrial work is recommended to follow the formula: Diameter of hub = 2 × diameter of bore.

A report made by the bevel and spiral bevel committee was adopted as recommended practice. The recommendations contained in this report will be published in a coming number of MACHINERY. The report of the herringbone gear committee was referred back to the committee for further consideration, as was also the report of the keyway committee. The reports of the inspection standardization committee and of the hardening and heat-treating committee were accepted as recommended practices, and the important features of these reports will be covered in a future number of MACHINERY. Progress reports were also presented by the committee on gears and pinions for electric railways and mines and by the committee on sprocket wheels, as well as reports by the committees on uniform cost accounting; commercial standardization; labor; worm, worm-gears, and spirals; and composition gearing.

Addresses Made before the Convention

Addresses were made before the convention by J. B. Doan, president of the American Tool Works Co., Cincinnati, Ohio; by Edward S. Jordan, president of the Jordan Motor Car Co., Cleveland, Ohio; and Charles Woodward, vice-president in charge of personnel, Hydraulic Pressed Steel Co., Cleveland. Papers of a technical nature were read by G. M. Bartlett of the Diamond Chain & Mfg. Co., Indianapolis, Ind., on the "Ideal Chain and Sprocket Drive"; by A. R. Mitchell of the Andrews Steel Co., Newport, Ky., on "Industrial Gears from the Users' Standpoint"; and by J. B. Foote, president Foote Bros. Gear & Machine Co., Chicago, Ill., on "Worm-gearing." The latter paper pointed to some definite developments in the methods of calculating the strength of worm-gearing, which will place this obscure subject upon a more rational basis and make it possible for manufacturers to get more accurate data in regard to strength calculations for worm-gear drives.

The following officers were elected for the coming year: President, F. W. Sinram; first vice-president, R. P. Johnson; second vice-president, B. F. Waterman; and secretary and treasurer, Frank D. Hamlin. The following members of the executive committee were elected: F. W. Sinram, H. E. Eberhardt, Frank D. Hamlin, A. F. Cooke, B. F. Waterman, and C. E. Crofoot.

HOBBING SCROLL CHUCK JAWS

By CHARLES O. HERB

A novel method of machining the teeth on jaws for scroll chucks was devised by the machine designer of the Philadelphia Engineering & Machine Co., during the development of the Sacrey vertical oil-groover. This machine is provided with a scroll chuck for holding bushings or other parts to be grooved in a vertical position. At first it was intended to furnish a chuck of standard make, but the small hole in commercial chucks of the desired size, made their use impossible. It was finally decided that the firm could manufacture just the chuck it required at a considerably less cost than if it were made special by an outside concern. This was done through the use of an ingeniously constructed hob for producing the teeth in the chuck jaws.

A detail drawing of the jaws furnished on the chuck, which gives an idea of their size, is illustrated in Fig. 1. The teeth are 5/32 inch in height, and the distance from center to center of each tooth is 0.175 inch. There are approximately twenty-five teeth on each jaw. The hob used in cutting these teeth is shown in Fig. 2 mounted on a Rockford horizontal milling machine, the over-arm and arbor support being removed from the machine. A jaw is clamped on the table and the teeth are cut as the jaw is fed past the revolving hob, only one traverse of the work being necessary to cut the teeth to the required depth. The jaws are annealed before this operation, and pack-hardened after they have been completely machined. As the jaws are fed past the hob at the rate of 3½ inches per minute, the cutting time is slightly more than 1¼ minutes.

Reference to the illustration will show that the hob greatly resembles a scroll, one continuous groove having been milled spirally on its face, the pitch of the groove being, of course, 0.175 inch to correspond to that desired on the jaws. In cutting this groove, the hob was mounted on the same milling machine and in the identical manner illustrated. A single-point tool held in an Armstrong toolholder secured to the table was set for cutting the groove to the required depth, being fed past the rotating work at the rate of 3½ inches per minute. The hob was revolved at the rate of twenty revolutions per minute in order to obtain the desired thread pitch. Thirty-six flutes were then milled radially across the face to produce cutting edges and chip clearance.

Prior to cutting the groove, the face near the rim was tapered, so that on the finished hob, the first few outer rows of teeth take roughing cuts on the jaws while the remaining teeth are for finishing. After having been machined, the hob was hardened and tempered, and the cutting edges of the teeth were ground. It will be apparent that these cutting edges can be reground from time to time as necessary. The outside diameter of the hob is 9 inches and the thickness is 2 inches. The diametral distance between the inner edges of the teeth is such that there is sufficient space for the entire length of a jaw to pass the innermost cutting edge of the hob without coming in contact with a cutting edge diametrically opposite.

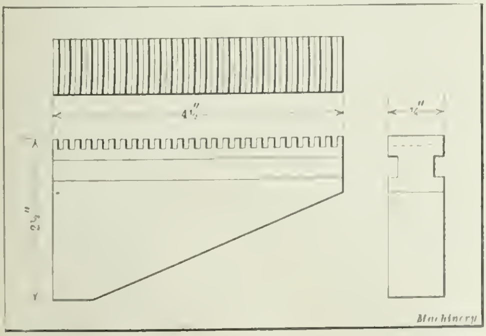

Fig. 1. Detail Drawing of Jaws used on Scroll Chuck of Oil-groover

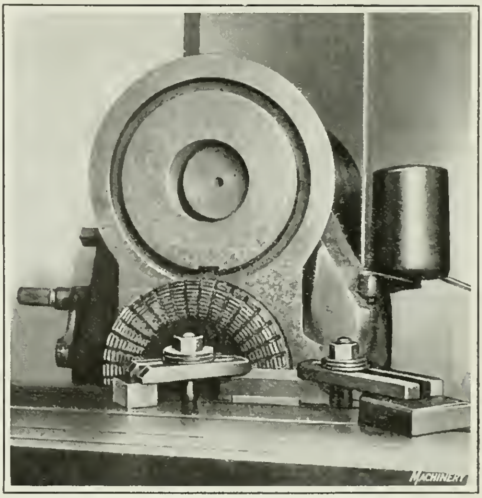

Fig. 2. Employing a Specially Designed Hob for machining Teeth on Chuck Jaws

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INCREASE IN WAGES DUE TO USE OF MACHINERY

Labor, on various occasions has opposed the use of labor-saving machinery, because of the belief that labor-saving machinery would reduce wages and decrease the opportunities for work. The whole history of industrial development has conclusively proved that the opposite has been the result—that wages have been increased and that the number of people engaged in industrial work has become greater. The use of machinery makes it possible to produce more with the same amount of work. As the production is increased, wages can also be increased; and when wages are increased, the consumption of manufactured goods is increased, creating a greater demand. This, in turn, necessitates the employment of a greater number of men in the industry, so that the use of machinery, instead of decreasing, increases not only production but also the opportunities for work.

Industrially, the United States and England are the leading countries in the world today. In the United States three times as much mechanical horsepower is employed per worker as in England, and because we use a greater amount of mechanical power, the production per man in the United States is 2.6 times as great as the average production per man in Great Britain, while the value of the output per wage earner is twice as great.

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STATUS OF PATENTS GRANTED TO GERMAN INVENTORS

The status of patents granted to German subjects by the United States Patent Office prior to the declaration of war by the United States in 1917 has not changed unless the patents have been seized by the Alien Property Custodian, or licensed under the provisions of the Trading with the Enemy Act. Information regarding the seizure of patents can be obtained by communicating with the Alien Property Custodian, Washington, D. C., and identifying the particular patents about which information is desired. Inquiries regarding patents which may have been licensed should be directed to Federal Trade Commission, Washington, D. C.

When Does Automatic Machinery Pay?

By ALBERT A. DOWD, President, Albert A. Dowd Engineering Co., 131 W. 39th St., New York City

THE development of automatic machinery in the last twenty-five years has been remarkably rapid, yet, at the same time, manufacturers in general are reluctant to experiment with it. They are glad to pay a visit to some progressive factory near at hand, and will examine with interest a number of automatic machines, working steadily, and delivering a uniform product regularly, without requiring much attention. They may feel convinced that these machines are money-savers for their owners, but it would be difficult to make them see that something of the same nature would be economical if used in the manufacture of their own product. Considering that a given manufacturer has an idea of installing automatic machinery for a certain operation on his product, and that he has called into consultation a well-known automatic machine designer, the following points would naturally come up for discussion:

1. Can an automatic machine be designed which will give the desired results, and which can be depended on to turn out a thoroughly satisfactory product?
2. How much will it cost?
3. What production rate will it give?
4. How much attention will it need to keep it in running order?

Now let these points be taken up in the order named, considering the matter from the viewpoint of economy to the manufacturer.

Will an Automatic Machine do the Work ?

The most successful automatic machines imitate the operations and motions which an operator's hand accomplishes. Frequently there are fingers of metal on the machines, and these are ingeniously operated by means of cams and levers, so that their action is very similar to that of the hand. Occasionally there are hand operations on a product which at first glance appear difficult to perform by means of machinery: To the uninitiated it would seem difficult to put a knot in a piece of string by machinery, and yet this is done every day and by various kinds of machinery. The making of paper boxes and packages of different shapes and sizes is an automatic process, and there are hundreds of delicate operations in the counting, packing, and sealing of various products, which are performed automatically in hundreds of factories throughout the country.

A capable automatic machine designer will go through a factory and watch the operators at work. He will note every detail of the processes used, and will plan his automatic machines along the general lines of the hand operations, making improvements wherever possible. It is possible that some of the operations may be such as to require considerable study and ingenuity, and it is problems of this kind that demand the skill of the designer. An idea may look all right on paper, and yet when the machine is built certain parts of the mechanism may not function properly. Many times it is found advisable to build a wooden or sheet-metal model of a certain part of the mechanism in order to make sure that the principle is correct. Models of this kind are easily made and comparatively inexpensive. After testing in this way, the designer can feel sure that the principle on which he is working is correct, and he can go ahead with the design of the mechanism.

How Much will the Machine Cost ?

"How much will it cost?" is usually the first question asked by a manufacturer when he thinks of installing automatic machinery. Assuming that a standard product is being manufactured, an analysis of his production problem must be made to determine whether or not it will be economical to use automatic machinery in place of hand labor. This problem should be solved by first finding out definitely what the labor cost is on the product when made by hand; next by determining a period of time for which the product will be manufactured without change; and finally by comparing the cost of production over a certain period of time by hand and by automatic machinery.

Now let a graphic example be taken, in order to make the matter clearer. Assume that a manufacturer of a certain tablet is at present employing girls to count out thirty tablets, put these into a standard bottle, cork and seal the bottle, and paste a label on it. The present production is from 50,000 to 60,000 bottles per week, employing six girls to do the work, in addition to several labor-saving devices of the manufacturer's own invention. These girls receive an average wage of $18 per week. In other words, the labor cost for filling, sealing and labeling 50,000 bottles is $108. This is approximately five bottles for one cent. The yearly labor cost for a production of 2,600,000 bottles is therefore practically $5600. Assuming then that the product will remain standard for ten years or more the labor cost for this period of time would be over $50,000. In addition to this, it must be assumed that the production will be materially increased as the years go by if the product is one that is continually in demand. Suppose the production is doubled and that at the same time labor is harder to get as well as more expensive. To see that this is possible it is only necessary to look back a few years and note the wages paid for labor at that time, as compared with the wages being paid today. However, assuming that production and labor costs remain the same, there would be a labor cost of $100,000 distributed over a period of ten years if the production were doubled. At the end of ten years, it will still be necessary to continue paying for labor.

Now, here is a basis of costs on which to form an estimate as to how much can be economically paid out for an automatic machine. Let it be supposed that it is possible to design and build an automatic machine at a cost of about $10,000, which will count the tablets, put them in the bottles, cork and seal the bottles and paste a label on the outside. Let it also be supposed that this machine will turn out about thirty bottles per minute, 1800 per hour, 14,400 per day of 8 hours, and that it requires the attention of only one girl operator. Thus let the production be set at 80,000 per week, which is well within the possibilities of an automatic machine.

The saving in labor cost for one year would be the wages of five girls at $18 each per week, a total of $90 weekly or $4680 for the year. Two years then would practically pay for the machine, and after that the savings over the hand method would be tremendous. It can be easily seen from the foregoing that it would be profitable to use an automatic machine for the operations mentioned, provided the cost did not exceed $15,000 to $20,000. It will also be seen that the production is over 50 per cent greater than that obtained by the hand method, so that this also must be taken into consideration, when figuring the saving involved.

In general, it may be stated that it is a paying proposition to install automatic machinery to replace hand work, provided the machine will pay for itself in the first three years. Of course there are many instances in which an automatic machine will pay for itself in one or two years, but speaking generally, and considering the matter from all angles, this statement seems to be borne out by facts.

It will be understood that we have been discussing special automatic machinery designed and developed to suit a particular condition. As is well known, there are various standard automatic machines on the market for making such articles as cigarette boxes, paper cartons, and also machines for wrapping, packing, and labeling certain products. These machines are adjustable within their capacities. It goes without saying that machines of standard types can be bought much cheaper than those developed to suit special conditions.

What Production will it Give?

Mention has already been made of the matter of production, but the factors which influence it have not been considered. If it is assumed that a machine is to be designed in which several operations are taken care of, it is evident that if these are performed in sequence, all the operations must be arranged so that they take the same amount of time. If one operation consumes twice as much time as the other, provision must be made accordingly. Idle time in the machine must be eliminated as far as possible, and when one operation requires twice as much time as the others, the longest time is the controlling factor. It is possible in cases of this kind to provide two units for the operation requiring the longest time, so that these units can maintain a rate of production equivalent to those employed for the other operations. This may not always be necessary, for if the production of the machine is sufficiently rapid, when considering only the operation requiring the longest time, the other operations may, of course, be timed to correspond.

There is also the matter of keeping the production rate of the machine up to normal by making sure that the speed at which it is running is neither too fast nor too slow. If it is to be driven from a lineshaft, care must be taken to make sure that the speeds are what they should be and that they do not vary greatly on account of overloading the power take-off from the shaft. Speaking generally, it is better to provide an individual electric motor, as this is constant and not influenced by the starting and stopping of other machines.

Attention Required by Automatic Machine

Let it be assumed first that the machine has been built and installed ready for work. On a short test it has operated satisfactorily, but will it continue to function properly day after day throughout the year? In the first place a great deal depends on the care that is taken to see that every part of the machine functions properly at the start. The manufacturer who expects to install automatic machinery, should be prepared to give it a thorough trial, and continue to watch over it, making adjustments that are necessary from time to time, until every part has been adjusted and tested thoroughly. Not until this has been done should an attempt be made to put the machine into the regular process of production.

The man who expects an automatic machine to work perfectly from the beginning is likely to be disappointed and had better not make the attempt. The writer knows of an automatic machine costing $12,000 that is not in use because the tolerances of the product which is being handled are so great that the machine will not always function properly. Yet when the machine was designed the allowance for variation in the product was sufficient to satisfy the manufacturer. The machine works perfectly and saves the labor of eight girls, yet it is condemned because it will not do something it was not designed to do. If attention were given to keeping the product within proper limits, the machine would work perfectly and would save nearly $5000 yearly.

It should not be expected that an automatic machine will handle a product properly if the product is not kept within reasonable limits. In regular production work the inspector sets aside the work which is outside the permissible tolerances, and an automatic machine should not be expected to accept and handle a product that the inspector will not pass. In regard to the general upkeep of automatic machinery, if it is properly designed it should not require anything more than an occasional adjustment. Much more care must be given to it, however, than is given to a hand-operated machine, because it must be remembered that it is working continuously, while the hand-operated machine is frequently stopped.

In summing up, the two following important factors influence a manufacturer's decision as to whether or not he is justified in purchasing automatic machinery:

1. A report from a competent automatic machine designer as to whether a machine can be designed which will give satisfactory results.

2. An estimate of the cost of the machine showing that it will pay for itself in the saving of labor in the course of two years, or in three years, at the outside, if the product is standard and not likely to be changed.

These are the only two points that need to be considered, and every manufacturer can use them as a basis to determine his need of automatic machinery.

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WROUGHT-IRON AND STEEL PIPE

The following information relating to the use of the term "wrought pipe" was given in a recent number of *Mechanical Engineering*, the A. S. M. E. Journal: Whether the pipemaker takes a length of steel skelp or a length of wrought-iron skelp and forms it into pipe, he performs exactly the same operation in either case, that is, he bends the skelp into tubular shape and welds the edges. Quite correctly, therefore, the American Society for Testing Materials in its specifications uses the word "welded" in reference to both wrought-iron and steel pipe made by the welding process.

Probably some thirty years ago, after the introduction of welded steel pipe, the term "wrought pipe" or "wrought steel pipe" was coined by steel-pipe manufacturers. This term gradually came into use by dealers and jobbers; thus steel pipe would be billed and listed as "wrought pipe." Many purchasers of pipe, not being acquainted with this trade name, frequently labor under the impression that it means wrought-*iron* pipe.

The manufacturers of wrought-iron pipe, actively aided by the American Institute of Architects, have therefore taken up with the supply associations the matter of clarifying these so-called trade names, suggesting instead names that would ultimately result in eliminating all confusion of pipe made from puddled wrought iron with that made from soft steel. As a result the National Pipe and Supplies Association at a recent meeting voted that the terms employed by the American Society for Testing Materials in differentiating between iron and steel pipe, namely, (1) welded wrought-iron pipe, and (2) welded steel pipe, should be accepted and adhered to by the distributors of both iron and steel pipe.

This step should result in the term "welded pipe" being applied when *both* wrought-iron and steel pipe are referred to, and in the latter two terms alone, namely, "wrought-iron pipe" on the one hand and "steel pipe" on the other hand, being used and interpreted, respectively, to mean exactly what these terms imply. Thus "wrought-iron pipe" will mean only pipe which is made from genuine puddled wrought iron, and "steel pipe" will be used exclusively to designate pipe made of soft bessemer or open-hearth steel.

Machining Nash Flywheels

Use of Vertical Automatic Lathes for Finishing All Surfaces at Two Settings of the Work

By EDWARD K. HAMMOND

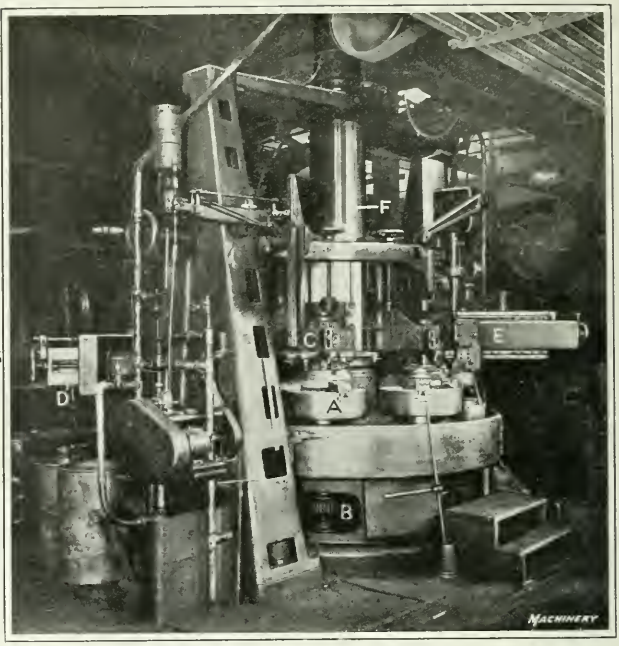


Fig. 1. Ryerson-Conradson Vertical Automatic Lathe equipped for performing Machining Operations on Nash Flywheels

FLYWHEELS for the engines of motor cars built by the Nash Motors Co., at Kenosha, Wis., are required to be machined on all surfaces, and for performing the necessary operations on these parts, this company's maximum schedule of production is easily fulfilled by two Ryerson-Conradson vertical automatic lathes built by the Conradson Machine Tool Co., of Green Bay, Wis., for Joseph T. Ryerson & Son, Chicago, Ill., who control their distribution. Machines of this type have been in almost continuous operation in the Nash plant for the past five years, so that there has been an ample opportunity to demonstrate their productive efficiency. Two settings of the work are necessary, and one of these machines is utilized for the performance of a sequence of operations on each side of the flywheel castings. Probably there are few readers of MACHINERY who are familiar with the features of the Conradson automatic, as only ten of these machines have been built up to the present time. Fig. 1 shows a front view of the machine performing the first series of operations on Nash flywheels. Before describing in detail how the work is done on these parts, a brief description of the machine will be given.

Design of the Conradson Vertical Automatic Lathe

Various methods may be employed for holding the work on one of these machines, but for the first operation on Nash flywheels it will be seen that three-jawed chucks *A* are employed. As shown in Fig. 1 these chucks are connected with the mechanism partially shown at *B*, which provides for rotating each piece of work about the axis of its chuck, while it is in contact with tools that are mounted on one of the five faces of a vertical turret, such a set of tools being shown at *C*. Fig. 2 illustrates in diagrammatical form the arrangement of the work-holding stations on the machine and of the tools above these stations. It will be seen that there are six stations, and while five pieces of work are being simultaneously machined the attendant removes the sixth piece that has been completed and sets up a fresh casting in its place.

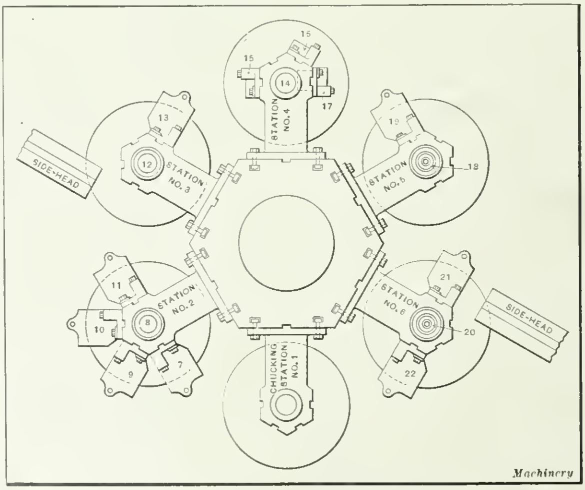


Fig. 2. Diagram illustrating Arrangement of Operating Stations and Tools for performing Successive Operations at these Stations

Most mechanics are familiar with the operation of machines which work on the so-called "progressive-station" principle. The present machine is a case in point, and each time the table is indexed, one finished piece of work is obtained, while the casting at each of the other stations is advanced one step further toward completion. In addition to the five sets of tools carried by the vertical turret of the machine, there are two slides *D* and *E*, Fig. 1, mounted on the housings of the machine, so that side tool-heads carried by these slides can be used for certain operations that can be more conveniently done by such means than with tools supported on the vertical turret of the machine.

How the Machine Operates

To provide for indexing the work from station to station, the turret on which the tools are mounted is connected with a hydraulic plunger *F* and when the turret tools have completed their various operations on pieces of work located at the five stations of the machine, a valve is automatically tripped to enable plunger *F* to withdraw the turret and thus lift all of the tools clear of the work. After this result has been accomplished, another trip mechanism is automatically engaged to provide for indexing the table on which the six chucks are carried, so that each piece of work may be advanced to the next position in the cycle of movements that it follows in passing under the cutting tools. In this manner, the casting on which the final operations have just been performed will come out from under the last set of tools at the right-hand side of the machine, Fig. 1, so that the operator may proceed to remove the finished piece and substitute a fresh casting. It will be apparent from the preceding description that the operation of this machine is entirely automatic, with the exception of loading and unloading the work-holding fixtures, and as a result, both the machine and its operator are kept constantly employed, so that non-productive time is reduced to a minimum.

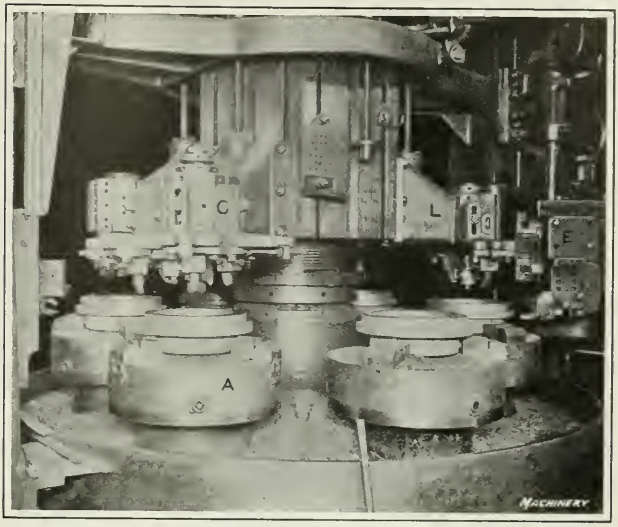


Fig. 3. Front View of Ryerson-Conradson Vertical Automatic Lathe equipped for performing First Sequence of Machining Operations on Nash Flywheels

Order of Performing the First Sequence of Operations

Fig. 4 illustrates the Nash flywheel to be machined, in place in a three-jawed chuck which is provided with false jaws that raise the work sufficiently from the face of the chuck so that clearance is provided to allow the outside diameter of the gear ring to be turned at this setting. Figs. 3 and 5 illustrate close-up views of the front and rear of the same machine that is shown in Fig. 1, in order that a better idea may be obtained of the arrangement of the work and tools; and Figs. 6 to 9, inclusive illustrate in detail the tools that are furnished at each station of the machine, and the exact character of the work done by each tool. In addition to the factor of reducing non-productive time of both men and machinery, one of the important reasons why the Conradson automatic is able to obtain such a satisfactory rate of production is that ample power and strength are provided to enable a large number of cutting tools to be used simultaneously. The work done at each station is as follows:

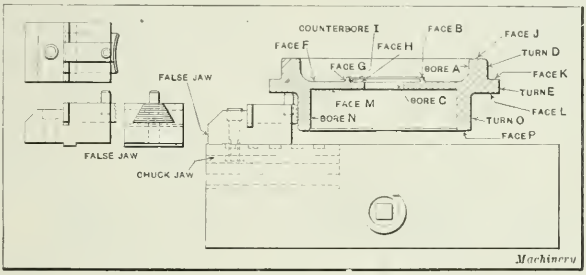


Fig. 4. Method of holding Flywheel for First Sequence of Operations

Station No. 1: Load casting in chuck.

Station No. 2, Fig. 6: There are seven tools at this station which work simultaneously to perform the following operations: Three tools at 7 and 8 rough-bore diameter *A*, rough-face at *B*, and rough-bore hole *C*. Two tools carried by offset brackets 9 and 10 provide for rough-turning diameters *D* and *E*, and the two remaining tools at 10 and 11 provide for breaking the scale on face *F* and forming the fillet *G*.

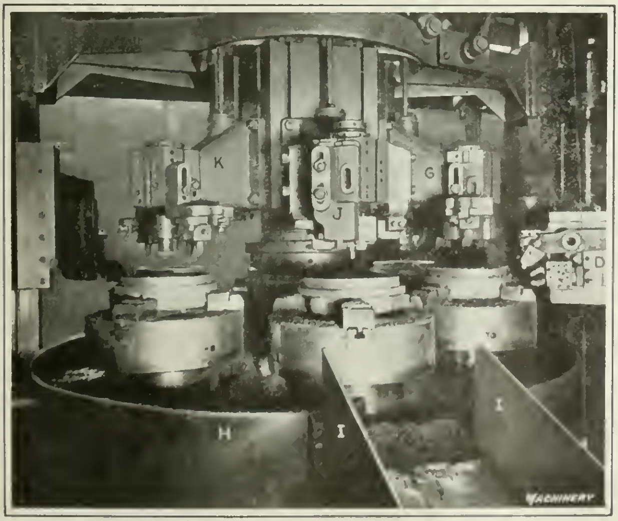


Fig. 5. Rear View of Machine shown in Fig. 3

Station No. 3, Fig. 7: At this station, there are sixteen cutting tools working simultaneously. On the central tool-holder 12 ten tools are mounted to provide for the performance of facing operations on surfaces *B*, *F*, and *H*; and the eleventh and twelfth tools on this holder rough-counterbore *I* and assist in facing surface *F*, respectively. The thirteenth tool is carried by an offset bracket 13 and it takes a second cut on diameter *D*, while the remaining three tools, which are carried by the side-head, provide for the performance of rough-facing operations on surfaces *J*, *K*, and *L*.

Station No. 4, Fig. 8: Five tools are used at this station, and the operations performed by them are as follows: At 14 there are two tools that take a second cut in hole *C*, face surface *H*, form a bevel on counterbore *I*, and take a second cut in the counterbore. The tool at 15 takes a facing cut on face *J*. At 16 there is a formed tool that finishes surfaces *D* and *K* and forms the fillets. The formed tool carried by holder 17 finishes surfaces *A*, *F*, and *B*, and forms the fillets.

Station No. 5, Fig. 9: Two tools are utilized at this station. At 18 there is a solid reamer for finishing hole *C*, while the tool carried by an offset bracket 19, takes a second cut on diameter *E*.

Station No. 6, Fig. 9: Four tools are utilized at station No. 6. A piloted reamer at 20 finishes counterbore *I*; two offset tools at 21 and 22 take third and fourth finishing cuts on diameter *E*; and a tool carried by the side-head finish-faces surface *L*. For the complete sequence of operations performed at the first setting of the work, the various steps of which are outlined in the foregoing paragraphs, the rate of output is 160 flywheels in a ten-hour day.

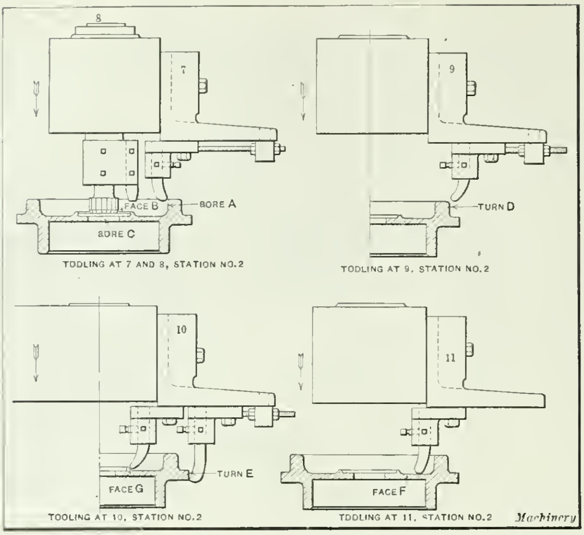

8
7
FACE B
BORE A
BORE C
TOOLING AT 7 AND 8, STATION NO.2
9
TURN D
TOOLING AT 9, STATION NO.2
10
TURN E
FACE G
TOOLING AT 10, STATION NO.2
11
FACE F
TOOLING AT 11, STATION NO.2
Machinery

Fig. 6. Arrangement of Tools at Station No. 2, where Seven Tools work simultaneously on Turning, Boring, Facing, and Filleting Operations

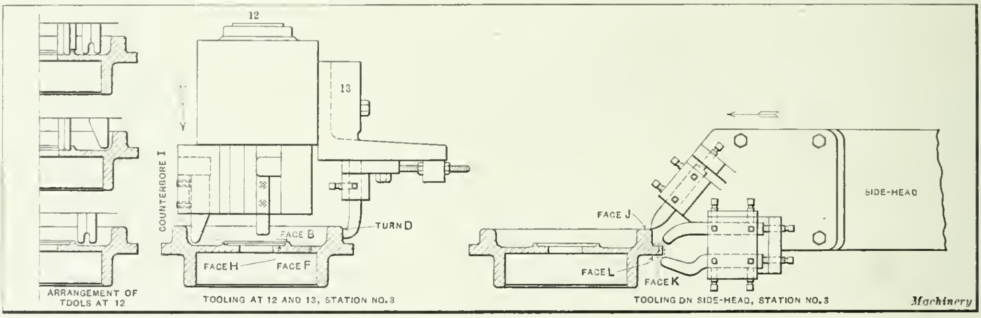

12
13
COUNTERBORE I
FACE B
TURN D
FACE H
FACE F
ARRANGEMENT OF TOOLS AT 12
TOOLING AT 12 AND 13, STATION NO.3
SIDE-HEAD
FACE J
FACE L
FACE K
TOOLING ON SIDE-HEAD, STATION NO.3
Machinery

Fig. 7. Arrangement of Tools at Station No. 3, where Sixteen Tools work simultaneously on Turning, Boring, Facing and Counterboring Operations

Design of Tool Brackets and Tool-holders

Fig. 10 shows in details the design of typical forms of tool brackets and tool-holders for use on the Conradson vertical automatic lathe, and by studying these illustrations in connection with the diagrams of the arrangement of tooling and operations performed at successive stations on the machine, the reader will readily understand the methods that are employed for simultaneously operating a number of tools on the same piece of work. Tool bracket *A* is arranged to bolt directly to a face of the main turret, this being the form of bracket that is shown at *C* in Fig. 1. At its outer end, this bracket is furnished with four finished faces that are grooved to receive locating tongues on tool-holders of the general form shown at *B*, which are arranged with slots and clamping bolts to provide for securing the cutter bits in position. In addition to the use of such tool-holders, it will be seen that bracket *A* is furnished with a central socket which may be utilized to receive the shank of a tool such as a reamer or drill, several examples of this

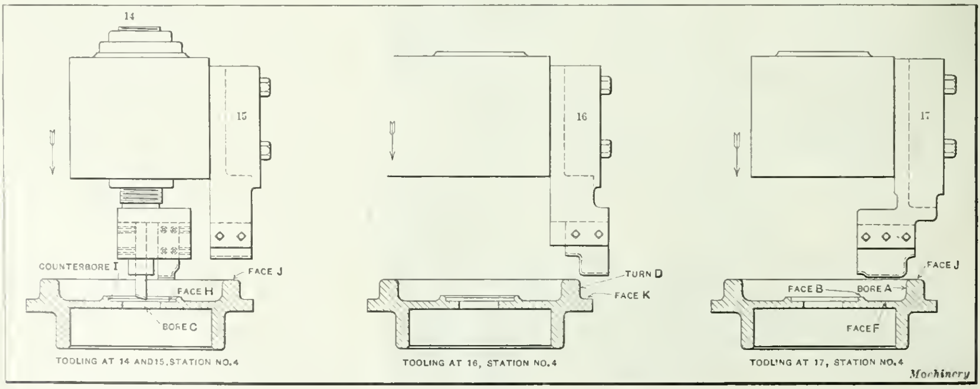

14
15
COUNTERBORE I
FACE J
FACE H
BORE C
TOOLING AT 14 AND 15, STATION NO.4
16
TURN D
FACE K
TOOLING AT 16, STATION NO.4
17
FACE J
FACE B
BORE A
FACE F
TOOLING AT 17, STATION NO.4
Machinery

Fig. 8. Arrangement of Tools at Station No. 4, where Boring, Facing, and Finish-forming Operations are performed simultaneously

method of tooling being illustrated.

Another form of tool bracket is shown at *C* in Fig. 10, this bracket being furnished with a tongue to fit into one of the grooves on bracket *A*. The use of an auxiliary bracket of this kind provides for obtaining the required offset for tools that are to work on the outside diameter of the work at points located at some considerable distance from the center of rotation. Other forms of tool-holders are shown at *D* and *E*. At *F* there is shown the design of the side-head tool bracket and tool-holder that are used at station No. 6 of the machine shown in Figs. 1, 3, and 5; and at *G* there is illustrated the side-head tool-holder that is employed at station No. 3 of the same machine.

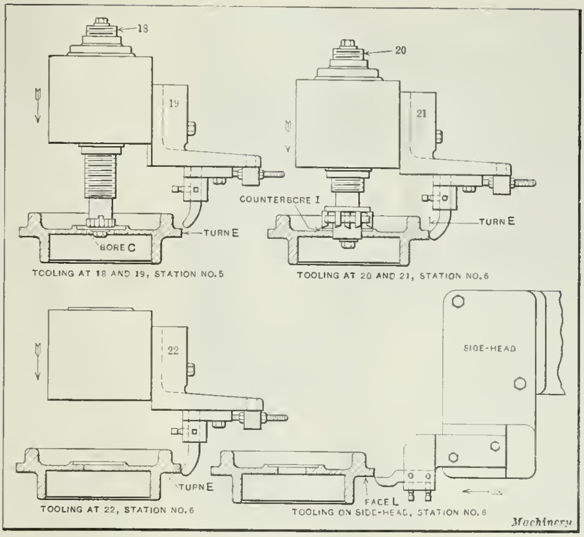

18
19
20
21
COUNTERBORE I
TURN E
BORE C
TURN E
TOOLING AT 18 AND 19, STATION NO. 5
TOOLING AT 20 AND 21, STATION NO. 6
22
SIDE-HEAD
TURN E
FACE L
TOOLING AT 22, STATION NO. 6
TOOLING ON SIDE-HEAD, STATION NO. 6
Machinery

Fig. 9. Arrangement of Tools at Stations Nos. 5 and 6, where Finish-turning, Facing, Boring, and Counterboring Operations are simultaneously performed

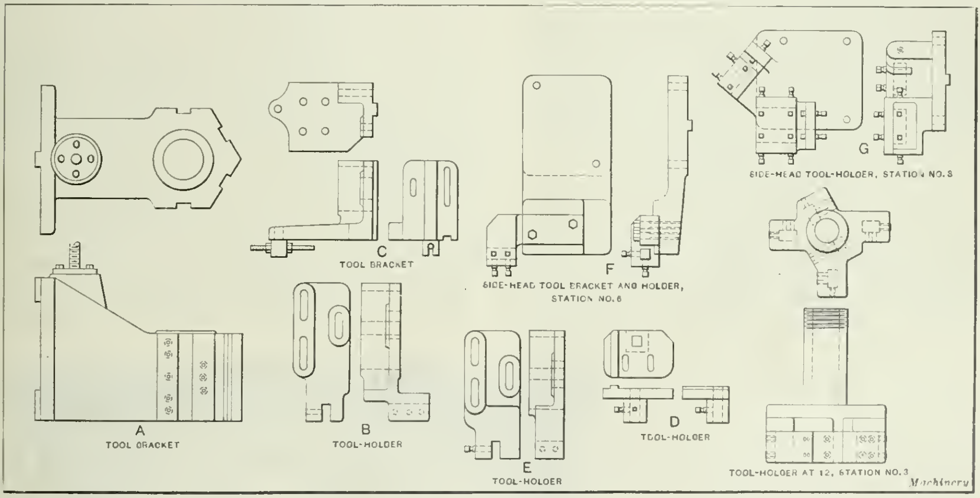

C
TOOL BRACKET
F
SIDE-HEAD TOOL BRACKET AND HOLDER, STATION NO. 6
G
SIDE-HEAD TOOL-HOLDER, STATION NO. 3
A
TOOL BRACKET
B
TOOL-HOLDER
E
TOOL-HOLDER
D
TOOL-HOLDER
TOOL-HOLDER AT 12, STATION NO. 3
Machinery

Fig. 10. Design of Tool Brackets and Tool-holders used on the Main Turret and on the Side-heads of the Machine employed for the First Sequence of Operations

Design of Tools and Planning of Successive Operations

After following through the preceding description of the successive operations that are performed to finish the entire upper side of a Nash flywheel, the reader will have already gained a comprehensive idea of how the cutting tools are designed and how the successive operations on work of this kind are planned. However, there are certain points which it may be well to emphasize, as they have an important bearing upon the amount of service which can be obtained from the tools and the rate of output that is secured. It will be seen that considerable use is made of standard forms of forged tools, because they are inexpensive to make and quite simple to grind. For such operations as rough-facing surface *F* and forming the fillet *G*, Fig. 6, it will be seen that a number of these simple forged tools are employed for removing the bulk of the metal. This service is severe and requires the tools to be ground quite frequently, but, as previously stated, the grinding is a simple operation which can be handled without great expense.

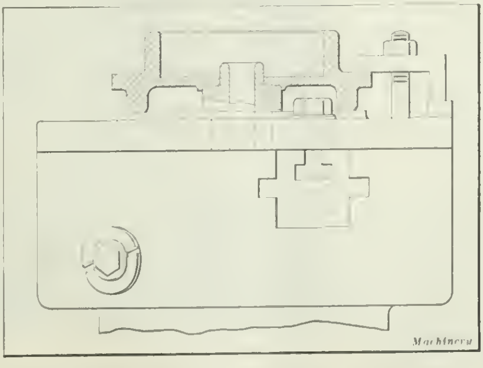


Fig. 11. Method of holding Flywheel for the Second Sequence of Operations, showing Pilot for locating the Work

After the surplus stock has been hogged out, the final finishing cut is often taken with a formed tool, as shown in Fig. 8, which illustrates the tooling at station No. 4. This tool provides for finishing faces *A*, *F*, and *B* and for forming a radius at the junction points between each of these surfaces. Similarly, it will be seen that formed tools of this kind are utilized for finish-facing surface *H*

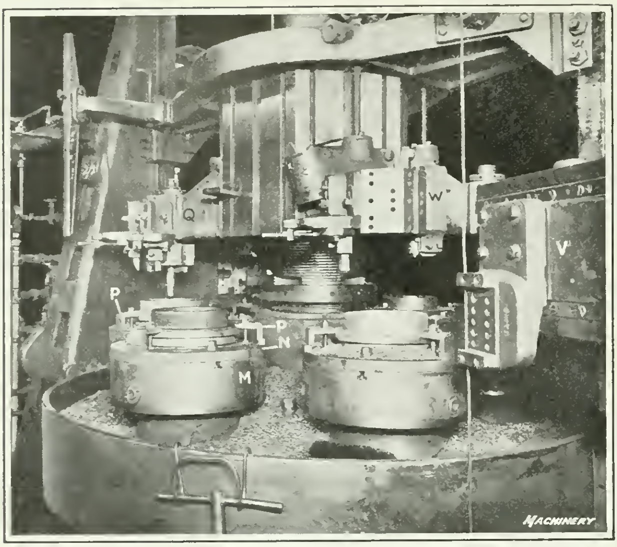


Fig. 12. Front View of Ryerson-Conradson Vertical Automatic Lathe equipped for performing Second Sequence of Machining Operations on Nash Flywheels

counterbore *I*, and the bevel at the top of the counterbore, and for facing surface *J*, diameter *D*, surface *K* and the radius that is required at the junction of each of these surfaces. Finish-forming tools of this kind enable a very satisfactory finish to be obtained, and as the greater part of the stock has already been removed by roughing tools, the expensive formed tools are not rapidly worn out.

Operations Performed on the Second Machine after the Work has been Reset

In resetting the Nash flywheel castings for performing a second sequence of machining operations that are required on the opposite side, advantage is taken of the fact that diameters *C* and *I* have been previously bored. These two openings in the work are dropped over a double pilot supported by a fixture of the kind that is carried on each of the rotating faceplates that are mounted on the main table of the machine. Reference to Figs. 11 and 12 will make it apparent that secured to the top of each chuck *M* there is a plate *N*, at the center of which there is mounted the double pilot previously mentioned. Plate *N* is held in place by bolts that enter T-slots in the faceplate; and the work is held down on the fixture by means of straps *P*. As on the previous machine, this Conradson vertical automatic lathe is equipped with five operating stations and a sixth position at which castings are loaded into the fixtures and removed after completing the required sequence of machining operations. For the performance of this sequence of operations, the general arrangement of cutting tools is similar to that for the first setting, and so a detailed description is unnecessary. The work done on this machine is as follows:

Station No. 1: Load casting into fixture.

Station No. 2: Nine tools are carried by the turret-head *Q* which operates on the castings at the second station; and the operations performed by these tools are as follows: Five tools operate simultaneously to provide for rough-facing surface *M*, Fig. 4, and two tools rough-face the inner portion of surface *L* which was not reached by the straddle-facing tools on the side-head *D* of the machine shown in Fig. 5, that simultaneously faced surface *K* and the outer portion of surface *L*. In addition to the facing tools employed at the second station of the machine shown in Fig. 12, there are two vertical tools that provide for simultaneously rough-boring diameter *N* and rough-turning diameter *O*, Fig. 4.

Station No. 3: At the third station there are eight tools engaged in performing machining operations on the work. They are carried by both the vertical turret-head *R*, Fig. 13, and the side-head at the rear of the housing. The arrangement of tools is very similar to that described for the second station. Five tools provide for taking an intermediate facing cut on surface *M*, Fig. 4, two tools rough-bore diameter *N* and rough-turn diameter *O*, respectively, and one tool takes a rough-facing cut over surface *P*.

Station No. 4: On the face of the turret above the fourth station at which the work stops for machining there is a head *T*, Fig. 13, which carries a broad-faced tool that provides for taking a finish-facing cut over surface *M*; also, there are two straddle tools which finish-bore diameter *N* and finish-turn diameter *O*; and while this work is being done, a fourth tool carried by the same head is engaged in taking a facing cut over surface *P* on the work.

Station No. 5: Above the fifth station, the turret-head *U* carries a single inserted-blade reamer that provides for reaming diameter *N* to the required size. It will be seen that this reamer is furnished with a pilot that enters a hardened bushing in the fixture to assure attaining the required degree of accuracy.

Station No. 6: It will be evident from Fig. 12 that there is a side-head *V* at the front of the right-hand housing on the machine, but no tools are mounted on this head for use in performing the second sequence of operations on Nash flywheels. The final work to be done on these castings is of quite a simple nature, consisting of finish-facing surface *L* and using a pair of straddle tools on surfaces *N* and *O* to provide for forming the upper portions of these

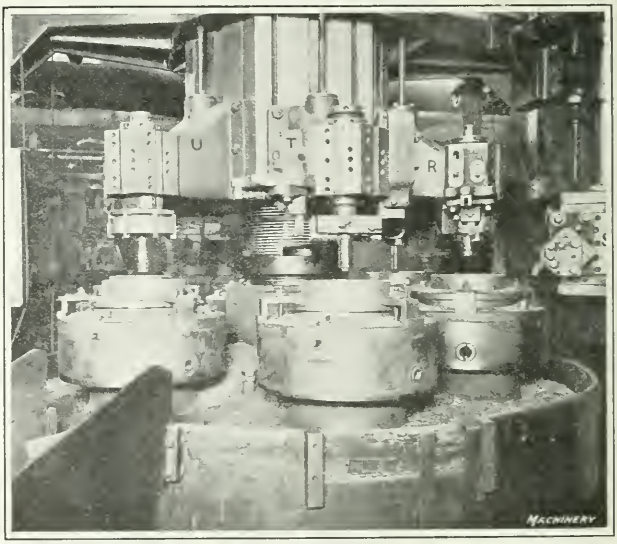
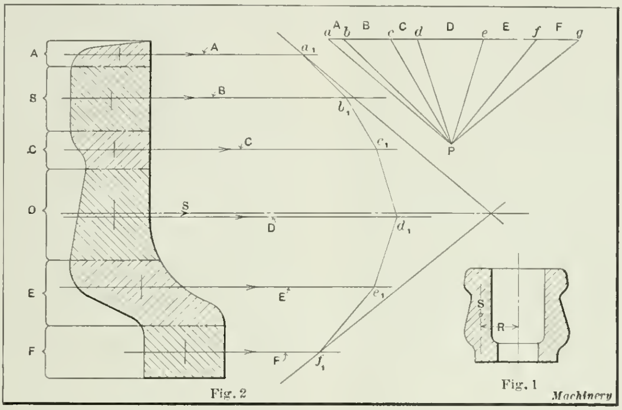


Fig. 13. Rear View of Machine shown in Fig. 12 equipped for performing Second Sequence of Machining Operations

surfaces to conform with the required radii of curvature. In performing this complete second sequence of operations, the rate of production is 130 flywheels per ten-hour day.

Classes of Work for which the Conradson Vertical Automatic Lathe is Adapted

Since the work of the sales engineer has become more fully understood, there has been a steadily increasing tendency toward the purchase of equipment for industrial plants on a basis of the actual expense of obtaining the required service, rather than upon the first cost of the equipment. It has been conclusively shown that this is the only true method of attaining maximum economy in performing machining operations, and the judicious purchasing agent is likely to regard the item of first cost as a secondary consideration. Take the case of the Conradson vertical automatic lathe. It is a machine of high productive capacity, but owing to the size and complexity of its parts the cost of construction is necessarily quite high. A machine of this kind will prove a profitable investment to a firm that has a sufficient volume of work on which the lathes can be run to keep them constantly employed during the full working day. But the size of the expenditure which is represented by the purchase of such a machine shop equipment is such that an experienced purchasing agent would not consider buying machines of this type unless there were a sufficient quantity of parts to be handled so that the machines could earn a satisfactory return on the investment.



Figs. 1 and 2. Irregular Section, and Graphic Method of locating Center of Gravity

* * *

GRAPHIC METHOD OF CALCULATING IRREGULAR VOLUMES

By R. KRAUS

Occasionally a question arises during the proposed design of a section where the basis of weight has to be considered. It is then necessary to figure the volume of the body. If the body is produced by the rotation of an irregular section around an axis, then the center of gravity, or at least the distance from the rotating axis, has to be found. In Fig. 1 the section of a round body is shown, the volume of which is to be determined.

The general formula for the volume is as follows: Volume $= A\,2\pi R$ in which $A =$ area of the section and $R =$ the distance from the rotating axis to the center of gravity of the area (see Fig. 1). In order to find the center of gravity the general practice is to cut the section desired from cardboard and suspend it from two different points; then plumb down, the intersection of the plumb lines being the center of gravity. For small and very irregular shapes this method is impracticable. Another method used is the mathematical procedure of calculating the sum of the moments of all the areas about two different axes.

A more satisfactory procedure is to find the center of gravity graphically by application of the polygon of forces. Divide the given section into a number of subdivisions A, B, C, etc. (see Fig. 2); find their respective areas, and consider these areas as forces acting through their respective centers of gravity. Let these forces also be called A, B, C, etc. The resultant of these forces will pass through the common center of gravity and is found by the use of the polygon of forces. To proceed, draw a line parallel to the direction of the forces A, B, C, etc., and show thereon, to some convenient scale, the forces A, B, C, etc. (this scale need not be the same as used for the section). Let the force A be represented by the length ab, the force B by the adjacent length bc, etc. Then choose a point P and connect the points a, b, c, etc., with this point. Now choose a point a_1 on the force line A, and draw a line parallel to aP, intersecting a_1 and of indefinite length.

Then continue with a line parallel to bP from a_1 until this line intersects the force line B, and so on until the final intersection at f_1. Now draw a line parallel to gP through f_1 and continue until it intersects the line parallel to aP. Through this intersection draw a line S parallel to the forces A, B, C, etc. This line will then pass through the common center of gravity. To find the location of the center of gravity, proceed as before using the same method and assuming that the forces are acting in a different direction, for instance at 90 degrees. Proceed the same as before, and the center of gravity will be where the new resultant intersects the resultant previously found.

In the illustration shown, only the distance R of the center of gravity from the rotating axis is required. For this solution only one polygon is necessary, namely, with the forces acting parallel to the rotating axis (Fig. 1). To give a clearer understanding of the method, the direction of the forces has been indicated in the diagram Fig. 2.

* * *

A NEW METRIC BILL IN CONGRESS

A new metric bill (H. R.-10) has been introduced in the House of Representatives by Mr. Britten, the bill being entitled "To fix the metric system of weights and measures as the single standard of weights and measures for certain uses." Under the provisions of this bill it would be unlawful after ten years for anyone to sell any goods, wares, or merchandise, or to charge or to collect for carriage or transportation of any goods, wares, or merchandise in accordance with any other system than the metric system of weights and measures. While the avowed purpose of the bill is to make its provisions applicable only to trade and not to manufacture, the Publicity Service of the American Institute of Weights and Measures, 115 Broadway, New York City, calls attention to the fact that it is clearly drawn with the idea of making it an entering wedge for further legislation. The manufacturers of the country objecting to the metric legislation promptly organized against the recent metric propaganda, and have presented such a strong opposition that they have been exempted from the operation of the law. Whatever might be said in favor of the metric system for laboratory and scientific work and for purposes of computation, no possible benefit can be conceived of which would accrue to the retail trade of the country by the use of the metric system as against our established units.

Industrial Conditions in Germany

From MACHINERY'S Special Correspondent

Berlin, May 6

OWING to the uncertainty of the present international situation there is a disinclination to business of any kind, domestic as well as foreign buyers hesitating to place orders. A definite turn for the worse occurred during the month of February. The possibility of an imposition by the Allies of a duty on all exports has been especially responsible for the loss of foreign trade. In the machine tool and small tool fields, the manufacturers of automatic screw machines, taps, and milling cutters have sufficient orders to keep them busy for months to come, but the remaining machine tool builders are working on stock. Manufacturers of drills have been compelled to leave all foreign business to competitors.

Many machine tool builders have returned to the piecework basis of payment, and in the report of Messrs. Pittler, who recently declared a 15 per cent dividend, great advantages are claimed for this system. The Magdeburger Werkzeugmaschinenfabrik Joint Stock Co. has also paid a dividend of 15 per cent. This concern has become affiliated with the Fritz Werner Joint Stock Co., Berlin. The Wotanwerke, Leipzig, have taken over the Saxonian gear factory of the late Max Schütz, Chemnitz.

Out of 5,626,000 workmen in all industries of which official reports were on hand March 1, approximately 266,000 were idle. The number of metal-workers included in this list was 1,332,500, of which 4.1 per cent were unemployed.

The Leipzig Fair

The amount of business transacted at the Leipzig fair held this spring surpassed the expectations of many exhibitors. Many machine tools, sheet-metal and woodworking machines, and small tools were sold. All types of machine tools were well represented, a machine of special interest being a lathe exhibited by Heidenreich & Harbeck, of Hamburg. This machine is designed for turning long shafts of various diameters, and is provided with two carriages on which six tools may be mounted. This arrangement permits the simultaneous turning to a number of diameters. Another machine that attracted considerable attention was a motor-driven open-side planer built by Billeter & Klunz. This machine is equipped with an ingenious head provided with vertical and horizontal feeding movements which may be operated simultaneously but independently of one another. A small internal grinder developed by the Fortuna Werke finishes holes down to 2 millimeters (0.0788 inch) in diameter.

The Locomotive Industry

Builders of locomotives and railroad cars are well supplied with work. According to the Railway Minister, the total orders placed consist of 4526 locomotives, 74,400 freight cars, 6000 passenger cars and 1000 baggage cars. One hundred of the locomotives were ordered by Spain, 40 by Roumania, and 600 by Russia. An indication of the competition offered foreign manufacturers of locomotives may be obtained from the following comparisons of bids made: In bidding on locomotives for Argentine railways, German builders bid 4.11 pesos per kilogram (79 cents per pound, present exchange), while the price asked by English competitors was 4.74 pesos per kilogram (91 cents per pound). In bidding on 10,000 railroad car wheels, also for Argentina, the bid of the Krupp Werke, of Essen, was only 40 per cent of the lowest American bid.

Business Relations with Soviet Russia

Negotiations concerning business relations between Germany and Russia resulted in the signing by both countries, of a protocol controlling this matter. The amount of trading between the two countries is larger than is generally thought. Between May 15 and December 31, 1920, the total exports to Russia of agricultural equipment, machinery, automobile accessories, and electrical equipment amounted to 173,200,000 marks ($2,700,000, present exchange). The trade was actually far greater than this, as many goods were illegally exported across border countries. The export figures will, no doubt, be considerably greater this year, due to the delivery of some of the locomotives mentioned.

In connection with the locomotive orders, it is interesting to note that the committee appointed by the Soviet Government to negotiate for the purchase of railroad equipment is instructed to order 2000 freight locomotives and from 4000 to 5000 passenger locomotives, besides much repair equipment and spare parts. Orders for 1000 locomotives have been placed in Sweden. The German locomotives will be designed by Henschel & Son, Cassel, but they are to be built in nineteen different plants on a strictly interchangeable plan. In order to see that this specification is carried out, a sample locomotive will be assembled from parts selected from each of the nineteen plants. The locomotive spare parts ordered in Germany amount to 48,000,000 Swedish crowns ($11,208,000, present exchange). The German bid on these parts was more than 50 per cent less than that of Swedish concerns. However, the reason German manufacturers received the orders was not so much on account of the cheaper prices but because of the earlier deliveries promised. The first contract was signed in October, 1920, and by January, 1921, 1500 tons of parts had been shipped.

The Automobile Industry

Many of the plants erected during the war for the manufacture of trucks and automobiles are now engaged in making a variety of products such as tractors, bicycles, typewriters, electric motors, pneumatic tools, ball bearings, small arms, etc. According to the census of February, 1919, there were then twenty-three automobile plants employing 33,350 men. In February of this year, the number of employes in the same shops was 26,470. The plants ordinarily operate from forty-four to forty-eight hours per week; but at present, some are only working twenty-four hours per week. All automobile plants pay the employes on the piecework basis. The hourly wages for skilled workmen average from 5.6 to 8.3 marks (from 9 to 13 cents, present exchange).

The Metal Industries of Holland

The metal-working industries of the Netherlands cannot be placed on the same level as in other countries, because there are no blast furnaces or rolling mills. Out of approximately 100,000 workmen engaged in these industries, 40,000 are employed in shipyards, 10,000 in machine shops, 4000 in foundries, and 3000 in automobile and motorcycle factories. In general, the working hours are from forty-five to forty-eight per week. Prior to the war employes worked sixty hours per week. The average weekly wages of skilled metal workers at that time amounted to 18 guilders ($7.23, normal exchange), while now they average 38 guilders ($13.37, present exchange), an increase of 110 per cent in Dutch money.

PROMOTING EFFICIENCY IN RAILWAY SHOPS

By M. C. WHELAN
Foreman, Frisco Railway, Kansas City, Mo.

With their present income barely sufficient to meet operating expenses, the railroads face the necessity of increasing efficiency in every possible way. This requires the cutting of war-time red tape so that employer and employe can deal more directly with each other and in a more personal manner than was possible during the war. Rules and regulations that restrict production must be eliminated.

Shop practice comprises a field of great magnitude and importance, without a comprehensive knowledge and constant study of which a supervisor of mechanics in a railroad shop is incompetent. The following are a few facts observed from time to time which should be given careful consideration by all supervisors. They are records of a few of the many inefficient and costly practices in railroad shops, and are given for the purpose of constructive criticism. From these records supervisors and shop foremen can draw their own conclusions as to whether present mechanical supervision is perfect or otherwise.

Highly Paid Mechanics Performing Helper's Work

Eight piston keys were brought from the roundhouse to the shop to be straightened by a mechanic and his helper, requiring four trips each way for two men, one man being paid eighty-five cents per hour and the other forty-five cents per hour. What mechanical skill was required to perform this work and wherein does proficiency in supervision appear? In another instance, a mechanic and helper walked from the roundhouse to the shop, obtained iron for U-bolts for guides, took the iron to the threading machine, and from there to the blacksmith shop, and gave instructions for forming. In about three-quarters of an hour the mechanic and helper again went from the roundhouse to the shop, obtained the U-bolts, and returning to the roundhouse applied them to the engine. The roundhouse is 350 yards from the shop and the threading machine seventy-five yards from the blacksmith shop. Under such conditions, is it any wonder that the management states that there are too many mechanics for the amount of mechanical work performed?

The proper way to perform the latter job would have been to have the mechanic measure the width and length of the U-bolts required, and then have the supervisor make a pencil sketch of the pieces wanted, after which a wiper or helper could be sent to the supervisor of blacksmiths, who would have the stock cut to length and sent to the threading machine, accompanied by a note giving specifications for the threads required and the engine number on which the parts were to be used. The mechanic could then be employed on some necessary work for which he is paid, and not be doing laborer's work at mechanic's pay.

Another instance noted was that of a skilled mechanic carrying spring hangers, equalizers, and various parts of spring- and brake-rigging, from the shop store-room to the drilling machine, slotter, and lathe. This is another case in which the supervisor failed in his duty while the laborer smiled at the thought that it required a mechanic to perform his task.

Again, a mechanic specializing on link motion, made eight trips between his work-bench and the blacksmith shop in one day. Perhaps he made more than eight trips, but this number was noted. Why was a helper not delegated to take and bring back the parts this man needed, so that at least 60 per cent of his time could be utilized in working at his trade instead of walking around?

Lack of Supervision the Cause of Much Inefficiency

A main air reservoir proving a hindrance to some frame repair work on an engine was required to be removed. The foreman ordered the clamp supports cut out, as the easiest way to disconnect the reservoir drum. An acetylene torch was used, and both top and bottom clamps were cut, although only one—the bottom one—was required to be cut to permit removing the reservoir. One band was left in the pit, and an order from the foreman to the shop read, "Make two as per sample," the sample being one of the bands that had been cut off. The supervisor had not even glanced at the job, and a lead pencil and pad took the place of supervisory energy and foresight. In this instance the orders of the foreman were not carried out, however. The two 6-foot bands of ⅞- by 4-inch iron were repaired and a saving of eleven dollars made in a job that should not have cost even five dollars if properly handled.

In a great many shops the injudicious use of the cutting torch, as in this case, results in adding needless expense items to repair jobs, and is also the cause of a great deal of inferior work. The instance cited above shows the fallacy of a supervisor in one department doing what he is told by the supervisor of another, or blindly following a written order to the letter without any investigation or knowledge of the purpose for which the work is intended. In other words, without cooperation and the exercise of the proper amount of supervision, there must be much inefficiency. To supervise properly, requires more effort than the use of a pencil and a slip of paper, and the supervisor's duty is not done when a task is reported completed unless he, as an expert, knows that the work is done properly.

National Railway Agreement Prevents Efficiency

The actual occurrences noted may appear magnified, but if each supervisor will adopt the rule of using his foreman's eye he will find conditions of a like nature in nearly all shops. The National Railroad Labor Agreement has tied the foreman's hands almost to the extent that he cannot show by actual workmanship how an apprentice shall perform a piece of work. Some foreman with a sense of humor who felt the restricting power of this agreement added another clause to the rule whereby "no foreman shall perform any work, except those stationed where no mechanics are employed" to read, "nor shall they in any way tax their thinking power in formulating plans for obtaining more mechanical and efficient performances or systems." Of course, a supervisor should not be placed at a given task where he cannot put into execution ideas and proper supervision, because his mental qualities should be at all times free to note defects, improvements, and proficient methods, which he may observe through the well-trained and experienced eye of a foreman. But he should be at liberty to turn his hand to a manual task when efficiency and results are promoted thereby.

* * *

ACCIDENT COSTS PART OF PRODUCTION COSTS

In a recent issue of *National Safety News*, attention is called to the fact that accident costs should be considered part of production costs. In many plants, reports are compiled at regular intervals, showing at what cost each department is operated and what the production is for each period. It is assumed by the reader of such reports that the most successful foreman is the one whose department shows the largest production at the lowest relative cost. Accidents lower production and increase cost, and yet many companies do not consider this item when preparing cost and production reports. Surely there is no more logical and better way to bring safety to the attention of the foremen than by adding to their operating cost the cost of all accidents that happen in their departments. There are some companies that appreciate this point and have for some time included the cost of accidents in their cost and production reports.

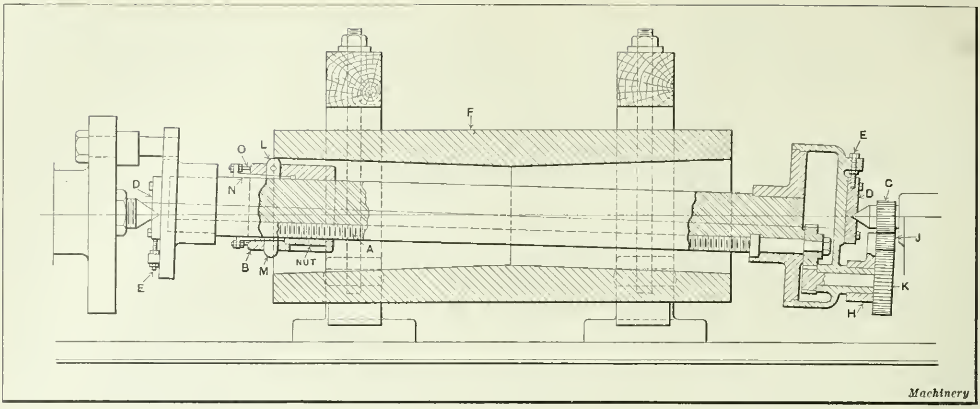


Fig. 1. Taper Boring Device mounted on Lathe in Position for boring Double Taper in Bushing

TAPER BORING DEVICES

By W. C. STEUART

The devices shown in the accompanying illustrations have been in use in the Detrick & Harvey plant of the Bethlehem Steel Co., Baltimore, Md., for many years and have proved invaluable in boring large taper holes in bushings. Each one consists of a traveling-head boring-bar mounted on centers and having a feed-screw *A* located in a groove on one side of the bar. This screw serves to feed the head *B* along the bar, deriving its motion from a train of gears rotated "sun-and-planet" fashion around a pinion *C* cut on the stationary or dead center. The required taper is obtained by offsetting one or both ends of the bar by means of slides *D*, which are adjusted by screws *E*. These slides have center holes in their faces, and are attached to the end or ends of the bar as indicated.

Fig. 1 shows one of the bars mounted on a lathe in position for boring a hole tapering in opposite directions from the middle to both ends of a bushing *F*. Offsetting slides *D* are provided at both ends of the bar. In Fig. 2 is shown a bar mounted on a horizontal boring machine. In this case only one offsetting slide is required, as the work consists of boring a single taper in bushing *G*. When the bar has an offsetting slide at each end, as shown in Fig. 1, it is necessary to provide a pivoted bracket *H* for idler *J* to permit bringing idler *J* and pinion *C* into proper mesh after adjusting slide *D*. It is not necessary to have a pivoted bracket on bars used in boring single tapers, but it is well to provide one as it permits using change-gears to vary the feed.

When double tapers are bored, two tools *L* and *M*, are required, one cutting half the length or one taper, and the other, the remaining distance or the other taper. For single tapers, only one tool *M* is necessary, as shown in Fig. 2. It will be noted that both the feed and rotary motion are confined to the bar itself, which is driven from the spindle of the machine. The work is entirely stationary, and where the device is used in a lathe the work may be held in blocks or in a cradle bolted to the ways. The tools are adjusted by means of a taper bushing or gland *N* located in place by set-screws *O*.

* * *

British trade reports indicate that Sheffield is making great progress in developing the manufacture of circular saws for cutting cold metal, as well as smaller screw-cutting and slitting saws for machine shop use. In the past, the bulk of this business in Great Britain went to the United States. It is stated that the prices at which the Sheffield concerns offer saws and cutters of this kind are much lower than the prices of the American product. Every process from the raw material to the finished product is carried on in the plants of the steel makers, as they are, themselves, taking up this line of manufacture.

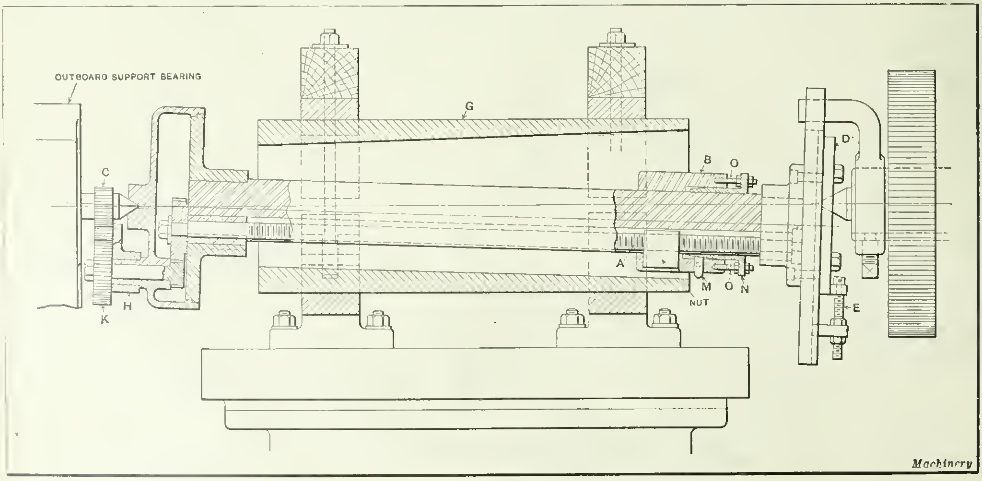


Fig. 2. Taper Boring Device mounted on Horizontal Boring Machine in Position for boring Single Taper

Common Causes of Errors in Machine Design

Accuracy in Drawings—Sixth of a Series of Articles

By R. H. McMINN

DRAWINGS are one of the principal means of conveying the instructions of the engineering department to the departments of the shop, so lack of clarity or errors in drawings result in parts wrongly made. In a well organized engineering department of a company that has been established for some time, old drawings of machines similar to the one being designed can often be used for reference to good advantage in suggesting the arrangement of views on drawings to be made and in showing many points which are the result of much experience in a particular type of machine. A designer should not be too quick to discard an old design or be too critical of some peculiar construction or shape of a part previously used. The very fact that it is peculiar probably explains its merit for the purpose intended. However, care should be taken not to use an old design when it is not adaptable to conditions demanded by the new machine, even though a superficial view may indicate its suitability. One must see that familiarity does not breed contempt and thereby induce a careless analysis of the proper design for machines which are constantly duplicated except for alterations to suit special conditions. The habit of the mind in assuming that parts usually unaltered in such machines will always be unaltered must be watched carefully, in order to prevent the adoption of unsuitable designs.

A draftsman working on part of the details of a machine may not be familiar with its whole design. He must, however, be careful to properly relate the parts he is detailing to the whole machine. The form, size, and location of any parts of a machine are largely determined by the form, size, and location of other parts. The parts, lines, and dimensions on any drawing being used for reference must be thoroughly identified. In copying a dimension from another sheet, the most accurate results are obtained by saying to oneself, "From edge of casting to center line of hole is so-and-so," and not merely glancing at the other drawing. This aids in concentration and helps to retain the proper relationships in the mind until the figure is correctly used.

Checking Calculations

Designers and draftsmen must be careful not to be misled by errors in their calculations of areas, volumes, centers of gravity, strength of parts, etc. Reason and past experience should be used as a check upon the results of any series of calculations, instead of accepting the result blindly. In figuring an area of irregular shape, a rough check may be obtained by noting the area of the nearest inscribed and circumscribed regular figures. One then knows that the result sought at least lies between these values. The same principle may be applied roughly in checking the volume of an irregular shaped receptacle.

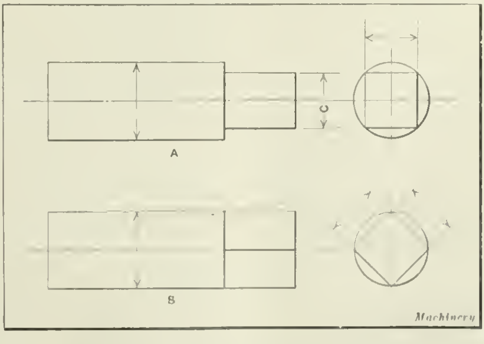


Fig. 7. When Part is dimensioned as at A, the Square End is sometimes turned to Diameter C; Dimensioning as at B prevents Such an Error

It is important to keep in mind during a series of calculations what the result of each step represents, and to label each result in any series. Frequently the mere indicating, in order, of a series of calculations which it is necessary to perform to obtain a certain result, leaving the figuring until later, will be an assistance in obtaining the result sought. It should constantly be considered what error is allowable without preventing good working or unsafe results. Known errors may therefore be admitted, instead of going into unnecessarily elaborate calculations to get exact results. The designer should be able to determine, however, when exactitude is necessary. If it were desired to revolve an irregular shaped body about its center of gravity, the exactness with which the center of gravity must be located depends somewhat on the size and weight and the speed at which the body is to revolve.

Checking from the Drawing Itself

When starting a lay-out, the correctness of location of lines should be checked as the work proceeds. An accurate beginning makes one less liable to make a mistake without detecting it by mere observation. No line should be drawn that can conveniently be drawn later in the design, in order to avoid possible need for erasure. Comparatively insignificant details should not be put in until last. Mere drawing is monotonous, so an attempt should be made to maintain alertness by keeping the mind free to plan correctly. As little drawing should be done as is necessary to give sufficient information to those who will use drawings; but enough should be done to prevent all chances of falling into error. A complete assembly, even down to the most minute details, offers the best obtainable guide for predicting the result of operation of a new machine.

If the true shape of a portion of a detail is considerably distorted in one or more views, due to its being at an angle with the main lines of the detail, additional views of this portion may have to be drawn from suitable viewpoints. When in doubt as to clearance between certain parts drawn to small scale, necessary portions of these parts should be drawn to a larger scale in a separate lay-out. If, while drawing, an impression occurs of something which should be done on a drawing before it is complete, and yet which might be overlooked, a written note should be made of it. Careful consideration must be given the question of alternatives in deciding upon the design of a part, its location in the machine, or the material to use. Frequently after a machine is made it seems desirable to change the material, design, or location of a part, because the part was made or located as first conceived without seeking for a possibly more logical alternative.

Refraining from crowding on drawings helps accuracy. Drawings should not be made to such a small scale that it is difficult to keep lines separated in tracing, or so that in dimensioning the figures have to be made so little that they are hard to make and read. When a detail contains parts that are so small that they are difficult to dimension, a separate enlarged view of this portion of the detail should be shown with the dimensions of the small parts given.

Clear Representation on Drawings

An attempt should be made to give correct first impressions in drawing, as the first impression may be acted upon without full investigation. Particular attention should be called to the unusual. It should not be the object to be only technically correct in a drawing but to be thoroughly understood. It has been found when the part in Fig. 7 is drawn as shown at *A* with the dimension of the squared end given at *C* that machinists sometimes turn the end round with a diameter equal to *C*. This danger of acting upon a wrong first impression has been eliminated by drawing the detail as at *B*. Likewise in Fig. 8 when the drawing is as shown at *A* the portion at *C* is sometimes turned with a diameter equal to *C*. By drawing the detail as at *B* with a section shown through the center, the machinist can hardly go wrong.

When Dimensions are not to Scale

If, after a detail is drawn to scale, it is found desirable to change the size or location of some part of the detail, this is frequently done by changing the dimensions only. In Fig. 9 the lug *A* is shown to the right of lug *B*, but by dimensions it must be located to the left of lug *B*. The width of lugs may be drawn 3 inches to scale and be dimensioned 2 inches. Leaving the width of the lugs out of scale is permissible. Even leaving the location of the lugs out of scale is probably permissible in such a simple case, but it is a doubtful time-saver when considering all the people who must use the drawing when first made and possibly many times in the future. It invariably brings up the question when the detail is seen alone, as to its correctness. It will probably be compared often with the detail with which it goes, to verify the dimensions which locate the lugs. Some engineering departments demand that a heavy line be put under dimensions not to scale, and this helps the situation somewhat. However, in more complicated details leaving parts considerably out of scale regarding location prevents proper checking by graphical methods and perception of true relationships by merely looking at the drawing. The practice therefore does not help to promote accuracy. In using an old drawing of an assembly or detail as a basis of a lay-out to sketch in a proposed addition or alteration, any dimensions used should be checked to see if they are to scale.

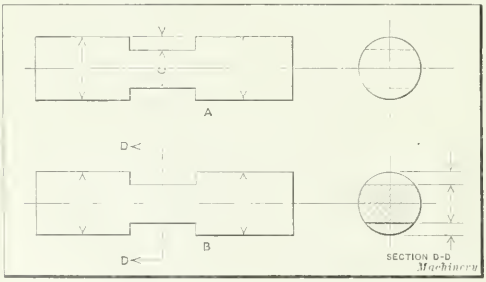


Fig. 8. Dimensioning as at B prevents Error of making Middle Part C Round, which is Likely to occur if dimensioned as at A

Relative Locations of Different Views

The third angle of projection is used almost universally for machine drawings made in this country. The first angle is used sometimes in structural and architectural drawings. Whatever angle of projection is used by a concern must be strictly adhered to by all of its draftsmen. Likewise, drawing each detail as far as practicable in the same angular relation to the top of a detail drawing as it is shown on the assembly drawing helps to keep its relation to the assembly clearly in mind while drawing it, and thus helps to prevent error. If a part, like a diagonal brace, has its longest sides at an angle with the top of the assembly drawing it is, of course, permissible to draw the detail with these longest sides parallel with the top or side of the detail sheet. It is also legitimate for the sake of grouping parts with their longest dimensions parallel to turn a part, which is shown vertical on the assembly drawing, like a building column, to a horizontal position on the detail drawing. Some plants require that the bottom end of such a member drawn in a horizontal position shall always extend toward the left side of the drawing.

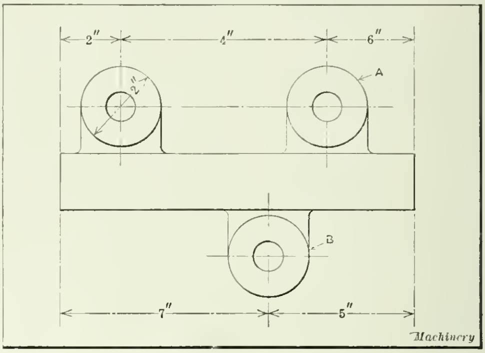


Fig. 9. Drawing with Dimensions which are not to Scale

Parts on a detail drawing should not be shown with the side elevation upside down from the position shown on the assembly drawing, for this invites error in the drawing of the part and is more difficult to check. If a bottom view is more essential than a top view, a top view should be shown at least in outline, and a bottom view should be shown under the side elevation. Likewise if the front view of a part is shown on the assembly, and the back view is not shown, and yet is the more important side when it comes to detailing, the front view should be detailed at least in outline, as it will help prevent the reversal in location of important parts in the back view. There are, of course, many simple cases where these top and front views are not needed to insure accuracy.

Explanatory Notes on Drawings

Notes on drawings must be prominent enough and so located that they will be seen at the right time—that is, they should be so closely associated with the part to which they refer that they will be seen when the part is being made. It is proper to place in a prominent position on a drawing a general note that will apply to all details on the drawing, such as "Punch all holes eleven-sixteenths inch unless otherwise noted." In such a case there is no authority for punching holes unmarked in size without referring to the general note. However, if it were desired to tap all holes shown on a drawing, with a thread different from that usually used, the change should not be covered only by a general note as "All taps used to have sharp V-thread instead of U. S. standard." General notes should be and usually are read by a foreman before the drawing is given to a workman, so such a note may insure the use of sharp V-thread taps; but instead of indicating the size of hole in one place and special thread in another the kind of thread should be given with the size of each hole or group of holes, and must be made especially prominent.

Notes must convey correct and full information regarding the procedure to be carried out. In one instance a pattern had core-prints to core holes for 3/8-inch bolts around a flange. A purchaser desired to have one of these with holes cored large enough to use 1/2-inch bolts. Instead of changing the size of the core-prints, it was easier to make the casting with the smaller holes and ream them out with a drill to 9/16 inch diameter. The following note was therefore put on the bills of material and blueprints sent to the shop: "Drill 9/16-inch holes." The core-prints for the smaller holes made in the sand were therefore stopped off by the foundry, and the flange was cast solid, thus necessitating the marking of the position of the holes before drilling. The foundry was justified in doing this, as holes are usually drilled in solid metal, and the brevity of the note was such that it did not give the exact procedure to be followed. The note should have read "Ream cored holes in flange with 9/16-inch drill." After writing a note, one should read it to see what acts the note will cause to be performed without further knowledge of the job. What does each word call for a person to do?

An endeavor should be made to avoid dividing notes at vital points, placing a portion on one line and the rest on another line; for instance, when a note indicates a size 8" x 9" x 10", these figures should not be separated by placing 8" x at the end of one line and 9" x 10" at the beginning of the next. Unusual abbreviations that may not be understood by some of the persons who may use a drawing—say on a drawing to be used by the purchaser to erect a machine—should not be used. The letters I and O should not be used in notations; they look too much like the figures one and zero. If arrow lines running from notes are made diagonal, they show up better, as they are in greater contrast with most of the lines on the drawing. However, a line from a note should not run through a sectional view at the same angle as the section lines, as this obscures it. Arrow lines running from notes should not be crossed if it is possible to avoid it.

The next installment of this series of articles will continue the discussion of points to be observed in making drawings, in order to prevent errors in the finished part, taking up the matters of dimensioning and checking of drawings.

* * *

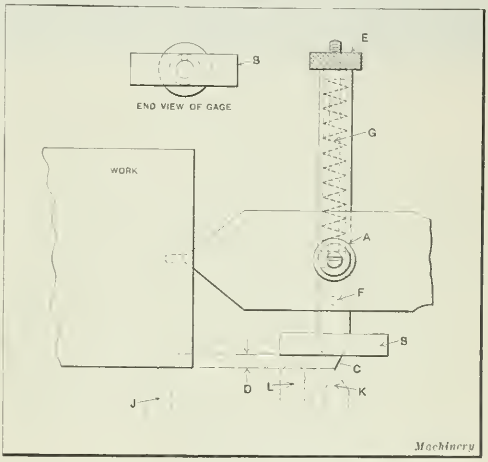
The necessity for manufacturers to combine for the purpose of carrying out research work is being recognized more and more all over the world. Abroad, various governments are also assisting in research work for industrial and engineering purposes. In Great Britain a special department of scientific and industrial research has been created, and the electrical and allied industries in Great Britain have availed themselves of the opportunity of cooperating with the government, and have formed an association known as the British Electrical and Allied Industries Research Association, which is to take over the work formerly done by the Research Committee of the Institution of Electrical Engineers and of the British Electrical and Allied Manufacturers Association. This research organization will have an income of about $75,000 a year to spend on research work, one-half of which is contributed by the British Government. If it were possible to establish practical working relations between the Bureau of Standards and the various manufacturing organizations in the United States, much might be gained in this country in the way of furthering research work.

GAGE FOR SETTING THREADING TOOL

By HARRY MOORE

In the accompanying illustration is shown a simple gage that has proved convenient when used in conjunction with a commercial thread gage for setting a thread-cutting tool. Those who have had any experience in cutting threads know that even when the work is turned to the correct outside diameter to start with, the burrs that are inevitably thrown up by the tool are quite likely to deceive the eye as to the exact depth of the cut, with the result that the thread must be finished to the final depth by cut-and-try methods, which requires considerable time.

By the use of the gage shown in the accompanying illustration, however, the amount of material to be removed to cut a thread of the required depth can always be easily determined. In equipping a lathe with this gage, the tailstock center must have a 3/8-inch hole drilled through it at right angles to its center line. The shank of the gage is inserted in this hole and is held in place by a knurled head screw *A*. The body of the gage should be turned down from 1-inch stock, leaving a collar at one end which is squared up as shown at *B*. A hole is then drilled through the shank of the tool to receive plunger *C*. The conical point of this plunger should be finished to an angle of 60 degrees. The other end of the piece is turned down to permit a spring *G* to be inserted as shown. The small end of plunger *C* should be threaded and provided with a knurled nut *E*.



Gage for determining when Thread is cut to Required Depth

When using the tool, a standard screw pitch gage is placed against the flat face of part *B* in such a position that the conical point of plunger *C* can be adjusted to fit one of the thread spaces in the gage. This adjustment is effected by knurled nut *E*. A pin *F* bearing on a flat surface of the plunger prevents the latter from turning when operating knurled nut *E*. It will be evident that point *C* projects beyond the face of piece *B* an amount equal to the standard depth of thread *D*, as determined by the standard gage. With point *C* set in this position, and the work turned to the correct outside diameter, the next step is to adjust the threading tool until its point just makes contact with the work, as shown at *J*. The carriage is next moved over until the point of the tool is opposite the conical point of the gage as indicated at *K*. The gage is then set in such a position that the conical point just makes contact with the point of the threading tool. The threading can now proceed in the usual manner. On the last or finishing cut, the tool should just touch the face of *B* as indicated at *L*.

Production Planing in Machine Tool Plants

Methods of Tooling up Planers to Expedite Rates of Output

In previous installments of this series of articles on production planing, the statement has been made that planers are used for a great variety of operations, and it will be apparent to any experienced mechanic, even though he has not had the opportunity of familiarizing himself with details of the methods used in the performance of planing operations, that a variety of different types of tools are required for handling work of this kind. In planing, it is usually necessary to take three or more cuts on work where a high degree of accuracy is required, these cuts consisting of a roughing, a straightening, and a finishing cut. Castings and forgings which have to be planed usually come to the machine shop with a considerable amount of excess metal to be removed, and the roughing cut removes practically all of this surplus stock.

In taking a cut which may be anywhere from ¼ to ⅝ inch or more in depth, it will be apparent that variations in the hardness of the work and other local conditions will cause the tool to spring to varying degrees, thus affecting the straightness of the surface produced by planing. The straightening cut is taken to correct these inequalities, a sufficient amount of metal being removed at this time to reduce the size of the work to such an extent that only a few thousandths of an inch remain for removal during the finishing operation. Tools used for the performance of roughing operations are of practically the same form on all classes of work, in most cases these tools being either round-nosed or square-nosed, the former type being most generally employed; but for straightening and finishing, the shape of the tool will vary over a wide range, according to the form of the work.

To attain maximum efficiency in the operation of a planer, careful attention must be paid to the design of the cutting tools and clamps that are used for holding the work in place; also, the accuracy of the foundation of the planer is a factor in determining the precision of the work that is produced. In this article, suggestions are given concerning the proper forms of cutting tools to use for the performance of roughing, intermediate, and finishing operations; data are presented on the proper working conditions to maintain in the taking of successive cuts over a piece of work; and information is given concerning the proper methods of setting up a planer, as well as of testing the accuracy of the planer foundation, and compensating for inaccuracies that may exist.

Types of Planer Tools Recommended by the G. A. Gray Co., and the Cincinnati Planer Co.

A comprehensive idea of the variety of forms in which planer tools are made will be gathered by reference to Figs. 1 to 4, inclusive, which illustrate tools that are used in the shops of the G. A. Gray Co., and of the Cincinnati Planer Co. Brief explanations of the purposes of these tools are presented beneath the illustrations, so that a detailed description is not called for elsewhere. In making planer tools, as in the production of tools for use on other types of machines, various methods are adopted for the saving of expensive high-speed steel. Tool-holders can be successfully employed on certain classes of work, while other shops find it more satisfactory to make their tools by brazing a high-speed steel bit to a carbon steel shank. Examples of tools made in accordance with this principle may be seen in the accompanying illustrations Figs. 1 to 4.

Another important point in this connection is the kind of steel from which the tools are made. For taking the roughing and straightening cuts, it is usually found that high-speed steel is the most satisfactory material, owing to its greater productive capacity; but where considerable accuracy and perfection of finish is required in performing the final planing operations, far more satisfactory results will usually be obtained by making the cutting tools of carbon steel, because this material can be ground to a keener edge, and experience has shown that the tools retain this edge longer and are thus able to produce a smoother and more accurate finish on the work.

Methods of Clamping the Work

Various methods are utilized for securing work to a planer table, but in most cases these are merely variations of the ways in which a combination of straps and bolts with their heads in the T-slots of the planer table may be employed to hold the work in place. By looking over the illustrations showing examples of planer practice in different shops, appearing in the different installments of this article, it will be seen that the methods of clamping work are matters in which the opinion of the planer foreman is allowed

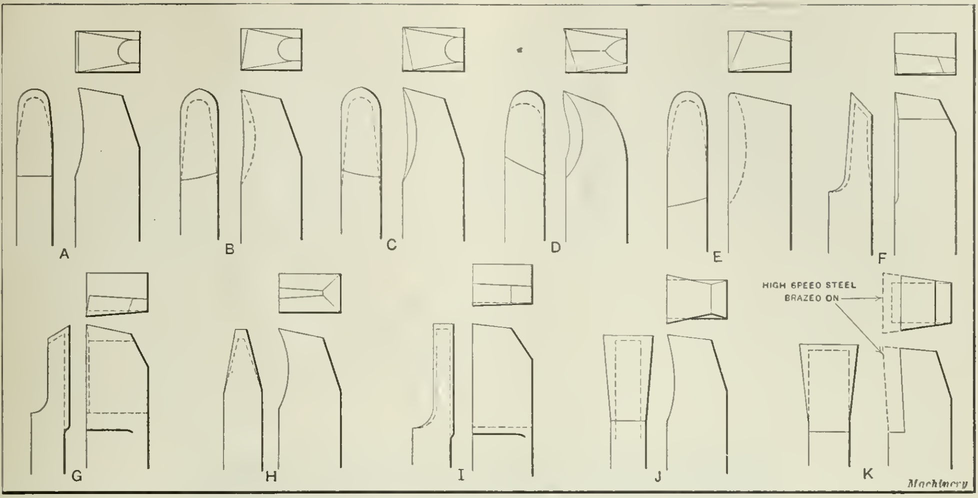


Fig. 1. (A) Roughing Tool feeds right to left or left to right; (B) Roughing Tool feeds left to right; (C) Roughing Tool feeds right to left; (D) Roughing Tool feeds right to left; (E) Roughing Tool feeds left to right; (F) V-hearing Finishing Tool made Right- and Left-hand; (G) Dovetail Finishing Tool made Right- and Left-hand; (H) Rough Beveling Tool; (I) Tool for finishing up to a Shoulder, made Right- and Left-hand; (J) Roughing Tool for Use with Vertical Feed; (K) Same as J, but with Brazed High-speed Bit. On All these Tools, Clearance behind Cutting Edge, 6 Degrees, and Side Clearance, 4 Degrees

considerable leeway. This is chiefly noticeable in the number of clamps which are used and in regard to the tightness with which they are held down. If there is any general criticism to be made of current practice in this part of the work of planer departments in even the most up-to-date shops, it is that an unnecessarily large number of clamps is used and that there is a tendency to screw down these clamps much tighter than is really required to fulfill existing conditions. It is true of a majority of examples of planing, but more particularly in cases where the work is heavy, that there is very little tendency for the piece to be lifted from the table. Consequently there is really no need to employ a large number of clamps, and those that are used need only be tightened up to a moderate degree. The practice of excessive tightening of clamping bolts is objectionable, because it is likely to distort the shape of the work that is being planed and also to pull the planer table out of shape, and either of these conditions is liable to result in the production of inaccurate work. In connection with this discussion of methods used in clamping work on a planer table, particular attention is called to the fact that in all cases the clamps should be located directly above the supporting blocks, when these means are employed for raising the work from the surface of the planer table, as this avoids danger of the pressure of the clamps distorting the form of the work.

In addition to the clamps that are used to overcome any tendency for the work to be lifted vertically from the table, various forms of stops are employed to resist the possibility of the work sliding endwise or sidewise. These stops may

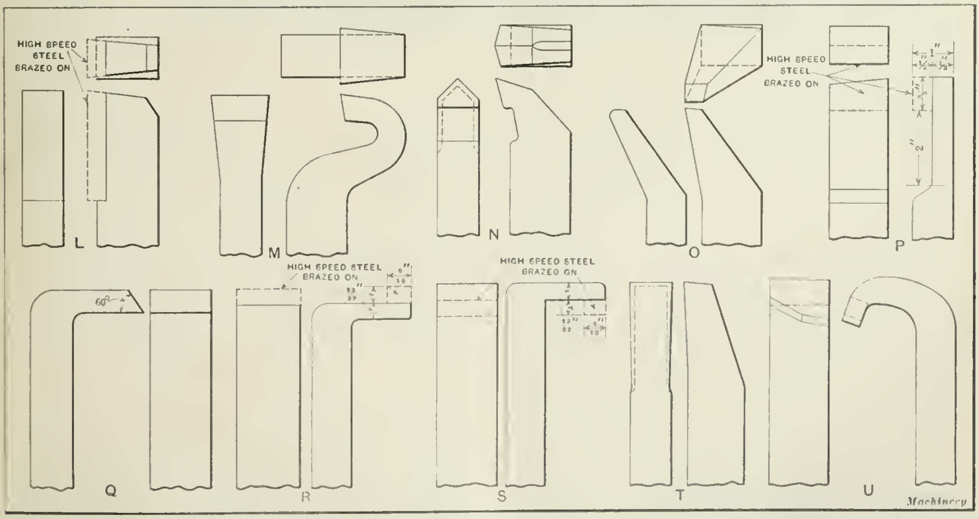

HIGH SPEED STEEL BRAZED ON
L
M
N
O
HIGH SPEED STEEL BRAZED ON
P
1"
2"
60°
Q
HIGH SPEED STEEL BRAZED ON
R
HIGH SPEED STEEL BRAZED ON
S
T
U
Machinery

Fig. 2. (L) Square-nosed Keyseating Tool; (M) Gooseneck Top Finishing Tool; (N) Slot Chamfering Tool; (O) Offset Roughing Tool for Light Work on Vertical Faces, made Right- and Left-hand; (P) Elling Tool for T-slotting, made Right- and Left-hand with Brazed Bits; (Q) Dovetailing Tool for Vertical Surface, made Right- and Left-hand; (R) Elling Tool for T-slotting from below; (S) Elling Tool for T-slotting from above; (T) Widest of Five Top Finishing Tools; (U) Tool for finishing Horizontal Surface from below. On All these Tools, Clearance behind Cutting Edge, 6 Degrees, and Side Clearance, 4 Degrees

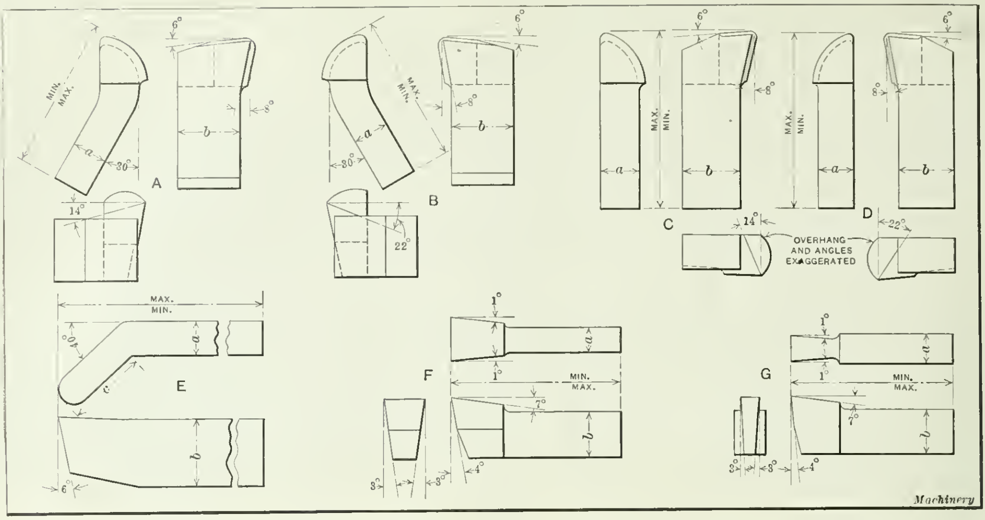


Fig. 3. (A) Blunt Round-nosed Bent Roughing Tool for Cast Iron and Hard Steel, made Right- and Left-hand; (B) Sharp Round-nosed Bent Roughing Tool for Soft Steel, made Right- and Left-hand; (C) Blunt Round-nosed Roughing Tool for Cast Iron and Hard Steel, made Right- and Left-hand; (D) Sharp Round-nosed Roughing Tool for Soft Steel, made Right- and Left-hand; (E) Bent Round-nosed Roughing Tool made Right- and Left-hand; (F) Broad Square-nosed Roughing or Finishing Tool; (G) Narrow Square-nosed Roughing or Finishing Tool. With the Exception of Tool E, all these Tools are made in Six Sizes with a, ½, ⅝, ¾, ⅞, 1, and 1¼ Inches; b equals 2a; Minimum Length for all Tools, 4 Inches; and Maximum Length 11, 12¾, 14½, 16¼, 18, and 21½ Inches. Tool E is made in Two Sizes with a, ¾ and 1 Inch; b, 1½ and 2 Inches; c, 1¾ and 2 Inches; Minimum Length of Both Tools, 4 Inches; and Maximum Length, 14 and 16 Inches

be of various forms, the most familiar type consisting of a small post set in one of the holes drilled in the planer table for that purpose, and provided with a tapped hole through which a screw passes to come into contact with the work. Frequently, a practice is made of using a finger or so-called "butter" between the screw and the work, and some shops arrange these butters with a pointed end so that they may be inclined to exert downward thrust on the work, in addition to preventing it from moving laterally.

Importance of Using an Adequate Number of Stops in Setting up Planer Work

In connection with the foregoing statement concerning the inadvisability of using too many clamps, the reader is cautioned against confusing the terms "clamp" and "stop" as applied to planer work. The use of an adequate number of stops is absolutely essential because, particularly in the performance of rough-planing operations, the tools exert a heavy thrust on the work, owing to the depth of cut that they are taking. This lateral pressure must be resisted, and stops are provided for that purpose. The number of stops required will naturally vary according to the work, but usually there should be at least two stops at each end and two or more stops at each side of a casting to assure holding it in position. Then it will generally be found that one clamp at each end will be sufficient to hold the work down. Despite this fact, it is not unusual to see a large number of clamps used on work where two would be adequate; and for the reasons previously mentioned, the use of such a number of clamps is not only unnecessary

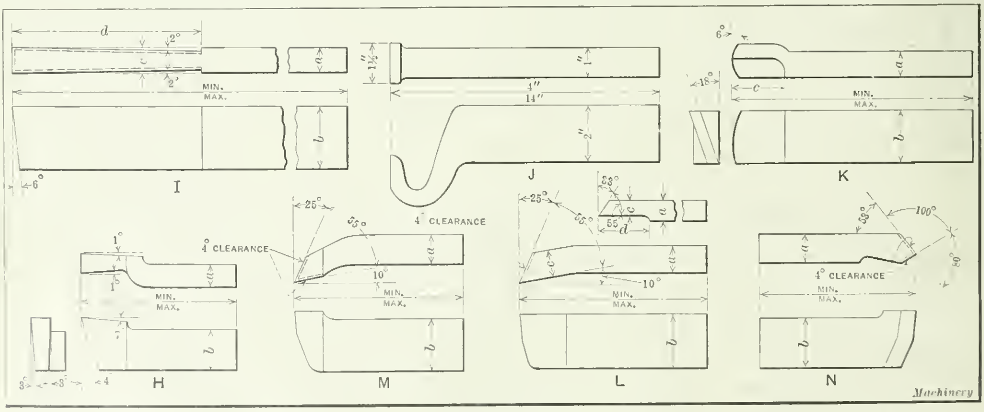


Fig. 4. (H) Offset Narrow Square-nosed Finishing Tool made Right- and Left-hand; (I) Square-nosed Finishing Tool; (J) Wide-nosed Gooseneck Finishing Tool; (K) Shearing Type Finishing Tool for Steel; (L) Dovetail Roughing Tool made Right- and Left-hand; (M) Dovetail Finishing Tool made Right- and Left-hand; (N) Side Finishing Tools made Right- and Left-hand. Tools H, M, and N are made in Six Sizes as stated beneath Fig. 3. Tool I, Two Sizes with c, ¾ Inch; d, 6 and 8 Inches; a, ¾ Inch; b, 2 Inches; Minimum Length, 8 and 12 Inches; and Maximum Length, 18 Inches. Tool J, One Size as per Dimensions. Tool K, Two Sizes with a, ¾ and ⅞ Inch; b, 1½ and 1¾ Inches; c, 1½ Inches; Minimum Length, 4 Inches; and Maximum Length, 11 and 12 Inches. Tool L, Seven Sizes with a, ½, ⅝, ¾, ⅞, 1, 1¼, and 1 Inch; b equals 2a; c, ½, ⅝, ¾, ⅞, 1, 1¼, and ¾ Inch; d, 2⅜ Inches; Minimum Length, 6 Inches; and Maximum Length, 11, 12¾, 14½, 16¼, 18, 21½, and 18 Inches

but distinctly detrimental, especially if the clamps are tightened sufficiently to make it probable that they will either distort the work or the table of the planer on which it is set up. Fig. 5 illustrates two planer tables set up for planing in the plant of the G. A. Gray Co., and the arrangement shown in this illustration constitutes a good example of the judicious use of end stops and clamps.

Advantages Secured by Releasing All Work-holding Clamps before Starting to Finish-plane

In practically all shops where good planing is done, a practice is made of releasing the clamps and resetting the work between the performance of the rough- and finish-planing operations. This is always a desirable practice, and it is absolutely essential in cases where the shape of the work is such that there is a probability of the clamps distorting its form. As previously stated, the tools exert a considerable lateral pressure while taking a heavy roughing cut, and this is likely to cause the casting to move. Hence, the need of reasonably tight clamping. But for taking a light finishing cut, the tool pressure is greatly reduced so that it is unnecessary to have the work clamped as tightly, and it is most desirable to release the clamps and reset them to an extent sufficient for holding the work for the finish-planing operation. Where this precaution is not taken, a piece of work may be planed with a high degree of accuracy while it is still held in place on the table; but as soon as the clamps are released, it will be found that the work springs back to its normal position, and this distortion immediately destroys the accuracy of the planed job, regardless of the degree of precision that had been attained before the clamps were released.

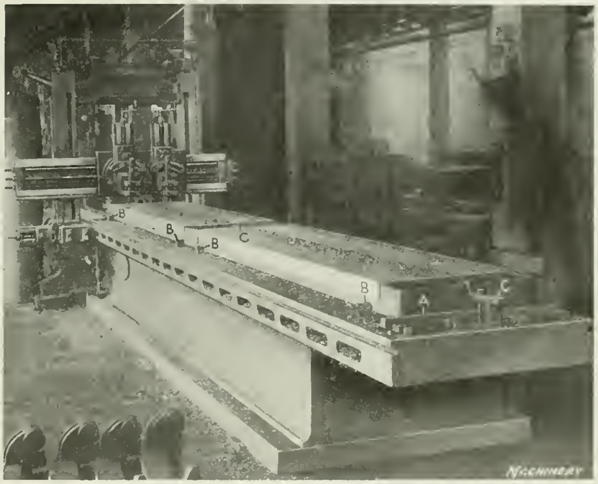


Fig. 5. Planer Set-up showing Judicious Use of Side and End Stops, with Dependence placed upon Weight of Work to assist in holding it down

In addition, it is sometimes found necessary to rearrange the packings placed between the supporting blocks and the under side of the work. This is necessary because the relieving of strains caused by removing the outer scale from the casting or forging is likely to cause slight readjustments in the form of the work, as a result of which all of the supporting blocks will no longer be carrying their due proportion of the load, regardless of the care that was taken in placing them under the work before the roughing cut was taken. It is attention paid to small details of this kind that makes the difference between a good job of planing and one that is of mediocre quality.

Tooling up Planers to Expedite Production

In general, it may be stated that the productive efficiency of planers as they are operated in many plants is not as high as that of other types of machine tools which are more extensively used for the rapid production of duplicate parts. Several factors are responsible for this condition, important among which is the fact that men in charge of the planning of machining operations have frequently had wider experience with the use of other types of machines. However, in addition to the large numbers of planers that are used on other than repetition work, there are sufficient examples of the possibilities of the planer for use in the manufacture of duplicate parts to commend a machine of this type to careful consideration at the time of deciding upon the form of equipment to be used for machining flat surfaces and certain forms of curved surfaces on castings, forgings, etc.

Almost invariably, it is required to take two or more cuts over a planed surface, and there are frequently a number of different surfaces to be planed on a piece of work, each of which requires the taking of more than one cut and the use of different types of tools for the performance of roughing, intermediate, and finishing operations. In order to be sure of obtaining satisfactory rates of production, detailed operation sheets should be furnished with the job tickets issued for each piece of work, explaining in detail the nature of the planing operations to be performed and stating step by step the order in which successive cuts should be taken, and the rates of cutting speed and feed to employ in each case. Where the length of the surfaces to be planed differs considerably or where there are short surfaces to plane at intervals along a piece of work, a point should be made of seeing that the operator resets the reversing dogs on the table so that time is not lost by having the tool "cut air" over a considerable length of table travel.

There is one very simple and apparently self-evident point in connection with the performance of planing operations that is frequently overlooked, and probably this is responsible for the loss of as much time in the planer department as any other one factor. Reference is made to failure of the shop management to provide plenty of blocks, packing, clamping bolts, washers, straps, and stops, etc., in a variety of sizes, so that the planer-hand is able to go to the tool-room and order these parts for a given job in just the same way that he would call for other tools that are essential for the performance of his work. This advice does not apply as definitely in the case of machines that are operated continuously on repetition work, because in such cases it is natural that the necessary clamping bolts and straps will remain at the machine, if it is not feasible to provide more elaborate work-holding fixtures that will assist the planer-hand in setting up his work. But in the case of shops which are using their planers on production work, although it is of a character that does not require to be handled in large quantities, the actual amount of time expended by a high-priced planer-hand in looking around the shop for the necessary means to clamp his work on the machine would be entirely disproportionate to the time actually spent in setting up and doing the job.

Economies Effected by Increasing the Number of Pieces of Work Set up on the Planer

Wherever such a method of procedure is feasible, experience has shown that important savings are effected through making provision for setting up a number of pieces of work on a machine at one time. This statement applies to work handled on milling machines, lathes, shapers, gear-cutting machines, etc., and it is particularly true in the case of those jobs which are handled on planers. Naturally, the method of applying this principle of setting up more than one piece of work on a planer table will vary according to the shape and size of the pieces to be planed, but in a great majority of cases the procedure is to place a string of castings or forgings along the table of the machine, so that it carries them successively under the cutting tool.

Substantial saving of time is accomplished in this way for the following reasons: First, it is impossible to prevent a loss of time at each reversal of the direction of travel of the planer table, and two such reversals must occur for each working stroke. The time lost in this way is as great for a short as for a long stroke; so it will be evident that if a long string of castings is set up on the table, so that the parts may be planed progressively, the time lost by reversing the direction of table travel is distributed over this number of parts, instead of all being charged against a single piece of work. Consequently, this item of loss is reduced as the number of pieces mounted on the table is increased.

TABLE 1. PLANING SPEEDS AND FEEDS FOR ROUGHING CUTS IN VARIOUS MATERIALS

Material	Cutting Speed, Feet per Minute	Feed, Inches per Stroke	Depth of Cut, Inches*
Cast iron	37–48	3/16	7/16
Cast steel	28–48	5/32	¼
Machine steel	28–48	5/32	¼

Machinery

*Note: Leave 1/32 inch of metal for removal by subsequent cuts. When so set, the tools tend to dig in and actually leave about 0.026 inch of surplus stock.

Second, multiple set-ups save time in setting the cutting tools, because it is necessary to change the tools a number of times for practically every piece of work, and as the same setting will provide for planing all of the pieces strung along the table, it will be evident that this item of loss is also reduced as the number of pieces that can be planed simultaneously increases. Third, in planing, it is necessary to so set the dogs that there is a certain amount of over-travel of the table in each direction. If only one piece of work is set up at a time, the same amount of over-travel is necessary that must be provided where a string of castings is set up for simultaneous planing. Hence, the multiple set-up also divides the time lost in over-travel by the number of pieces that are planed at a time, thus making the economy resulting from this method directly proportional to the number of pieces held on the planer table.

Limiting Factor in Applying Principle of Multiple Set-ups

As a general proposition, this principle of increasing the number of pieces of work set up on a machine at one time can profitably be applied until a point is reached where the number becomes so great that it is impossible for cutting tools used to perform one class of operation to complete their service without requiring regrinding. Then, the time lost in removing and replacing tools more than offsets the advantage resulting from the multiple set-up. Also, where special work-holding fixtures, clamps, etc., are required to hold the work, it would not be a profitable plan to provide a large number of such devices for holding a string of pieces on the planer table, unless the number of pieces of work to be handled were great enough so that the cost of such work-holding fixtures could be distributed over a sufficiently large number of pieces of work to reduce it within the limits of a reasonable item of expense.

TABLE 2. PLANING SPEEDS AND FEEDS FOR STRAIGHTENING CUTS IN VARIOUS MATERIALS

Material	Cutting Speed, Feet per Minute	Feed, Inches per Stroke	Depth of Cut, Inches
Cast iron	45	3/16 to ¼	0.018
Cast steel	45	⅛	0.018 to 0.021
Machine steel	45	⅛	0.018 to 0.021

Machinery

TABLE 3. PLANING SPEEDS AND FEEDS FOR FINISHING CUTS IN VARIOUS MATERIALS

Material	Cutting Speed, Feet per Minute	Feed, Inches per Stroke	Depth of Cut, Inches
Cast iron	28–35	¼ to 1½	0.003 and 0.001*
Cast steel	45	1/32	0.004
Machine steel	45	1/32	0.004

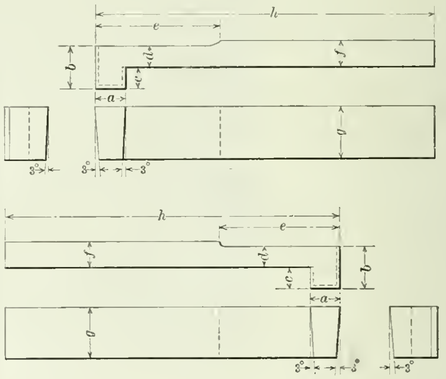
Machinery

*Note: For finishing cuts on cast iron, it is good practice to divide the work up into two operations, taking off 0.003 inch with the first cut and 0.001 inch with the second cut. This prevents a tendency for the tool to dig in at the high spots.

Importance of Accurate and Solid Planer Foundations

Remarks which have been made concerning the flexure of large pieces of work, and in regard to the necessity of adequately supporting such pieces to prevent distortion, apply with equal force to the necessity of firmly and accurately supporting the bed of a planer in order that it may hold the table in correct alignment. This advice is of particular importance in the case of large planers, as any inaccuracy of the foundation will result in settling of the bed and consequent flexure of the table as it runs back and forth over bearings which are not in precise alignment. Evidently, it would be impossible to firmly support work on a table which is constantly changing form as it recip-

TABLE 4. DIMENSIONS OF ELLING TOOLS FOR PLANING T-SLOTS



a	b	c	d	e	f	g	h
5/16	½	¼	¼	1	½	1¼	14
11/32	11/16	7/16	¼	1	½	1¼	14
7/16	21/32	13/32	¼	1⅜	½	1¼	14
½	¾	7/16	5/16	1½	½	1¼	14
17/32	23/32	13/32	5/16	1⅝	½	1¼	14
9/16	25/32	15/32	5/16	1¾	½	1¼	14
11/16	⅞	9/16	5/16	2⅛	½	1¼	14
13/16	1	⅝	⅜	2½	⅝	1¼	16
15/16	1⅛	⅝	½	2¾	⅝	1¼	16
13/16	1 3/16	¾	7/16	3	⅝	1¼	16
1	1 3/16	⅝	9/16	3	⅝	1¼	14
17/32	2⅜	1⅜	1	0	1	2	12
⅝	3	2	1	0	1	2	14
¾	2½	1½	1	0	1	2	12
1⅛	1½	⅝	⅞	3½	1	1½	14
⅝	3½	2½	1	...	1	2	12

Machinery

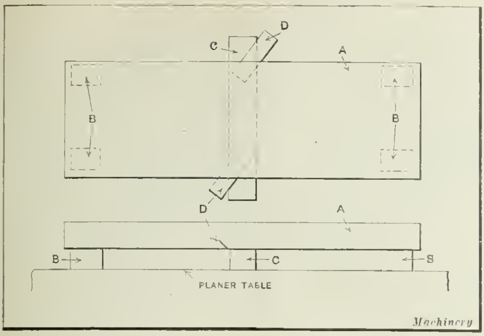


Fig. 6. Diagram illustrating a Convenient and Reliable Method of testing Accuracy of a Planer Foundation

rocates back and forth on the planer bed, and it has already been explained that without a solid foundation for the work, accurate results cannot be obtained in the performance of planing operations.

A few years ago, it was the practice to level up the bed of a new planer on the machine shop floor and then to set the bed in concrete, the idea being that this procedure would be the means of effecting a permanently accurate foundation. Subsequent experience has shown that this is not the case, and today all progressive shops make a practice of setting their planers on adjustable blocks so that the accuracy of the bed may be tested from time to time, and the foundation adjusted, as found necessary, in order to maintain it in true alignment. For holding large machines, several well-known planer builders manufacture special foundation plates, which afford means of easily compensating for any settling of the planer that occurs as a result of service.

In the case of small planers, it has been found to be entirely adequate to use two hard wood shingles under each leg. These shingles are placed with their tapers running in opposite directions, and when either leg of the planer has to be raised, this is easily done by tapping the thick ends of the shingles so that they are driven in opposite directions under the leg, the taper of the shingles causing the leg of the planer to be raised. Accurate adjustments may be effected in this way.

Test for Accuracy of a Planer Foundation

Fig. 6 shows in diagrammatic form a simple method of determining whether a planer bed is level. This is done by placing a piece of work *A* on four blocks *B* on the table of a planer whose foundation is to be tested. Midway between blocks *B* there is placed a parallel bar *C* of the same height, so that tissue-paper feelers *D* may be inserted between this bar and the finished under side of the work The test is conducted by slowly moving the planer table along the bed and ascertaining whether feelers *D* are held with an equal degree of tightness at all points.

Evidently, if the foundation of the planer is inaccurate and the table tends to sag at various points as it reciprocates on the bed, such a condition will be revealed by the fact that feelers *D* can be pulled out when the portion of the table under parallel bar *C* has dropped even to a very slight extent. In conducting this test, work *A* should be of considerable length, in order to create a condition where the table is able to sag sufficiently over the distance between blocks *B*, so that any inaccuracy in the foundation is readily detected. Such an error is overcome by raising the foundation blocks beneath the planer bed at those points where it is found to be low. Planers maintained in this way should continue to give accurate results for a far greater length of time than those which are not subjected to a careful survey at regular intervals.

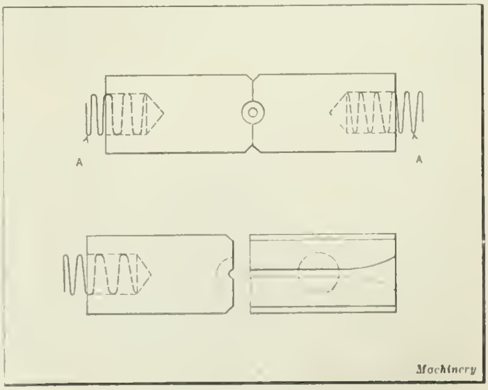
DIES FOR SWAGING SMALL WIRE

When pointing small wire in reducing or swaging machines, where the adjustment of the dies is not particularly close, or in some cases even with a close adjustment, the wire has a tendency, after the dies have passed the point of contact with the rolls and hammers, to jump out of the die groove and momentarily ride over the edge of the die. This roughens the end of the wire, causing chips to fly into the dies and from the dies into the roll cage. The amount of stock spoiled in this way and the labor wasted soon represent a considerable loss, especially if the wire is gold, gold-plated, or silver-plated.

The method of preventing this loss described in the following is simple and can be easily applied. It consists of placing small wire springs in the dies in such a position that the latter will be held in contact with the work at all times, thus preventing the work from riding up on the faces of the dies. It has proved especially useful in pointing very small wires and pin points.

The accompanying illustration shows two sets of dies equipped with springs as described. A hole is drilled in the bottom of each die, and an open-wound coil spring inserted in each hole and just caught in place with a little soft solder at the bottom of the hole to prevent it from falling out. The springs are shown at *A*, the holes in which they are placed in this particular case being 5/16 inch in diameter, and about 3/8 inch deep. These springs project beyond the bottoms of the dies from 1/8 to 1/4 inch. When these dies are inserted in the machine the springs being compressed force the dies together. This is a distinct advantage and will give excellent results on small tubing which is very likely to split or splinter unless handled by a highly skilled operator. With dies equipped as shown, unskilled labor can operate the machine at the maximum speed with a minimum of spoiled work.

Take for instance, a machine that is in first-class condition when starting operations on a large order of tubular parts which are required to be pointed; after the machine has run for a while the hammers or the backers become worn, the rolls wear down, and the adjusting stud that fits into the hammers or backers also wears a little, with the result that the dies open a little more as they spin around. Under these conditions, the tubing will begin to ride up on the edge of the die, and the splinters caused by this action will rough up the dies so that they will have to be fixed and the machine readjusted to obtain good results. With springs inserted in the manner described, the dies will have a longer life, and considerable time will be saved that would otherwise be required in making adjustments. T. E. W.



Dies equipped with Springs to prevent Work from riding up on Face of Dies

EFFICIENCY IN FOUNDRY CLEANING ROOMS

Overhead and labor charges are the two important cost items in the cleaning room of a cast-iron foundry, because the carbide of silicon wheels used for snagging the castings have a comparatively long life, and therefore the wheel cost per part produced is small compared to the labor and overhead charges for the part. A number of helpful suggestions for securing efficiency in cleaning rooms and the reduction of labor and overhead costs were given in an article by L. M. Krull, appearing in *Grits and Grinds.*

The amount of grinding to be done on a casting is in proportion to the excess metal left after the gates and fins have been knocked off, and so poor methods of making gates in molds result in excessive grinding. Where it is feasible, the gates should be molded instead of hand-cut and, in any case, they should be tapered so as to cause them to break off close to the point where they join the casting. It will be found that broad thin gates break more easily than thicker and narrower ones. Tumbling is the cheapest method of removing the sand from the general run of castings and, many fins and gates are knocked off in this operation.

Method of Handling the Work

An important point to observe is the method of handling the casting, the object being to keep the wheels of the grinding stand in contact with the castings as continuously as possible. The time spent in getting a casting to the grinding wheel and properly disposing of it after the operation should be kept at a minimum. This can be brought about by a good arrangement of the machines in the department, and an efficient system of trucking. The castings should be arranged in three groups—heavy, medium, and light. Large, heavy castings should be ground by means of swinging-frame or portable machines placed within easy reach of a crane. Castings from about 1½ to 60 pounds in weight should be snagged on floor stands, but castings smaller than 1½ pounds can be more economically handled on bench stands.

The feeding of the castings to the grinding machines and the removal of the finished pieces without interruption are first points to be taken into consideration, so that the work can be kept going continuously. To effect this, the small and medium sized castings should be placed within easy reach of the operator so that he can quickly grasp them with one hand and deposit them in a receptacle with the other, without requiring much movement of his body. Bench stands can be arranged along a wall upon solid benches, a bin being provided at the side of each wheel into which rough work can be readily shoveled. The operator can deposit the finished pieces into small kegs or boxes on the floor for removal by the truckman. The best arrangement for floor stands is in a line at a sufficient distance from a wall or from other machines, to permit boxes of castings to be fed to the machines from one side and taken away from the other.

Machines Should be Free from Vibration

The greatest success is obtained with any machine by having it run without vibration. When such is not the case, the wheel wears away because of the continual hammering, tending to make the wheel out of round. The operator then trues the wheel to remedy this condition, thereby wasting wheel material. Finally, depreciation and repair items become alarmingly great. Vibration can be greatly reduced by the use of heavy machines bolted securely to a concrete floor. Such an installation will absorb the slightly out-of-balance condition that any grinding wheel may inherently have or acquire when worn out of round.

Facts to be Considered in Selecting Grinding Wheels

The wheel used for an operation should be of such a bond strength that the grains will tear out of their setting when they become dull, and of such a grain size that the penetration is at a maximum unless a certain finish is required. Such a wheel would require little dressing for the purpose of sharpening the wheel face. The great factors that affect wheel selection are: The type and condition of the machine; the material from which the castings are made, and their size and shape; the speed of the wheel; and the personal factor.

Large castings generally require a coarser and harder wheel than small castings. This is because of the different pressures exerted by the operator, and because the inertia is greater. In general, the greater the mass of the casting in comparison to the mass of the wheel, the harder the wheel must be, other things being equal. Coarse grinding wheels remove metal most rapidly when the castings are soft, and, on the other hand, finer grained wheels are best for hard castings or castings having a hard skin. Another fact to be considered is the shape of the casting; thus, for example, on stove plates where the operation consists of removing sharp fins and flashes, and where the wheel edge is constantly used for cleaning corners, a finer, harder wheel must be used because of the dressing action and the small area contact of the work on the wheel.

By personal factor, is meant the operator's method of working. It is noticeable that men under a piece-rate system, use a grinding wheel more severely than those being paid by the day, and under such conditions of increased pressure and roughness, a harder wheel must be employed. For efficient running, a wheel should never run much less than 5000, nor more than 6000 surface feet per minute. Because of the importance of maintaining proper wheel speeds, many foundries have adopted a method of obtaining the correct speeds when the stands are not equipped with variable-speed motors or cone pulleys. This method is to use the same wheel successively on two or three different machines, each machine operating at a higher speed than the preceding one. For example, when a wheel 20 inches in diameter has been worn down to 16 inches in diameter when mounted on a machine on which the wheel-spindle operates at the rate of about 1125 revolutions per minute, it is taken off and mounted on another machine on which the spindle rotates at the rate of about 1450 revolutions per minute.

Piece- or Day-rate Pay for Operators

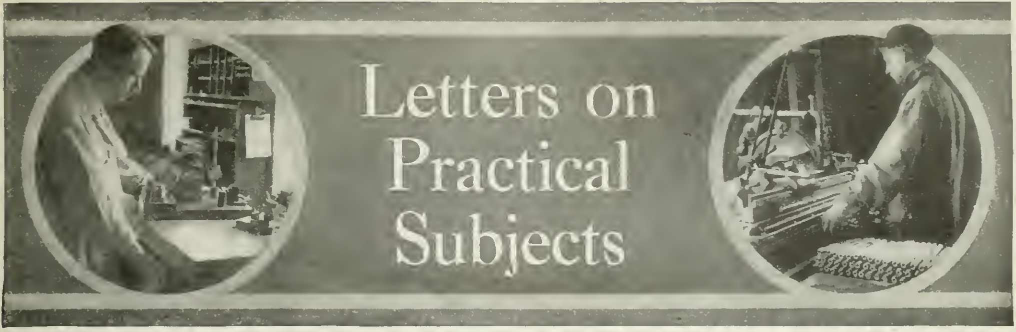
The operators in many cleaning rooms are still paid by the hour, but whenever a piece-rate system can be installed, it is advisable to do so, because the increased production is almost always remarkable. Even if only a production increase is the result, and the piece-rate is the same as figured from old performances at the day rate, there will be a large decrease in the overhead expense. If a record is kept by the foreman as to the performance of wheels and operators, it is easy to distinguish instantly the good and poor workman and to tell the average life and productiveness of various kinds of wheels. A record of this kind also enables the determination of the feasibility of instituting a piece-rate system and a fair idea of the rates which might be set under such a system.

* * *

PRESERVING JAMES WATT'S WORK-SHOP

The death of George Tangye, the founder of Tangyes, Ltd., has raised the question as to the permanent preservation of James Watt's work-shop. Mr. Tangye resided at Heathfield Hall, about three miles from Birmingham, England, for many years the residence of James Watt. The inventor of the steam engine had a work-shop in an upper story, where he was accustomed to spend a great deal of his time, and which was preserved by Mr. Tangye exactly as it was when Watt died, with the various tools lying just as he left them. This garret work-shop has been untouched for over 100 years, and it is proposed by the Watt Centenary Committee to take such steps as will preserve it for the nation.

Letters on Practical Subjects



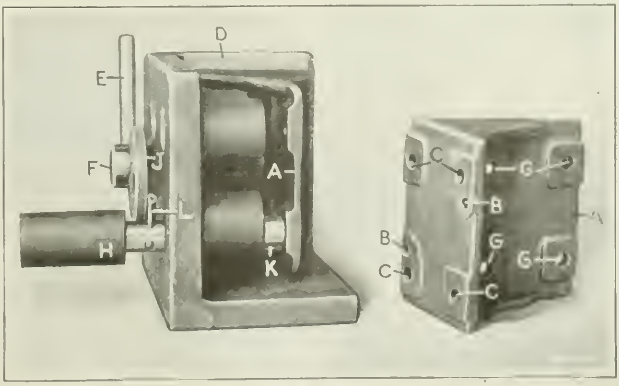
INSPECTION GAGE FOR GENERATOR BRACKET

The inspection gage shown at the left in the accompanying illustration is employed in the inspection of generator brackets used on a Paige automobile motor. One of the brackets *A* is shown at the right, while another bracket is shown in the gage in the position that it occupies during the gaging operation. The bracket is located by two dowel-pins which extend through plate *D* into holes *B*. Four pins also projecting from plate *D* check the location of holes *C*. Plate *D* is, of course, attached to the cast-iron body of the gage, and forms a flat surface on which the machined surfaces around holes *C* can rest. Thus it will be seen that plate *D* with its locating dowel-pins and checking pins corresponds with that part of the motor unit to which one side of the bracket is attached.

After placing bracket *A* in the gage in the position shown, handle *E* is swung over to one side. The movement of this handle rotates pin *F*, which extends through the gage casting. At the inner end of pin *F* is a cam which clamps the bracket to plate *D*, when handle *E* is swung over. The machined surfaces of the pads through which holes *G* are drilled are checked for their relation to dowel-pin holes *B*, by the flush-pin gage *H*, which also checks the spacing of these holes. One of the notable features of the gage is the positive action of the flush-pin. This pin carries a projecting pin *L* that passes under the mushroom shaped piece *J*. On the under side of piece *J* are two circular stepped faces, the outer step or face being 0.003 inch above the inner one, this being the tolerance allowed on the dimensions between the centers of dowel-pins *B* and the surfaces of the machined pads of holes *G*.

In using the gage, the piece is clamped over the two dowel-pins as previously mentioned, and flush-pin gage *H* inserted successively in each of the four holes in the gage. When the shoulder at the end of the pin comes in contact with the face of the pad as at *K*, the pin is turned, and if pin *L* passes partly under piece *J*, the work is within the 0.003 inch limit of accuracy. If the pin does not pass under, the distance is too small, and if it passes entirely under, the distance is too great. This type of gage leaves nothing to the judgment of the operator, and can be employed in many cases where it is desirable to maintain close limits of accuracy on work of the type here illustrated.

Detroit, Mich. J. Lannen



Inspection Gage for Generator Bracket

MAKING FORMED TOOL FOR RELIEVING WORM-GEAR HOBS

The following simple method of making a formed tool for relieving a worm-gear hob was found to give satisfactory results. The thread of the hob in an axial plane was required to be straight-sided, with the sides at an included angle of 29 degrees. The dimensions of the hob were lead, 0.750 inch; pitch, 0.750 inch; outside diameter, 3.575 inches; pitch diameter, 3.022 inches; root diameter, 2.545 inches; and helix angle of thread, 4 degrees 31 minutes.

A disk of oil-hardening steel about 3¼ inches in diameter by 1 inch thick was turned up, and a 1-inch hole was bored in the center. The edge of this disk was next turned to approximately the shape of the thread, a shoulder being left at each side of the thread profile. A tool with a rounded point was used in this operation, which left the corners of the shoulders rounded to approximately the required radius so that only a light cut would be required in the succeeding operation. The difference between the outside diameter of the disk, and the shoulder diameter was made to equal twice the depth of the thread. The disk was next taken to a Cochrane-Bly No. 14 universal shaper. The milling spindle of this machine was swung to an angle of 4 degrees 31 minutes from the horizontal position. A 1-inch expanding arbor was then inserted in the spindle and the turned disk secured to it.

The circular table was placed on the table of the machine, and the compound circular table was placed on top of the circular table, with the transverse slide of the latter located at right angles to the line of travel of the machine table, and with the circular table at zero. A turning tool was next clamped to the top of the compound circular table, the height of the cutting edge being adjusted so that it would be at the same height as the center of the disk. The cutting end of this tool was ground to a radius equal to the radius required at the corners or points of the thread-forming tool to be produced.

The circular table was then turned to the right and set at an angle of 14 degrees 30 minutes. With the table set in this position the left-hand side of the disk was turned to the required form, using the transverse slide of the compound circular table. The circular table was then turned to the left and set at an angle of 14 degrees 30 minutes with the zero mark, and a tool similar to the one first used but of the opposite hand was employed to turn the right-hand side of the disk to give the correct tooth thickness at the pitch line, the thickness in this case being equal to 0.375 × cos 4 degrees 31 minutes = 0.3738.

A Brown & Sharpe vernier tooth caliper was employed to determine the thickness at the pitch line or at a depth of 0.2387 inch. The corners of the tooth form at the outer diameter of the disk were next formed to the required radius. A 90-degree section of this disk was then cut away so as to form a cutting edge. The disk was then hardened and the cutting face ground along a radial line, after which it was placed on an arbor in a milling machine with the cutting face at an angle of 5 degrees from a vertical plane. A master form tool which had been roughed out was then held at a similar angle and the form shaved or planed to size by the disk cutter. The master form tool was then hardened and placed in a special fixture on the tool-head of a shaper at an angle of 5 degrees. The tool for relieving the hob was also set at the same angle on the shaper platen and planed to size by the master form tool. The tool for relieving the hob was then set in the relieving attachment of a lathe at the correct helix angle of the hob thread, in which position it was satisfactorily used to relieve the hob.

Lithgow, New South Wales, Australia JACK FINLAY

RELEASING THE LOCKED DIES OF A HEAVY POWER PRESS

A heavy power press of the type indicated in Fig. 1 had been set up for a forming operation on "motor scooter" wheels and was being tried out, when the press suddenly became locked, due to the placing of a blank of excessive thickness between the dies. The dies for the press had been made by an outside firm which had charge of the setting-up operation.

The press had a heavy flywheel *A*, which weighed about 1500 pounds. The energy of this wheel, running at 60 revolutions per minute, was transmitted through a pinion *B* and spur gear *C* having a ratio of 30 to 1. The machine was driven by an 8-inch belt running from a lineshaft to the tight and loose pulleys at *D*. The slide to which the upper die was attached consisted of two members *E* and *F*, as shown in Fig. 2, the inner member *F* being adjustable for different sized work by means of thickness plates *G*. This slide was operated through spur gear *C*, shaft *H*, and crank *I*, Fig. 1, the full pressure of the press passing through toggle *L*, and the bronze bearing block *M*, Fig. 2.

For this forming operation, the adjustment of the dies was required to be held to an accuracy of 0.001 inch, but it was almost an impossibility to obtain such a fine adjustment by the use of plates *G*. It was necessary that the forming operation be performed just as crank *H* of the press passed over the dead center, because the construction of the dies was such that no give or depression was permitted as the dies came together on the downward stroke. About six blanks had been formed and the press seemed to be working satisfactorily, when by some mistake a blank about 0.015 inch too thick was put into the press, thus preventing the crank from passing over the center and wedging the dies and work together. The force with which the dies became locked on the blank can be realized when the energy developed by the 1500-pound flywheel revolving at 60 revolutions per minute and transmitting its energy through gearing having a 30 to 1 ratio is taken into consideration.

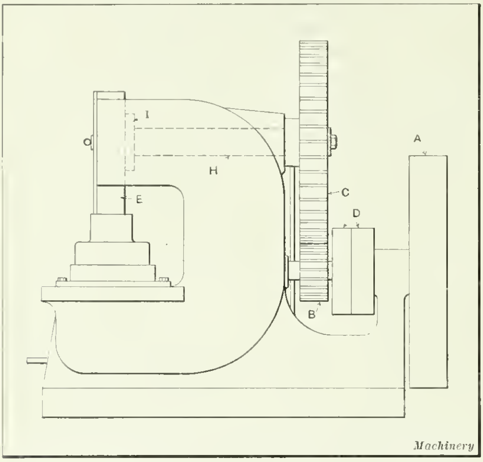


Fig. 1. Power Press which became Locked because of Insertion of too Thick a Blank

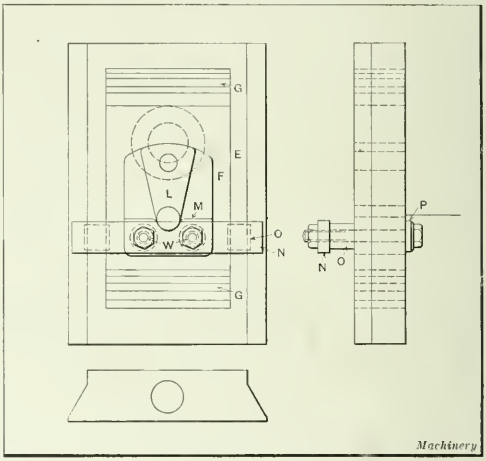


Fig. 2. Diagram illustrating Method employed to release Dies that became locked

The first attempt to release the press consisted of wrapping a heavy chain about the spokes of gear *C* and passing through this chain a 2½-inch steel bar 10 feet long in such a way that it could be employed as a lever. On this bar ten men exerted their strength in an endeavor to release the press but with no avail, as the bar simply bent. After this and several other methods had failed and the press had been idle for over a week, the writer worked out a plan for releasing the dies, which proved effective after about five hours had been expended in carrying out the work. Two 1¼-inch holes were first drilled through the bronze block *M* by the use of a ratchet drill. This permitted two bolts *W* to be passed through block *M* as indicated in Fig. 2. A steel plate *N* was next drilled and placed across the front of the slides. Two packing blocks *O* were put behind plate *N* and clamped in place by the two 1¼-inch bolts *W* which were provided with washers *P* under their heads. The nuts were then screwed down simultaneously by the use of two long-arm wrenches. After about ten complete turns, block *M* gradually began to slide out of part *F*.

The block was next soaked with gasoline, and after having renewed the bolts three times, the block was drawn out until its inner edge was within 1/32 inch of clearing the slide. In this position the block was still held as tight as ever between the lower adjusting plates *G* and link *L*. It might be mentioned here that the width of the block was 4½ inches. When the block was nearly out, the matter of concern was whether the block would fly out or what would happen when the operation of drawing it out was continued. However, when the block was drawn to a position in which it lacked only a few thousandths inch of clearing the slide, it simply dropped out with a thud, and with the remainder of the loose pieces fell on a staging that had been erected for the purpose of catching them when the dropped out.

In order to determine the amount of deflection caused by locking the press, the writer had measurements taken before and after the piece was released from the press, and the deflection was found to be over 1/16 inch. The brass or bronze bearing block was removed as described without causing any mutilation that would prevent it from being put back in service. This method, therefore, not only proved effective in releasing the press, but also resulted in saving the cost of a new block which would have been required had other methods been employed. It may be mentioned here that the first holes drilled through block *M* were threaded for 1-inch studs, but when the first strain was placed upon the studs, they pulled through, thus necessitating the drilling of the 1¼-inch holes.

Cleveland, Ohio — C. F. George

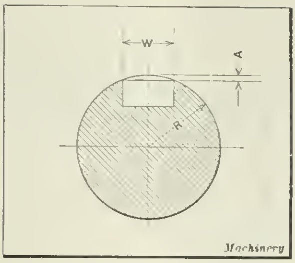


Diagram used in finding Height of Arc

DETERMINING HEIGHT OF ARC WHEN MILLING KEYWAYS

When milling keyways or designing cutter-bars for broaching keyways, it is necessary to determine the height of an arc having a radius equal to one-half the diameter of the shaft or hole in which the keyway is to be cut, and a length of chord equal to the width of the keyway. This required dimension can be easily obtained by the following method, which is similar to one described in the December number of MACHINERY on page 377. The formula here given, however, only requires the use of a table of trigonometric functions containing sines and cosines, whereas the formula given in the December number requires the use of the cosecant and the versed sine functions, which are not always given in tables employed in the shop.

Referring to the accompanying illustration, the width of the keyway is designated as *W*, the radius of the shaft or hole as *R*, and the required height of the arc as *A*. Let θ represent an angle, the sine of which equals

$$\frac{W}{2R}$$

Then

$$A = R - R \cos \theta$$

To find *A*, locate sine θ in a table of natural trigonometric functions, and on the same line find cosine θ. Multiplying cosine θ by *R* and subtracting this product from *R* gives height *A*.

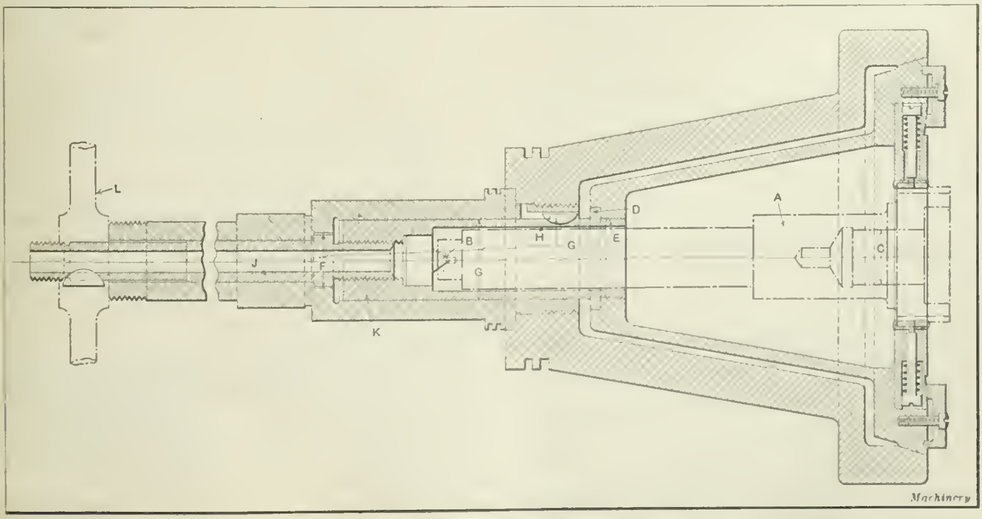
Detroit, Mich. — Palmer Hutchinson

GRINDER CHUCK FOR HOLDING CLUTCH GEAR SHAFT

The accompanying illustration shows how the standard chuck of a small-size Bryant internal grinder was redesigned to hold the clutch gear shaft *A*. The gear-shaft is 12¾ inches long, and the hole at *C* must be ground concentric with the pitch circle of the gear teeth, and parallel with the center line of the shaft. From the illustration it will be seen that the shaft is located and supported at one end by a center *B*, while the other end on which the gear teeth are cut is held by the Bryant standard pitch-line control jaws, which make contact with the gear teeth at the pitch circle.

In redesigning the standard chuck to accommodate the work, it was necessary to enlarge the counterbore at *D* and the threaded hole at *E*. The diameters *F* and *G* of the hole in the spindle were also increased, and a key *H* provided as shown. A new draw-bar *J* and a special draw-bar head *K*, fitted with a center *B*, were also required. In order to grind hole *C*, the work *A* is inserted in the chuck and forced back until the small end is located in position by center *B*. The work is held in this position by the wheel-spindle arm until the operator tightens the handwheel *L* at the end of the draw-bar, which causes the pitch-line control jaws to grip the work, thus holding it firmly in place.

Pittsburg, Pa. — William Owen



Grinder Chuck which was redesigned to hold Clutch Gear Shaft

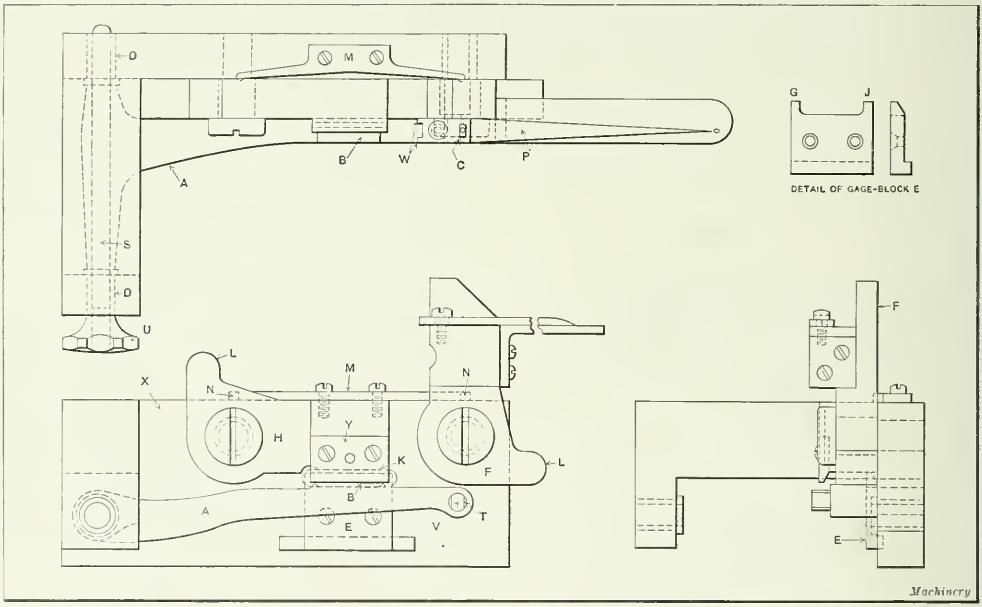
GAGE FOR TESTING ACCURACY OF MILLED SURFACE

The small machine part shown at *A* in the accompanying illustration was required to be milled on surface *B*. It was necessary for this surface to be parallel with the shaft hole *S*, and in a specified relation to this hole and the small hole at *T*. The gage in which the piece is mounted was made for the purpose of rapidly checking the accuracy of the milled surface. The gage consists primarily of a piece of machine steel *X* forged to shape and machined all over; two hardened and ground steel bushings *D*; a locating pin *U*; a stationary locating plug *V*; and two swinging gage-blocks *F* and *H*.

When swung into position for gaging, the outer end of block *F* rests on point *G* of block *E*. When swung into a similar gaging position, the outer end of block *H* rests on point *J*. Hinged block *F* is provided with a pointer *P* which indicates the degree of parallelism between the surface milled and the main shaft hole *S*. Block *H* is provided with a straightedge which shows whether or not the surface has been finished to meet the requirements as regards its position relative to holes *S* and *T*. A slot is cut through the main forging to admit light so that the inspector can observe the condition of the finished surface and more readily compare it with the straightedge. The swinging blocks, as will be noticed, are hinged or pivoted on large bearings made in the form of shouldered studs fitted snugly in the reamed holes of the blocks.

The knobs *L* on swinging blocks *F* and *H* serve as handles by which the blocks can be easily thrown in or out of the gaging position. The spring *M* is provided with knobs at each end which drop into notches *N* in blocks *F* and *H* for the purpose of holding the blocks upright when they are not in use. It will be noted that indicator *P* is provided with a slot at *C*, and that a pin in this slot limits the movement of the indicating point. When block *F* is swung over, the two contact points *W* at the lower end of the indicator arm come in contact with the finished surface of the work, and cause the indicating point to deviate from the zero mark if the machined surface is not parallel with the axis of hole *S*. When block *H* is swung into a gaging position, the lower edge of block *Y* coming almost in contact with the surface of the work, permits the inspector to determine if the height and straightness of the milled surface is within the required limits of accuracy by noting the amount of light that is visible between the milled surface of the work and the block *Y* of the gage.

Devon, Conn. CHARLES W. OVIATT



Gage for testing Accuracy of Milling Operation

CYLINDER BORING FIXTURE

The cylinder-boring fixture described in the following was designed by the writer for use on a Colburn drilling machine. Before performing the boring operations, the cylinder castings are ground on both ends and drilled for attaching to the crankcase. This permits the castings to be accurately located by pins set into the rotary indexing table of the fixture, which holds four single- or two twin-cylinder castings. The fixture is attached to the bed of the drilling machine in such a manner that the cylinder castings can be successively indexed into position for performing the boring operations.

The first roughing tool is not changed until the fourth cylinder is bored. After replacing the first roughing tool and performing the second rough-boring operation on the four cylinders, the finish-boring tool is placed in the spindle and the finish-boring operations performed. As soon as one cylinder casting is completed, it is removed and replaced with a rough casting, so that the machine can be kept at work continuously.

One advantage resulting from the use of this fixture is that the cylinder castings have a chance to cool between the roughing and finishing operations, as three castings must be bored before the first one has been indexed to the starting point for the next operation. The tools are held in a quick-change chuck. The spindle is provided with a sliding steadyrest which is attached to the column of the machine.

Toronto, Canada J. J. LINTON

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

TOOLMAKER'S PROBLEM

L. M. S.—Referring to the accompanying illustration, please show how to find the distance x between the 3/16-inch plugs.

ANSWERED BY GEORGE WARMINGTON, BEVERLY, MASS.

The dimension x can be found in the following manner: In triangle OKL,

$$OK = \sqrt{1.875^2 - 0.750^2} = 1.7185 \text{ inches}$$

In triangle CKL,

$$CK = LK \times \cot 25 \text{ degrees} = 0.750 \times 2.1445 = 1.6084 \text{ inches}$$

$$OC = OK - CK = 1.7185 - 1.6084 = 0.1101 \text{ inch}$$

Draw line OB parallel to CF, making angle COD equal 25 degrees.

Now,

$$FB = CD = OC \times \sin 25 \text{ degrees} = 0.1101 \times 0.42262 = 0.0465 \text{ inch}$$

and

$$EB = EF + FB = 0.0937 + 0.0465 = 0.1402 \text{ inch}$$

Also,

$$OE = 1.875 - 0.0937 = 1.7813 \text{ inches}$$

Therefore,

$$\text{Sin } EOB = \frac{EB}{OE} = \frac{0.1402}{1.7813} = 0.07871$$

Hence angle EOB = 4 degrees 30 minutes 50 seconds or approximately 4 degrees 31 minutes

Now in triangle HOE, angle $HOE = COD - EOB$ = 25 degrees — 4 degrees 31 minutes = 20 degrees 29 minutes

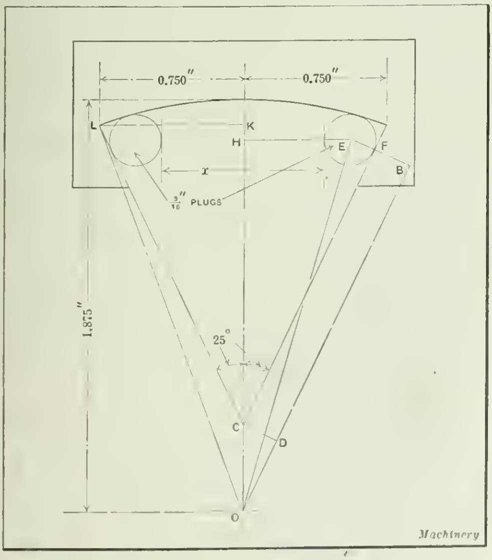


Diagram used in solving Toolmaker's Problem

and $HE = OE \times \sin 20$ degrees 29 minutes $= 1.7813 \times 0.34993 = 0.6233$ inch

Therefore,

$$\frac{x}{2} = HE - 0.0937 = 0.6233 - 0.0937 = 0.5296 \text{ inch}$$

and

$$x = 2\ (HE - 0.0937) = 2 \times 0.5296 = 1.0592 \text{ inches}$$

MATHEMATICAL PROBLEM INVOLVING HORNER'S METHOD

W. A. M.—The accompanying diagram shows a triangle ABC superimposed on the triangle AFC. The angle α is common to both triangles. If the sum of sides c and x is 15 inches, the length of side a 4.5 inches, and the length of side h 5 inches, how can the length of sides x and y be determined?

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—Let $c + x = s$. From the triangle ABC,

$$a^2 = x^2 + c^2 - 2xc \cos \alpha$$

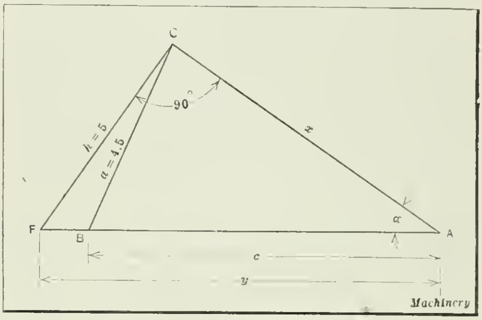


Diagram used in the Solution of the Problem

But if $s - x = c$, then

$$a^2 = x^2 + (s - x)^2 - 2x(s - x) \cos \alpha \qquad (1)$$

From the right triangle AFC,

$$\text{Tan } \alpha = \frac{h}{x}$$

From trigonometry we have the relation:

$$\text{Cos } \alpha = \frac{1}{\sqrt{1 + \tan^2 \alpha}}; \text{ then } \cos \alpha = \frac{x}{\sqrt{x^2 + h^2}}$$

Substituting this value for cos α in Equation (1), we get

$$a^2 = x^2 + (s - x)^2 - 2x(s - x) \frac{x}{\sqrt{x^2 + h^2}}$$

Clearing of fractions, factoring, and transposing,

$$\sqrt{x^2 + h^2}[x^2 + (s - x)^2 - a^2] = 2x^2(s - x)$$

Squaring both sides of the equation,

$$(x^2 + h^2)[x^2 + (s - x)^2 - a^2]^2 = 4x^4(s - x)^2$$

and expanding,

$$(x^2 + h^2)[4x^4 - 8sx^3 + 4(2s^2 - a^2)x^2 - 4s(s^2 - a^2)x + (s^2 - a^2)^2] = 4x^6 - 8sx^5 + 4s^2x^4$$

Expanding, transposing and arranging terms,

$$4(s^2 - a^2 + h^2)x^4 - 4s(s^2 - a^2 + 2h^2)x^3 + (s^4 + a^4 - 2a^2s^2 + 8h^2s^2 - 4a^2h^2)x^2 - 4h^2s(s^2 - a^2)x + h^2(s^2 - a^2)^2 = 0 \qquad (2)$$

Substituting the known values in Equation (2) we obtain,

$$919x^4 - 15285x^3 + 84897.5625x^2 - 307125x + 1048064.0625 = 0$$

Solving this equation by Horner's method, we find

$$x = 7.22785 \text{ inches}$$

From the right triangle AFC,

$$y = \sqrt{h^2 + x^2}$$

Substituting the value just found for x in this equation,

$$y = \sqrt{77.241815} = 8.78873 \text{ inches}$$

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, May 12

AT the present time it is not easy to take comprehensive views and still more difficult to make definite statements regarding the conditions and prospects of the machine tool trade in this country. As far as home trade is concerned, nearly every one agrees that the depression is profound, and recent indications of brightening have been temporarily lost to sight. Against this, however, the export trade, judging by the official returns, has never been in so flourishing a condition.

Unprecedented Increase in Export Trade

The overseas trade returns for the first quarter of the present year are instructive, when compared with similar periods ranging over the last ten years. From the point of view of total tonnage, imports have fallen to the low figure of 1454 tons, but exports have risen to the unprecedented total of 7231 tons. This seems to indicate that we are maintaining our supremacy in heavy machines. We are rapidly attaining a figure representing double the pre-war export tonnage.

From the point of view of total values we have reached a figure substantially more than four times the pre-war level in exports of £232,000 ($928,000, present exchange) although the value per ton is not quite two and a half times the pre-war level. There is a gradual rise in the value per ton of imports, and this probably indicates that foreign makers find their market in this country becoming more and more restricted to special machines commanding high prices. The relative position with regard to exports and imports can be summarized by saying that for every 100 tons of machine tools imported we are exporting 499 tons, and for every £100 ($400, present exchange) in value of machine tools imported we export to the value of £277 ($1108). The value per ton of imported machine tools is £265 ($1060), whereas tonnage exported is valued at £175 ($700) per ton. Satisfactory as these figures appear on the surface, it is felt that they cannot continue at this level.

It is interesting to note the character of the machines referred to in these returns. During March this country shipped for export 101 grinding machines, whereas only 9 were imported; 125 milling machines were exported and only 6 imported. Only in drilling machines were more machines imported than exported, the numbers being 188 and 159, respectively. The classified monthly return points to the fact that this country can compete in and satisfy demands for nearly every class of machine tool, a preponderance, however, being shown in lathes. A feature within recent times has been an increasing inquiry from Japan for British machine tools. The naval dockyards there have always favored the production of this country, and at present there seems to be a certain activity demanding an increase in their plant. The Indian market is uncertain and hesitating, and although there are numerous and apparently quite bona fide inquiries from Calcutta and Rangoon, very few of them come to maturity.

Labor Conditions

It is now felt that reductions in wages are an immediate necessity. The protraction of the present coal strike is causing the elucidation of the whole economic structure of this vital industry, and it is patent that it is no longer simply a question of profits, since even the waiving of the whole of these would do little to outweigh the adverse balance, under the present circumstances, and there is no alternative to wage reductions but state subsidies—a totally unsound procedure.

Conferences are taking place between representatives of the Amalgamated Engineering Union and kindred organizations, and the Engineering and National Employers Federation to discuss the question of reduction of wages. The proposals include a reduction of 6s ($1.20, present exchange) a week on time rates and 15 per cent on piece-work rates, together with the abolition of the bonuses of 12½ per cent on the earnings of time-workers and 7½ per cent on the pay of piece-workers. It is understood that it was represented on behalf of the men that the proposed reductions were not warranted, having regard to the rate of wages paid to workers in other trades which did not require higher or equal skill.

It was further claimed that the rate of remuneration paid to the skilled machinists was not commensurate with the value of the engineering products to industry generally. The average rate of pay for skilled machinists is £4, 9s, 1d (about $18) a week. The effect of the employers' proposals would reduce the present average wage to £3, 13s, 3d (about $15) a week. At the same time definite moves in wage reduction have taken place, and in the Birmingham locality men in skilled trades who were formerly receiving something over and above the base rates, plus the war extras, are now reduced to the regulation level. Further than this, discussion of the situation between individual firms and their employes has resulted in many cases in the latter foregoing bonuses.

In the engineering and allied industries the arrangements usually take the form of surrender of the last awards of 6s ($1.20) per week, and 15 per cent to piece-workers, which were granted for reasons unconnected with the cost of living, when trade was uncommonly prosperous last June. Alternatively, the awards of 12 per cent and 7½ per cent made by Mr. Churchill during his tenure of office have been given up in certain cases. Union difficulties, however, are operating in some cases against the voluntary relinquishing of bonuses. For example, the well-known Daimler Co., of Coventry, made a definite offer to its employes, that if they would accept a reduction in bonus, the district rate to remain the same as hitherto, the company would provide full-time employment on a new car which it was desirous of placing on the market. A large body of workers were in favor of accepting this offer, but the Union objected, which resulted in a shut-down.

Prices of Materials

Prices of materials continue to fall, and steel bars have now reached £15, 10s ($62) to £16, 10s ($66) per ton, though imported Belgian bars, which are apparently of a somewhat inferior quality, have maintained their margin and are now selling at £8, 10s ($34) per ton. Considered as a whole, the prices of iron and steel had by the end of last month fallen 28 per cent since the same date twelve months ago, but by far the greater part of the fall has occurred in the last four months. Although having little direct effect on the prices of machine tools, these falling prices are significant of the general fall in the price of commodities, which eventually is likely to cause a general lowering of wages that now remain the only excuse for the maintenance of high prices for goods representing a high labor percentage of value.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool Descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

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Anderson Automatic Nut Tapping Machine

The Anderson Die Machine Co., Iranistan Ave., near Admiral St., Bridgeport, Conn., has recently developed a double-spindle automatic nut tapping machine, which is adapted for the performance of a wide range of work. It represents a radical departure in designing the reversing type of tapping machine in that no clutches are employed for the purpose of reversing the spindles for the performance of the threading operation and for the backing out of the tap. Instead of clutches, the spindles are positively driven in either direction by means of a gear segment meshing into a train of gears, this segment being oscillated back and forth through the medium of crank motion. The throw of the crank is adjustable to give any desired number of revolutions to the tapping spindles in either direction, within the capacity of the gear train and the length of segment, which, in this machine, is fifteen revolutions of the tap in either direction. This, on a 32-pitch tap, would give at least ten complete threads in the piece to be tapped, or through a thickness of 5/16 inch, although the machine is built and intended for use on work not exceeding 3/16 inch in thickness.

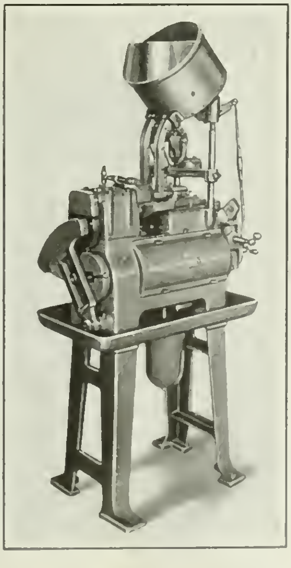


Fig. 1. Front View of Double-spindle Automatic Nut Tapping Machine built by the Anderson Die Machine Co.

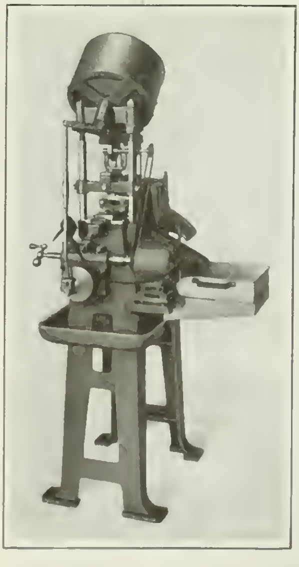


Fig. 2. Rear View of Double-spindle Automatic Nut Tapping Machine built by the Anderson Die Machine Co.

Of course it is understood that the crank motion which controls the oscillation of the gear segment should never be any greater than is actually necessary for the complete tapping of the nut. The crank disk is mounted on the end of a horizontal shaft running throughout the entire length of the machine frame. This shaft is driven by means of a worm-gear enclosed in an oil-tight case, the worm being driven by a constant-speed motor, either direct or alternating current, at a speed of 1750 revolutions per minute. The worm and worm-wheel are of such a ratio as to give approximately 56 revolutions per minute of the horizontal shaft, and the crank is so arranged that the spindles will complete 56 cycles per minute. As there are two work-spindles, it will be seen that this gives a total of 112 pieces tapped per minute. In machines intended for tapping very small nuts, say up to No 6-32 in brass, a worm and worm-wheel can be furnished which

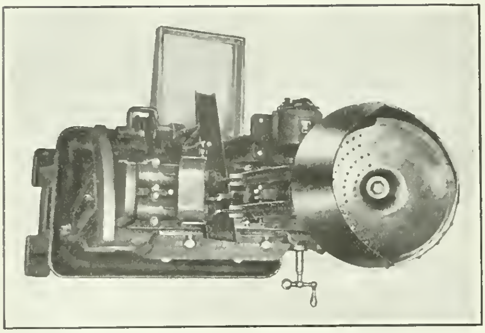


Fig. 3. Top View of Anderson Tapping Machine, showing the General Arrangement of the Mechanism

will give 68 cycles per minute, or a production of 136 tapped pieces of work from the two spindles.

The horizontal shaft carries the cams necessary for operating the feeding mechanism. These cams are adjustable so that the machine can be timed very accurately, and inasmuch as the shaft which carries the cam also has the crank disk secured thereto, it follows that the timing of the various feeding elements with the direction of rotation of the spindle will remain accurate. A hopper is provided which will readily feed either hexagonal or square nuts, and chutes carry the work from this hopper into the tapping position.

Push-rods carry the nuts from the feeding positions in the chutes into engagement with the taps. The construction of the chutes is such that the nuts never leave the chutes until they are completely tapped. This eliminates any possibility of the nuts sticking, due to obstructions which might occur in transferring them from the chutes into some other holding elements. The hopper has an agitator in the form of a disk which oscillates through a crank motion that is also mounted on the horizontal shaft to which previous mention has been made. A vibrator is provided on the machine that will prevent the parts or nuts from sticking in the chutes during their transfer; and an oil pump, reservoir, and complete lubricating devices are built into the machine. The spindles are made of high-carbon steel and mounted on ball bearings where their speed warrants the use of such a construction. The horizontal shaft has plain bearings, which are of ample length to assure long life.

This machine will tap either square or hexagonal nuts ranging in size from 3/16 to ⅝ inch across the flats, from 1/16 to 3/16 inch in thickness, from the smallest diameter tap up to No. 10–24, without providing special chutes and at the rate of 112 per minute. No special taps are required. The only necessary change is in the making of two small blocks that form the entrance for the nuts into the chutes, two push-rods made of ⅝-inch square cold-rolled steel, approximately 4 inches long, and two fingers that hold the nut while it is being transferred from the feeding position of the chute into engagement with the tap.

In a great many cases, the push-rods or the fingers need not be changed. This all depends upon the size of the tap being used and the dimension across the flats, so that the fingers will cover a wide range of work. The small blocks referred to, which form the entrance of the chute, will serve for either square or hexagonal nuts of the same dimension across the flat and of the same thickness. Such parts as may be necessary to tap the nuts of various sizes can be furnished as special equipment. From the foregoing it is evident that the machine as designed will cover a wide range of work without making special feeding devices. Adjustments are provided for taking care of practically all conditions that might arise.

CARLTON RADIAL DRILLING MACHINE

A line of heavy-duty radial drilling machines is being built in 2-, 2½-, 3-, 3½-, 4-, 5-, 6-, and 7-foot sizes by the Carlton Machine Tool Co., 2994 Spring Grove Ave., Cincinnati, Ohio. All sizes are of the same design, and among the principal features it may be mentioned that ball bearings are used throughout, and that the control levers governing the feed, speed, and locking mechanisms are conveniently placed and interlocking so that they are foolproof. The machines are designed and built on the unit principle, and each unit is equipped with a sight or oil-level gage, in order that the operator may tell at a glance whether or not the machine is being sufficiently oiled.

Any of the following drives may be furnished on these machines: Cone pulley, tight and loose pulley through a gear-box, constant-speed motor through a gear-box, or variable-speed motor driving directly without a gear-box. Ordinarily, these drives are mounted on the base as shown in Fig. 1, which illustrates a constant-speed motor driving through a gear-box, but either of the motor drives mentioned may also be placed upon a rear extension of the arm as shown in Fig. 2, which also shows a constant-speed motor used in connection with a gear-box. In drives employing a gear-box, six speed changes are obtainable, and these may be secured while the machine is running, by operating the lever on the front end of the speed-change shaft, either by hand or foot. There are two columns on the machine, the outer one being of large diameter and machined from a semi-steel casting finished by grinding. All drives mounted on the base of the machine are connected by a coupling to a unit containing bevel gears which transmit power to a vertical shaft at the center of the columns. This shaft, in turn, transmits power through three gears to the vertical shaft on the outer column. The outer vertical shaft drives, through bevel gears, a horizontal shaft which conveys power to the spindle head.

The arm elevating screw is stationary, the arm being raised and lowered by means of a revolving nut. The arm may be clamped to the column by two eccentric levers, and when this has been done, it cannot be raised or lowered until both of the levers have been released. These levers cannot become engaged while the arm is in motion. When the arm is raised to the top of the column, it is stopped automatically through a plunger disengaging the elevating mechanism, and if the arm or head meets any obstruction while being lowered, it is also stopped automatically.

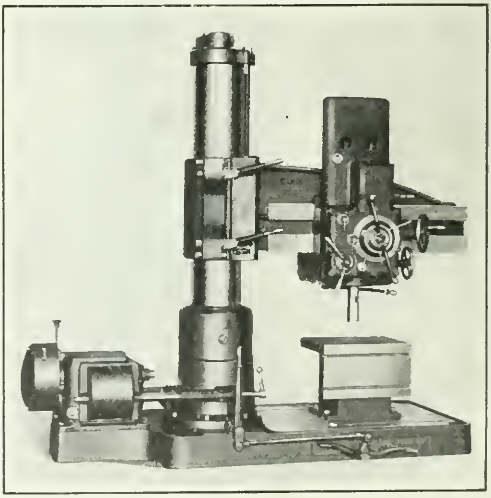


Fig. 1. Front View of 4-foot Carlton Radial Drilling Machine with Belted Motor Drive through Gear-box

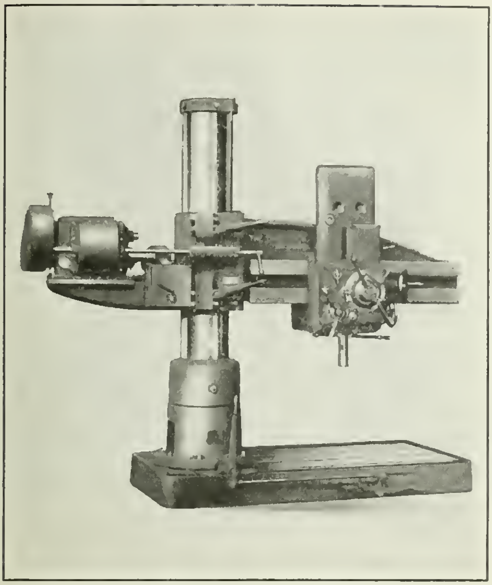


Fig. 2. Carlton 5-foot Radial Drilling Machine with Belted Motor Drive through Gear-box on Arm

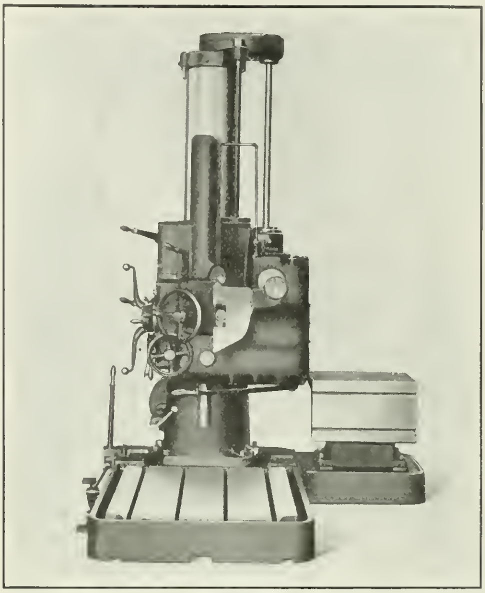


Fig. 3. Carlton 4-foot Radial Drilling Machine, showing Plain Box Table, and Table Wing on Base

The outer column revolves on ball and roller bearings on the inner one, this arrangement permitting the arm to be swung around with little effort. When this movement is too free, the condition may be remedied by adjusting a brake on the column. Neither the inner nor the outer column is split. The outer column is locked to the inner one or unlocked by operating either the hand-lever or the foot-treadle at the front of the base, as seen in Figs. 1 and 2. The base has a large working surface and is provided with pockets on each side of the column, which are connected to an oil-channel that passes completely around the base. From these pockets the oil is returned to a reservoir. A pump is mounted on the top of the reservoir at the back of the column.

As previously mentioned, a horizontal shaft delivers power to the transmission at the rear of the head. There are four speed changes in this transmission which, together with the six speed changes obtained by means of the gear-box, give twenty-four speeds to the spindle in geometrical progression, covering a range of from 18 to 800 revolutions per minute. All gears in the transmission are chrome-nickel steel, hardened and mounted on shafts supported at each end by ball bearings. The transmission case holds ten gallons of oil, and contains a pump for flooding oil to the

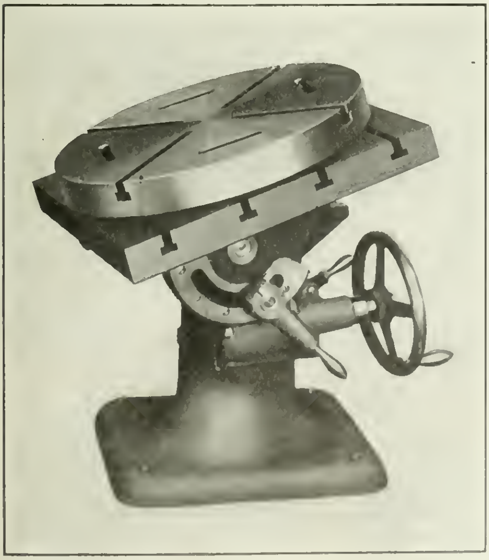


Fig. 4. Universal Table for Carlton Radial Drilling Machine, with a Round Table mounted on it

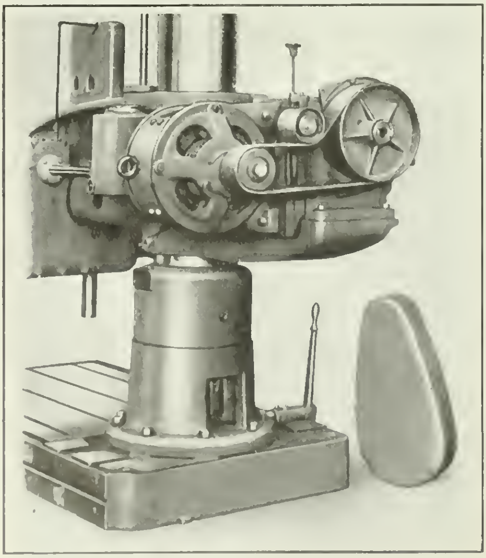


Fig. 5. Belted Motor Drive through Gear-box on Arm, with Cover removed to show Belt Tensioning Device

bearings and gears at all times. Twelve spindle speeds covering a range of from 0.005 to 0.069 inch per revolution can be obtained by operating small levers at the front of the head. The head is made up of sub-units which are entirely enclosed, and it can be pushed or pulled the entire length of the arm by hand. The arm is furnished with long flat ways to accommodate the head.

The spindle drive is placed as close as possible to the lower end and on the largest diameter of the spindle. The latter is provided with a hardened renewable tang socket. The sleeve for raising and lowering the spindle is mounted near the top, and the spindle is balanced by a counterweight that acts through the same pinion that operates the rack for raising and lowering the spindle. Thus, when the spindle is lowered, the weight is raised, and vice versa. The spindle is stopped automatically when it has been raised or lowered through its maximum movement. A dial on the front of the head may be set to stop the travel of the spindle when any desired depth of hole has been obtained.

The base extension shown in Fig. 3 can be attached to the base at any time this is necessary. The extension, as well as the universal table shown in Fig. 4, are furnished as separate equipment. When a constant-speed motor is used in conjunction with the gear-box, a belted motor drive is recommended as shown in Fig. 5, in which the motor is mounted on the arm. The same drive is used when the motor is placed on the baseplate. Through an idler pulley arranged as shown, it is possible to obtain enough belt contact on both the driving and driven pulleys to assure obtaining an efficient drive.

H & G THREADING MACHINES

Two new threading machines have been brought out by the Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. The features of these machines include the application of hardened and ground spindles, and round tool-steel ways with bronze bearings that are easily replaced if it should ever become necessary. The design of the slides is such that the piece to be threaded is held low and near the slide bearing. This is said to do away with all cross strain and cramp, and to make perfect alignment possible under all conditions. Although designed with liberal margins of safety, the machines will be found to be relatively small and compact for their range of work and the rate of production which they are capable of attaining.

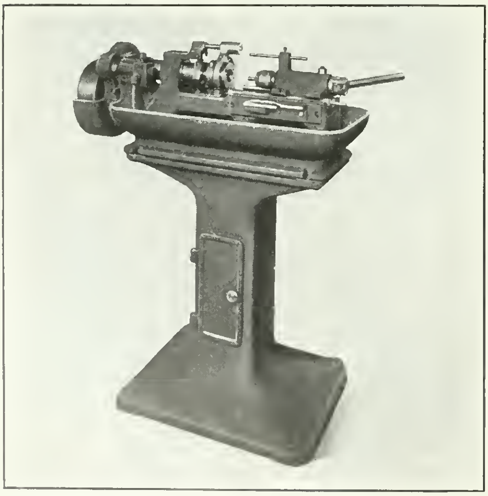


Fig. 1. Model SS Threading Machine built by the Eastern Machine Screw Corporation

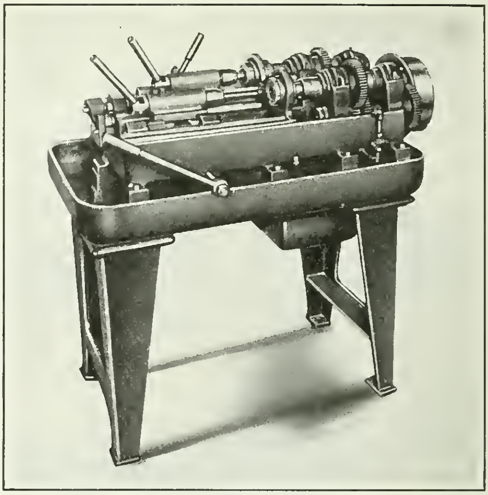


Fig. 2. Model DS Threading Machine built by the Eastern Machine Screw Corporation

Single-spindle H & G Threading Machine

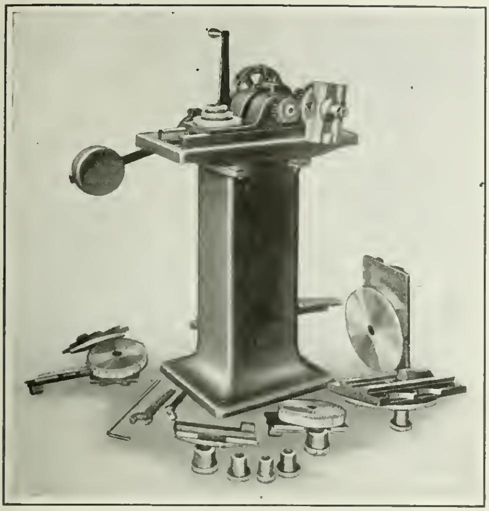
The small bench threading machine which has been on the market for a number of years has been recently redesigned for the purpose of improving its appearance and durability, and enlarging the range of work which it might be called upon to do. The new design is shown in Fig. 1, and it is known as a Model SS. This machine will be found useful in any shop where threading is done, especially for all sorts of second-operation work. It may be obtained as a bench machine or it may be equipped with a cabinet base, as desired.

While regularly equipped with spring collets, the slides may be furnished with an open-side jaw, when the shape of the work is such that this method of holding will be more desirable. An automatic stop provides for holding each piece of work at the same point, and an easily adjustable tripping arrangement insures having the proper length of thread cut on each piece. An interesting feature in connection with the open-side jaw is that the operator need use only one hand to close the jaws, feed forward the work, draw back the work, and open the jaws. All is done with one smooth action, leaving the other hand free at all times.

Equipped with a pump which may be instantly made to run right- or left-hand, the machine is capable of cutting either right- or left-hand threads, by simply changing chasers and reversing the belt. The hollow ground spindle permits threads to be cut up to 9¾ inches in length, whereas the open-side jaws provide for holding stock of any length required. Production with this machine should range from 300 to 1000 pieces per hour, depending upon the class of work, and it can be operated with practically unskilled labor. The machine is, of course, equipped with H & G dieheads; it will accommodate any size of head up to 1¼ inches capacity, and is designed to cut pitches as coarse as 11.

Double-spindle H & G Threading Machine

In response to a demand from many of its customers for a threading machine of greater capacity and maximum rate of production, the Eastern Machine Screw Corporation has brought out the double-spindle H & G threading machine illustrated in Fig. 2. The different gear ratios provided on this equipment make it possible to always operate at the most efficient speed, and with one operator handling two spindles, the cost of threading is reduced to a minimum. This is known as the Model DS threading machine.



Graduating and Marking Machine built by the Noble & Westbrook Mfg. Co.

NOBLE & WESTBROOK GRADUATING AND MARKING MACHINES

To provide for the performance of graduating operations, where accuracy of the product and speed of operation are required, the Noble & Westbrook Mfg. Co., Hartford, Conn., has recently placed on the market a machine which is shown in the accompanying illustration. Hand and power machines are furnished. On the power-driven machine, the loading of pieces of work on the machine and removing them when the operation has been performed are the only duties required by the operator. With the hand machine, one turn of the handle completes the work. Provision is made for holding the work in the proper relation to the graduating die, and the depth of the marking is governed by means of a foot-lever, cam, and weight, which are governed by a positive stop that is adjustable to provide for making any desired depth of lines. This insures making even and accurate impressions. The machine is equipped with steel spindles, adjustable bearings, and is fully automatic in operation, being stopped by means of a clutch on the spindle which drives the marking die. An idea of the range of work for which the machine is adapted will be gathered by referring to the pieces that are illustrated. Parts of various diameters can be graduated by changing the position of the intermediate gear located on the adjustable sector. Practically all types of modern machine tools are equipped with micrometer adjustments, and this machine is well adapted for the graduation of the dials used on micrometer adjusting screws; it is also adapted for graduating and numbering cross-slides and compound rests for lathes. The graduating and numbering are completed in one operation. The Noble & Westbrook Mfg. Co. also furnishes the full equipment for these machines, including the engraved steel marking dies.

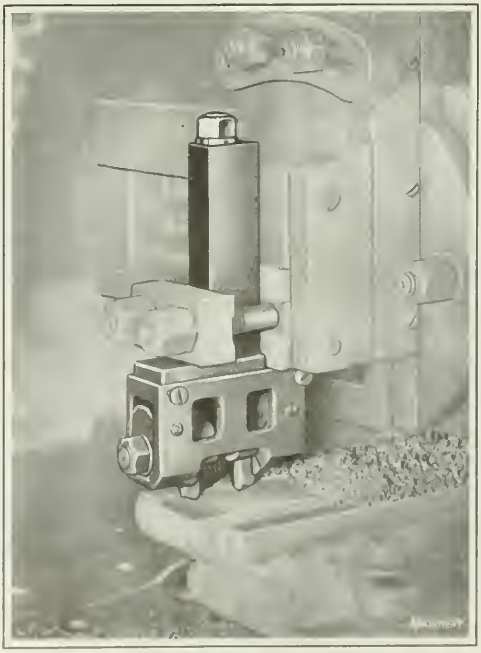
DUSENBURY DUPLEX PLANING TOOL

A tool known as the Dusenbury duplex planing tool is a recent product of the Waltham Machine Works, Waltham, Mass. It consists principally of a shank that is held in the regular manner. The planer clapper is fastened down, usually with a tapered pin. The tool-head contains two opposed clapper-boxes that operate the same as a planer clapper. The head can be swiveled, and in it there are held two high-speed tool bits. With this construction a chip can be cut, not only during the regular cutting stroke of a planer, but also with equal efficiency during the return stroke, thus taking advantage of the ordinarily idle stroke of the machine. This reduces by one-third to one-half the time required to plane a given piece of work. The tool is used to equal advantage on various operations of metal planing on horizontal, vertical, or inclined surfaces, and also in slots and dovetailed bearings. The positions of the tool bits are such that the result is the same as that obtained when using an underhung tool. This planing tool is strongly and simply constructed. All surfaces which are subject to wear are hardened.

The swiveling feature of this tool is a very important point, as it works to advantage on every operation on which the tool is applied. This motion swings the tool-head so that one tool stands ahead of the other, and with the adjusting screws which bear against the graduated foot of the tool shank, any desired cut or position is easily obtained.

Horizontal surfaces may be planed by the Dusenbury duplex planing tool in about one-half the usual time, by doubling the customary feed of the planer. The tool shank is clamped vertically, the same as any tool-holder. The tool-head, containing the two tools, is swung one or more degrees to suit the feed set for the planer, so that the two tools cut an equal amount, or the tool-head may be swung over and then the feed of the planer can easily be adjusted to correspond.

Vertical or inclined surfaces can also be planed in about one-half of the usual time, by using this duplex planing tool which is placed in position with the shank straight with the planer clapper-box that is thrown over away from the work. The tool-head is swiveled one or more degrees to suit the amount of chip desired. The tools are placed in the angle slots of the clappers at about 45 degrees, until the ends rest against the surface to be planed, and then they are tightened. This will bring one tool higher than the other. Then the feed is increased until each tool cuts an equal amount. Having planed one side of the work, move the planer clapper-box over and swing the tool-head one-half turn, and the tools will be set for planing the other side.



Dusenbury Duplex Planing Tool made by the Waltham Machine Works

Slotting operations can also be done in about one-half the usual time. When using tools that are of the same width as the slot to be made, one tool is set higher than the other by the amount desired for the chip. The planer feed is increased so that both tools will cut the same amount. When cutting slots with tools that are narrower than the slot which is required, the tools are set the same height and the tool-head is swiveled through the desired amount by the adjusting screws, so that one tool will cut one side of the slot and the other will cut the other side, making the slot the desired width with one down feed of the slide.

The same increased production can be obtained on dovetail planing by using the duplex planing tool as is possible in the other planing operations. By setting one tool higher than the other and feeding double the usual amount, after planing one side, swing the tool-head one-half turn, after making the usual planer changes, and the tools will be set for planing the other side.

POWERS DUPLICATE-DRILLING MACHINE

The duplicate drilling of a small number of parts, so as to make them interchangeable, is generally accomplished with difficulty, due to the fact that the expense of a special jig or fixture for the job is unwarranted. To facilitate such work, the Sterling Tool & Machine Works, Inc., 205-209 W. 19th St., New York City, are placing on the market the duplicating machine shown in the accompanying illustrations. This machine is so designed that after one part has been drilled, it can be clamped to the right-hand side of the table and used as a model for drilling the remaining unfinished parts, means being provided for shifting the spindle and locating it properly for the drilling of each hole on an unfinished piece. This machine may also be used for the performance of spot-facing, reaming, and milling operations.

An arm *A* extends forward from a bracket integral with the side of the column. This arm at the outer end supports a vertical center *B*. The distance from the face of the column to the center of the spindle is identical with the distance from the face of the column to the center of center *B*, and as arm *A* is stationary on the column the same relation between the spindle and center *B* is always maintained. The column can be moved transversely on a slide mounted on the base, and this slide has a lateral movement. By these means, when a finished part is clamped on the table beneath center *B* and an unfinished part is bolted in a like position beneath the spindle, if the column and slide are shifted until the center can be inserted into a drilled hole on the finished part, the unfinished part will be properly located for the drilling of the corresponding hole.

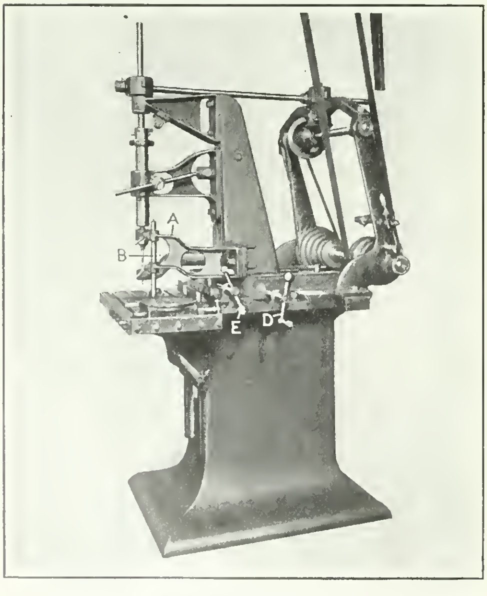


Fig. 1. Machine placed on the Market by the Sterling Tool & Machine Works, Inc., for the Duplicate Drilling of Work

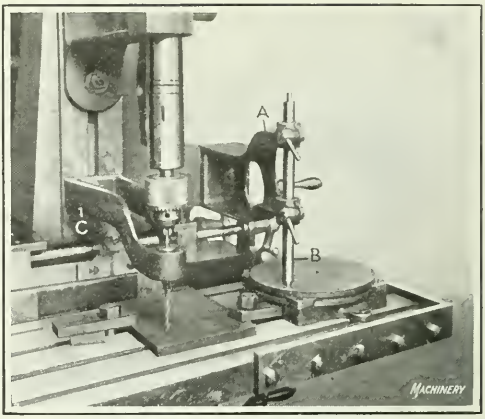
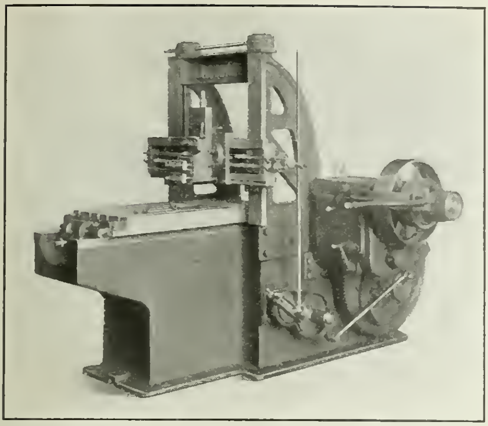


Fig. 2. Close-up View of the Device provided to assist in locating the Spindle over the Work

After the latter has been done, the column and slide are moved to permit the placing of center *B* in a second hole, the spindle being, of course, at the same time similarly shifted over the unfinished part. This method of drilling from a finished part enables a repair part to be machined correctly when the original part has become broken or worn. It is not necessary, however, to drill from a previously machined part, as center *B* can also be set to the intersections of lay-out lines. On very accurate work, toolmakers' buttons can be screwed on the table and used for locating purposes. Center *B* is then reversed, the end shown at the top in the illustrations being suitable for fitting over the buttons. The drill is guided through a bushing in arm *C*, and a number of bushings are supplied to suit various sizes of drills. A special wrench is furnished to facilitate the removal of these bushings from the arm.

The lateral movements of the column slide are obtained through the rotation of crank *D*, Fig. 1, on the right-hand side of the machine, while the transverse movements of the column on the slide are obtained by rotating crank *E*. The latter is mounted on a shaft which drives the adjusting screw of the column through helical gears. Graduated dials on the crank-handles permit settings of 0.001 inch to be obtained. The spindle is hand-fed through a rack and pinion, and a stop collar is provided for drilling to depth. The arm which guides the spindle rack may be adjusted vertically to suit the length of the drill being used.

The table is adjusted vertically through a rack and pinion mechanism, and is provided on the upper surface with five T-slots. The machine is designed for being driven from a lineshaft, the countershaft being mounted on a frame bracketed to the rear of the base. A mechanical belt shifter is provided for changing the driving belt from the loose to the tight pulley and vice versa. This shifter is so designed that the belt cannot move across the pulley faces of its own accord. The cone-pulleys, with which the machine is equipped, permit the use of five spindle speeds. The drive from the upper cone-pulley shaft to the spindle is through a set of bevel gears, a short vertical shaft, two sets of helical gears, and a long, sliding, horizontal shaft. This equipment was invented by James Powers and is known as the Powers duplicate-drilling machine.



Crank Planer lately developed by the Woodward & Powell Planer Co.

WOODWARD & POWELL CRANK PLANER

The Woodward & Powell Planer Co., 97-99 Webster St., Worcester, Mass., has recently developed a 24- by 24- by 24-inch crank planer which is particularly adapted to such forge and railroad shop work as the machining of die-blocks, rod straps, gibs, shoes, wedges, cross-heads, etc. From the illustration it will be seen that the bed, housings and cross-rail are massively constructed, so as to furnish ample rigidity. The table has large bearing surfaces on the bed, and is gibbed its entire length. The length of stroke is adjustable up to 24½ inches. The table is 40 inches long, or 15½ inches longer than the maximum stroke; however, the table can be adjusted along the bed so that a piece of work placed anywhere on the table, can be brought past the head. The latter can be swiveled to either side for angular planing, and is graduated in degrees.

The cross-rail gibs are secured by nuts on studs threaded into the cross-rail, and the cross-rail screw and rod are squared at both the front and rear ends to suit a crank. The feeds for cross, vertical, and angular traverses of the head are operated automatically by power or by hand, and take place on the return stroke, so that a longer stroke than necessary for a cut is not required. The planer can be driven by a single pulley, connected to a four-speed gear-box, by a motor mounted on the top of the gear-box and directly connected to it by gears, or by a four-step cone pulley without a gear-box. The handle for operating the starting and stopping clutch of a planer driven through a gear-box also operates a brake for stopping the table when the clutch is thrown out.

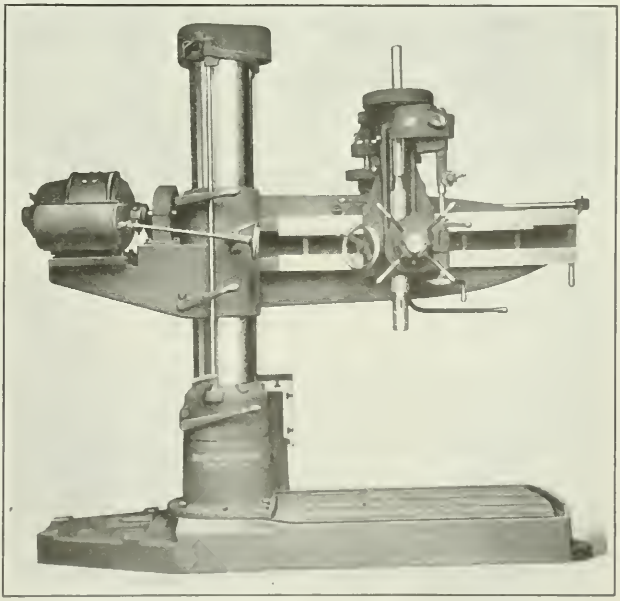
All gears and revolving parts are thoroughly guarded; these guards were removed from the machine at the time the photograph was taken, in order that the working parts might be shown to better advantage. Some of the specifications of the planer are as follows: Stroke, from 0 to 24½ inches; height between table and cross-rail, 25 inches; width between housings, 25 inches; working surface of table, 40 by 21 inches; table strokes per minute by means of cone pulley or gear-box, 10, 17, 29, and 48; approximate weight of the machine, 8000 pounds; and horsepower of motor required, when motor drive is employed, 5.

DRESES MOTOR DRIVE ON RADIAL DRILLING MACHINE ARM

About sixteen years ago, a radial drilling machine provided with motor drive on the arm was brought out in England. The first arrangements were rather crude and complicated, and some makers in England, and subsequently in this country, used two motors—one for driving, and the other for elevating the arm. The disadvantage of the dangling connecting wires, the swinging of the heavy motor and driving mechanism, the complicated provision for operating the controller, and the adaptability for direct-current or variable-speed motors only, retarded the general adoption of such an arrangement in this country. With the advent of high-speed drills, the simplification of the driving mechanism became of great importance, and this changed the view of users; therefore this type of drive has gained much in favor in recent years.

In the arrangement here illustrated on a 5-foot radial drilling machine, the simplification is carried out to what the builders of this machine believe to be the last detail. The pinion on the motor meshes directly with a large gear on the horizontal back-shaft of the arm. It thus eliminates two pairs of bevel gears, three spur gears, eight bearings, and two long and one short shaft in the driving mechanism. This reduces the total friction by about one-half, so that a motor can be used which is of one-third less capacity than the size required when the motor is placed on the base of the machine.

It will be noticed that the controller is mounted in front of the motor, and by means of a universal joint, shaft, and bracket, the controlling handwheel is brought within easy reach of the operator. The handwheel rim is beveled at an angle of 45 degrees and indexed, giving the spindle revolutions at the different stations of the controller. A fixed pointer, reaching over the handwheel, serves as an indicator. By this arrangement, four sprocket wheels with chains, several brackets with bearings, two bevel gears, and a long shaft are eliminated, all of which are necessary when the



Radial Drilling Machine built by the Dreses Machine Tool Co., equipped with the New Motor Drive on the Arm controller is placed at the rear of the motor and arm. The motor is placed on a sub-base, so that any type can be used without making a change in the arm. This form of motor drive has lately been applied to radial drilling machines built by the Dreses Machine Tool Co., 227-239 W. McMicken Ave., Cincinnati, Ohio.

CINCINNATI HIGH-SPEED DRILLING MACHINE

The Cincinnati Hy-Speed Machine Co., Cincinnati, Ohio, has developed the drilling machine shown in the accompanying illustrations, which has several unique features. It is driven by a single pulley connected to the cone pulley shaft at the rear and top of the machine. The second cone pulley is mounted directly on the upper end of the drill spindle. An idler pulley is provided for the cone pulley belt on the right-hand side of the machine. This idler is mounted on the belt-shifter, and assists in leading the belt from one step of the cone pulleys to another. The machine is quickly stopped or started by means of the handle that projects toward the front from the left-hand side of the column.

The table-elevating mechanism is placed sufficiently back of the spindle so that arrangements can be made to allow the passing of taps through the table. This feature, together with the use of a quick-release chuck, enables tapping operations to be accomplished at high speeds and without necessitating a reversal of the direction of the tap rotation. The various spindle speeds are controlled by the handle on the right-hand side of the column. The clutch is of the dry-plate type, and is operated in connection with an air-cooled brake. All pulleys on the machine are made of aluminum. A power feed and an automatic tapping attachment can be furnished if desired, and an oil pump and tank can also be supplied as separate equipment to be attached to the base. In addition to the type illustrated, this machine is built in bench, single-speed, and motor-driven types.

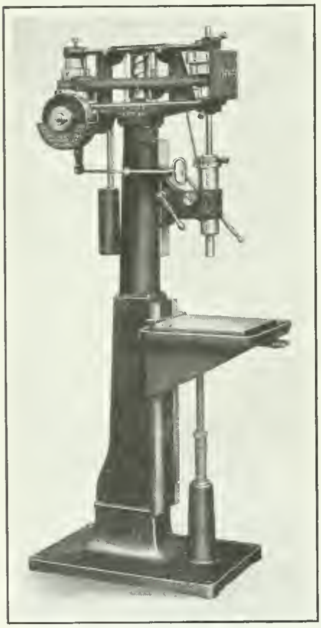


Fig. 1. Drilling Machine developed by the Cincinnati Hy-speed Machine Co.

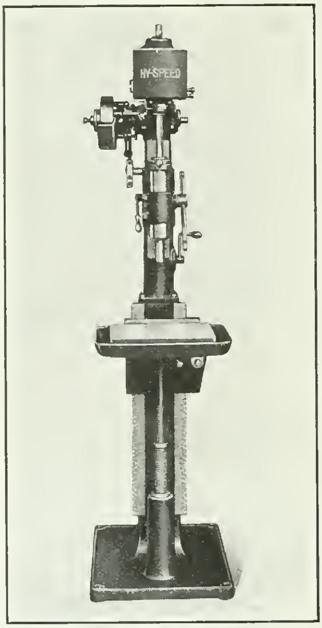


Fig. 2. Front View of High-speed Drilling Machine shown in Fig. 1

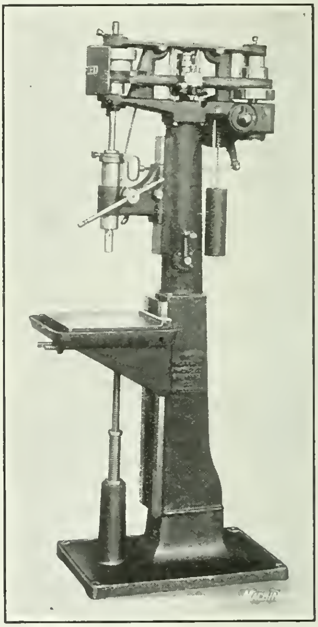


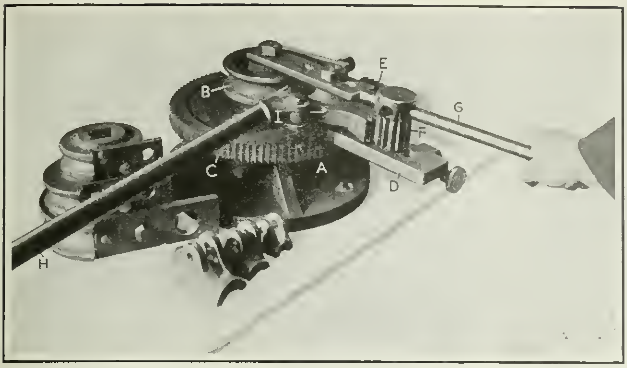
Fig. 3. Right-hand Side of Machine, showing Idler Pulley and Speed-control Handle

LEONARD PIPE-BENDING MACHINE

The Leonard Machine Works, 1023-1027 Race St., Philadelphia, Pa., has recently placed on the market, a pipe-bending machine which is made in three sizes, Nos. 1, 2, and 3. The No. 1 machine bends pipe from 0 to 1 inch; the No. 2, from 1 to 2 inches; and the No. 3, from 2 to 4 inches. A No. 1 machine is shown mounted on a bench. This size may be furnished with or without a floor pedestal, while the Nos. 2 and 3 sizes are furnished with the floor pedestal as a regular equipment. Each machine is equipped with four forming heads and four bending shoes, which accommodates the regular run of pipe bending. For handling unusual work, special shoes may be furnished.

The machine consists of a cast-iron base *A* carrying a large upright center stud, the upper part of which is square to fit a hole of the same shape in the forming head *B*, thus preventing its rotation. This stud is a light driving fit in the base, and is held against movement by two large setscrews on top of the base. Secured by the stud, there is a cast-steel ratchet segment *C*, and above this ratchet is a cast-steel arm *D*, on the lower part of which is a plunger-pin engaging the teeth on the ratchet wheel. This cast-steel arm has several tapped holes into which the center studs for the shoe-carrying gear segment lever *E* and pinion *F* are mounted. The pinion is made of steel and casehardened, and it has two large holes on top that are drilled at right angles to each other, into which the hand-lever *G* is inserted when operating the machine.

In operation, the workman slips the straight pipe *H* through a hole in the guard that protrudes from the forming head; then he rotates the pinion *F* until the swiveling shoe *I* contacts with the pipe. Further movement of the hand-lever causes the pipe to bend uniformly around the forming head *B*, and as the bending progresses it is necessary to move the cast-steel arm *D* further around the circle, which is done by the spring-pin engaging the ratchet *C* further around the circle. This process is repeated until the bending is completed. Pipe may easily be bent cold and unfilled. This machine is of special use to plumbers,

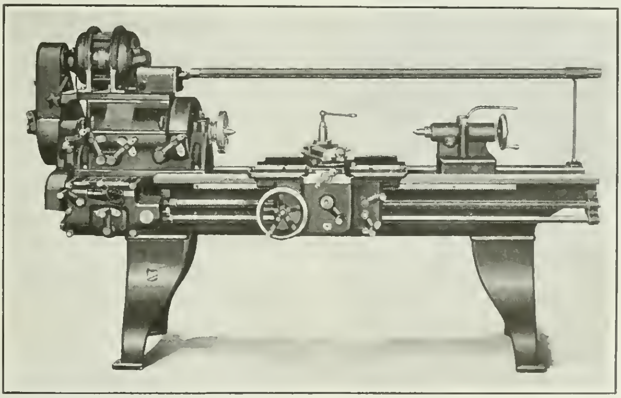


Pipe-bending Machine built by the Leonard Machine Works

electricians, and general machine shops, or wherever pipe-bending is done. The No. 1 machine is portable and may be taken to the work. Its weight is 95 pounds when equipped for bending; but complete with all four forming heads, it weighs approximately 115 pounds.

MORRIS GEARED-HEAD LATHE

The Morris Machine Tool Co., Cincinnati, Ohio, has recently added to its line a single-pulley-driven geared-head lathe which is built in 16-, 18-, and 22-inch swings. The geared head provides twelve spindle speeds, and with a double friction countershaft, twenty-four speeds or twelve forward and twelve reverse are obtainable. All the gears are steel, heat-treated and hardened. The headstock is filled with oil up to a certain level, permitting the gears to dip in enough so that they will be thoroughly lubricated.



Geared-head Lathe built in 16-, 18- and 22-inch Swings by the Morris Machine Tool Co.

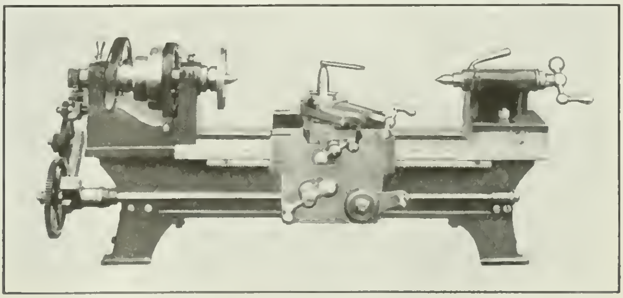
All speeds are secured through sliding gears and one positive back-gear clutch, friction clutches or any parts requiring adjustment having been eliminated. The only friction clutch is in the pulley at the initial drive, which is of a large diameter and is controlled by a shifter rod running the full length of the lathe. This permits the operator to start and stop the lathe from any working position. Speed changes are secured through the levers in front of the head. The two levers at the back end control a set of sliding gears, giving six speeds. The lever at the front end operates the back-gears and clutch. This lever, when engaging the direct-drive clutch, slides the back-gear pinion out of mesh, preventing the back-gears from running idle at high speed and from absorbing unnecessary power when releasing the friction clutch in the pulley. A brake can be applied by the same pull which stops the idle rotation of the spindle. This is a great convenience, both when shifting gears and when turning the work partly around for inspection at different points on the diameter. The pulley is protected by a guard which can be swiveled to suit the angle of the belt.

The Morris geared head is interchangeable with the cone head. All geared heads are arranged to receive the motor drive unit at any time. The motor is mounted on a plate, bolted to the head, and drives the clutch pulley by an endless belt which is furnished with the motor drive details. An idler pulley adjusts the tension of the belt by means of the star handle at the front of the motor plate. The idler pulley and bracket are mounted on the motor plate, making the motor drive unit self-contained. On the 16-inch lathe, the available range of spindle speeds is from 12 to 347 revolutions per minute, and on the 18- and 22-inch machines, the range is from 10 to 297 revolutions per minute. On all sizes of lathes, the speed changes are arranged in geometrical progression.

JOHNSTON ENGINE LATHE

The "Invincible" 9-inch swing, back-geared screw-cutting lathe shown in the accompanying illustration was designed by the Johnston Mfg. Co., 582 Elm St., Arlington, N. J., especially for use in garages, machine shops, and manual training schools requiring a small heavy-duty lathe of this type. It has been carefully designed for ease and convenience in operation. The bed is of heavy construction and is made to avoid chatter or vibration in taking a heavy cut. The actual swing of the machine is 9½ inches and the distance between centers is 17½ inches, the bed being 36 inches long.

The spindle is hardened and ground, and is made of high-grade steel. The hole is ¾ inch in diameter, and it extends the entire length of the spindle. The bearings in the headstock are lined with bronze. Like the head spindle, the tailstock spindle is made of high-grade steel. The tailstock is equipped with a taper-turning attachment which may be



Heavy-duty 9-inch Engine Lathe built by the Johnston Mfg. Co.

set over for turning tapered parts. The carriage is of rigid design, having a bearing of 9⅜ inches on the ways of the bed, and it is so constructed that when the slide-rest is removed, it leaves a perfectly level surface for clamping and boring purposes. T-slots are provided for use in connection with the performance of this class of work.

WALLACE BENDING MACHINES

In Fig. 1 is shown a No. 3 ring coiling machine, and in Fig. 2 a power-driven pipe-bending machine. These two equipments are recent products of the Wallace Supplies Mfg. Co., 412-420 Orleans St., Chicago, Ill. The machine shown in Fig. 1 is adapted for the manufacture of rings and coils of various diameters, and its rolls are removable so that the machine may be arranged to suit the form of material that is to be bent, namely, pipe, angle-iron, channels, tees, square bars, etc. Another application is in the production of spirals made of reinforcement rods, such as those used in reinforcing concrete columns.

As shown in Fig. 1, the machine is arranged for bending angle-irons, for which duty the machine can handle work having a diameter of 30 inches, and lighter sections may be formed to circles of smaller diameters. It is operated by a lever which engages friction clutch pulleys for furnishing the forward and reverse drives. Rollers can be furnished which are suitable for bending material of any shape or cross-section. The upper of the two rollers is adjustable by means of a hand-screw to provide for securing any diameter of coil that is desired. Standing in front of the machine is an angle-iron which was bent cold on a machine of this design. The machine occupies a floor space of 42 by 54 inches, and weighs 1200 pounds.

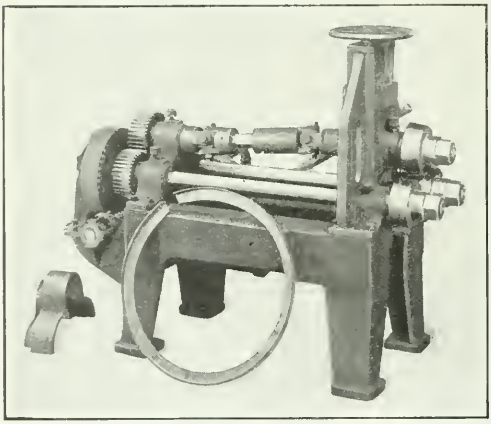


Fig. 1. Ring Coiling Machine made by the Wallace Supplies Mfg. Co.

Although the machine shown in Fig. 2 has been referred to as a pipe-bending machine, it is actually suited for the performance of various other bending operations such as are required in the manufacture of concrete reinforcement rods, angle-irons, flat bars, and other steel sections. It is known as a No. 8 power-driven bending machine, and was especially designed for the purpose of bending reinforcement bars in large quantities. Provision may be made for driving the machine with an independent motor or through a friction clutch and pulleys from a countershaft. The machine has a capacity for handling twisted reinforcement bars up to 1½ inches; and two 1¼-inch bars can be bent at the same time. Similarly, the machine will bend simultaneously an equivalent number of smaller sized bars. By using especially high forming pins and rollers, a quantity of eight or ten small bars may be bent at a time. When several bars are bent in this way, a U-shaped clip is placed over them for convenience in handling. The machine is so arranged that bars may be bent with equal facility from right to left or left to right. This is a great advantage, as it avoids the necessity of reversing bars in order to make all bends, thus effecting a considerable saving of time and labor in handling the material. A special equipment is employed for bending flat bars, round bars, or tubing, squares, channels, angles, tees, flat bars on edge, and various other sections. Where individual motor drive is employed, a 7½-horsepower motor is used. The machine occupies a floor space of 6 by 6 feet, and weighs 3500 pounds.

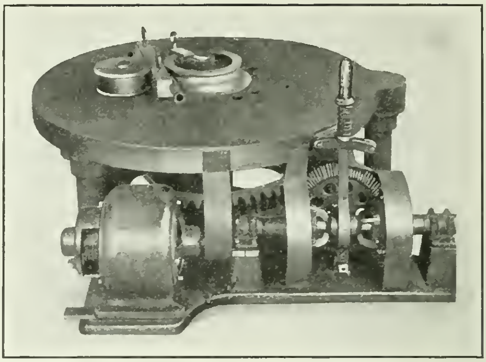


Fig. 2. Pipe-bending Machine made by the Wallace Supplies Mfg. Co.

ROBERTSON POWER SAWS

In Machinery for June, 1912, a description was given of a No. 2 "Economy" hacksaw manufactured by the W. Robertson Machine & Foundry Co., 56-58 Rano St., Buffalo, N. Y. This saw has been remodeled, as shown in Fig. 1. It is a 6- by 6-inch capacity draw-cut machine, and is equipped with an arrangement for relieving the teeth of the blade of all drag on the idle or return stroke. This mechanism consists of a two-cylinder pump submerged in oil, which is contained in a tank (not shown). One pump plunger is timed with the crankshaft, while the other is connected to the saw frame.

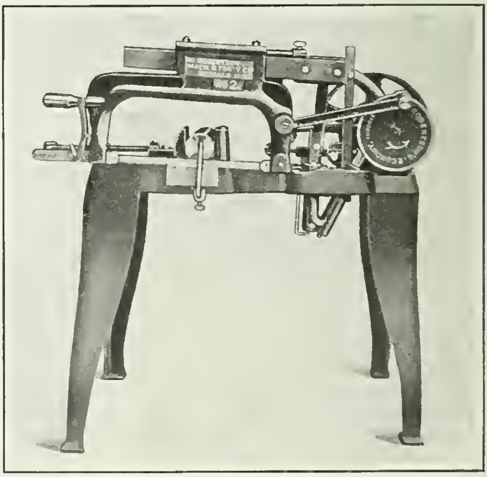


Fig. 1. No. 2 Improved Type "Economy" Saw, built by the W. Robertson Machine & Foundry Co.

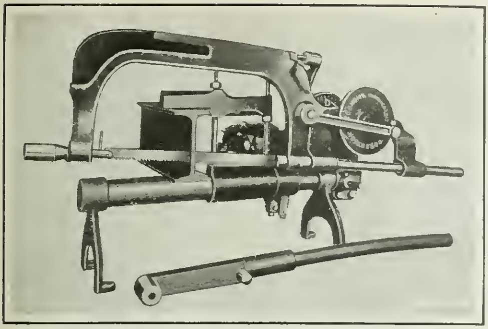


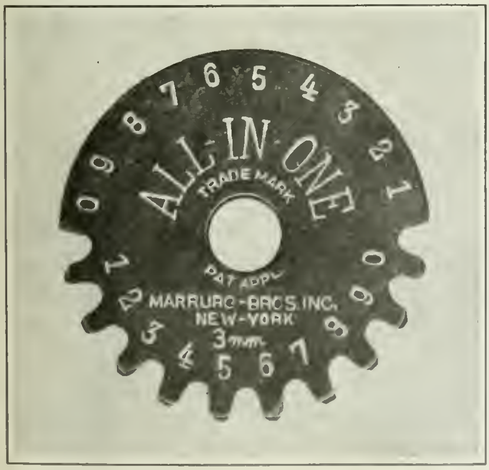
Fig. 2. Portable Power- or Hand-driven Saw built by the W. Robertson Machine & Foundry Co.

At the end of a cutting stroke, the plunger connected to the crankshaft is on the down stroke and forces oil under the plunger connected with the frame, thus causing the saw frame to be raised from the work. At the beginning of the cutting stroke, the pump, being timed with the crankshaft, allows oil to escape and permits the frame to be lowered on the work. The same arrangement has been employed on larger sizes of saws manufactured by this concern. It is said that blades do not become broken by the frame falling on the work. A swivel vise is provided for cutting work to angles up to 45 degrees. The machine is driven by a friction clutch, and stops automatically at the end of a cut.

Fig. 2 shows a portable hand- or power-driven saw, which is also built by the concern mentioned. This machine can be used as a general utility saw when the two legs are applied. The current for driving the motor may be taken from a lamp socket. In cases where current is not available, the lever shown lying at the front of the machine may be used for driving the saw by connecting it to the crank disk and the stationary frame. The machine uses 17-inch blades, and has a capacity for 8-inch work. The motor is coupled to a shaft which, through worm-gearing running in oil, drives the crank-wheel. The latter is connected to the saw frame by the connecting-rod.

MARBURG NUMBERING PUNCHES

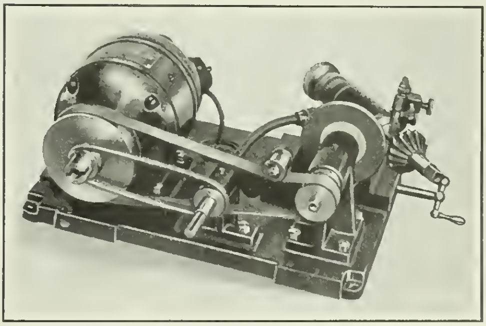
For use in marking various metal parts with numbers, Marburg Bros., Inc., 90 West St., New York City, has recently placed on the market, a set of numbering punches known as the "All-in-one." From the illustration it will be apparent that this name is derived from the fact that all ten numerals are carried by small projections on a disk, so that they are all contained in one piece. Around the circumference adjacent to each projection on which a number is cut, the corresponding number is stamped in the side of the disk; and diametrically opposite, there is cut a corresponding number. Holding the disk edgewise with the numbering punches downward, the lower of the two numbers stamped on the disk indicates the punch that is in contact with the work, and the operator strikes the upper edge of the disk opposite the corresponding figure. A set of numbering punches of this kind would find application for any of the great variety of purposes for which separate tools of this kind are commonly employed.



"All-in-one" Numbering Punches made by Marburg Bros., Inc.

FRANKLIN PORTABLE UNIVERSAL GRINDER

The Franklin Machine & Tool Co., Springfield, Mass., has recently placed on the market a portable grinder provided with attachments especially designed for use in performing various grinding operations required in automobile repair work. The complete equipment is designated as the Franklin portable repair shop unit Model B, and consists essentially of a cast-iron base on which is mounted a 1/4-horsepower motor, a grinding wheel driven by a flat belt from the motor, and a swiveling head with a spindle mounted on compound slides, which is driven by a flexible shaft. The slides are scraped in, and fitted with adjustable gibs to take up wear; they are fitted with feed-screws that permit the work-holding spindle to be fed toward the face of the grinding wheel and also in a direction parallel with the face.



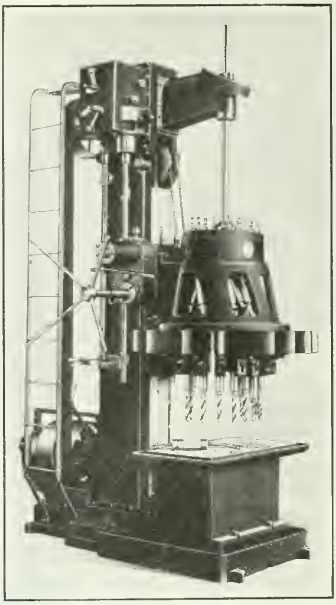
Portable Grinder made by the Franklin Machine & Tool Co., set up for grinding Valve Reseating Cutter

The equipment includes collets for holding valves that are to be reground, and a simple indexing device, shown in the illustration, for use in grinding valve reseating cutters, as well as a flexible shaft equipment adapted for light drilling, buffing, and grinding operations in inaccessible places. Other rotating tools can also be used to advantage with the latter attachment, which is not shown in the illustration. When equipped with a scratch-brush, the latter attachment will make it possible to quickly remove rust from any rust-coated surface, or carbon from cylinder heads, valves, etc. A complete set of attachments for grinding standard types of breaker contacts is also provided, thus making it possible to quickly give pitted contact points the flat contact surface which is so essential to efficient ignition.

An attachment for sharpening reamers, not shown in the illustration, places this tool in the universal grinder class, and gives it a wide range of usefulness. The equipment also includes a line of valve reseating cutters, especially designed to eliminate chatter marks and give maximum service with one grinding. These cutters, one of which is shown in the illustration in the work-holding spindle, consist of an accurately piloted cutter shank having removable cutters with staggered teeth on both sides. When the teeth on one side become dull, the cutter can be quickly reversed on the pilot of the holder, thus presenting the sharp side to the work.

FOX MULTIPLE DRILLING MACHINE

The Fox Machine Co., Jackson, Mich., has developed and placed on the market a machine called the D-32, which is said to be adapted for the driving of a number of large drills in an economical manner. Not only has it been designed to drive the drills satisfactorily, but this machine has also been arranged to speed up and make easier for the operator the raising and lowering of the head carrying the spindles. This is accomplished by mounting an Ingersoll-Rand "Little David" four-cylinder air-motor on the head. The motor, through the medium of reducing gears, rotates the rack pinion, thereby moving the head up and down at the rate of 7 feet per minute. It is controlled by a special valve at the front of the head in such a manner that it is impossible to engage the air motor and power feed at the same time.


Type D-32 Heavy-duty Multiple-spindle Drilling Machine built by the Fox Machine Co.

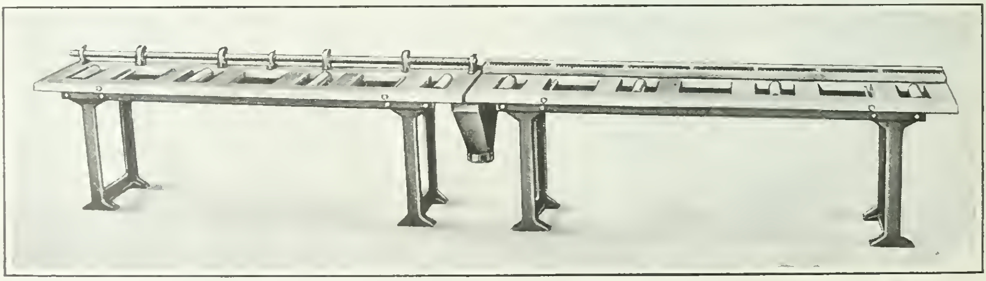
The machine illustrated is a D-32 with a 20-inch round head equipped with twelve spindles, 2 inches in diameter. It can be furnished with heads for large ranges in drilling areas, and for many sizes of spindles. The machine is similar in general construction to the smaller machines built by this firm. The speed and feed changes are obtained by sliding gear transmissions, the gears being flooded with oil from a pump at the base of the column. The gears are all hardened, and Hyatt roller bearings of liberal size are used. The head is mounted on a saddle which permits a longer bearing on the column ways than is possible with a head mounted directly upon the column. This is a particularly desirable feature in a machine of this type, where an enormous pressure is required to force the large drills to their work. The head can be furnished with two speeds to each spindle, so that the speeds of all spindles can be varied independently of one another. All spindles which are not in use may be thrown into a neutral position. The feed is engaged by means of a sawtooth clutch, so arranged that its members are forced apart when the adjustable stop on the side of the column has been reached. This is particularly desirable when drilling blind holes, as the angle of the teeth is such that they cannot cling together.

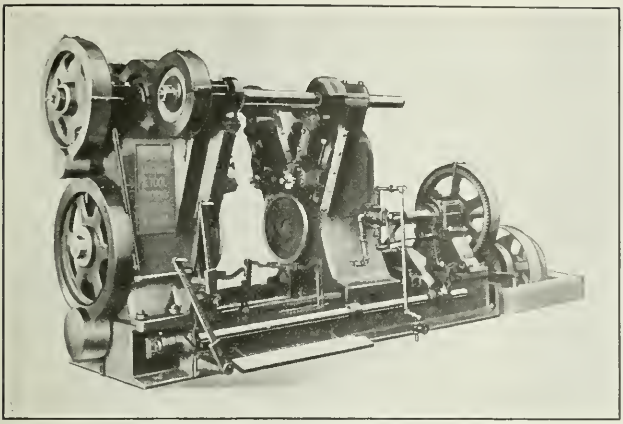
This type D-32 multiple-spindle drilling machine can be equipped with the Fox tapping attachment, which is built so as to make it possible to reverse the spindles at any time during the tapping operation, and to instantly change the rotation back to the original direction. The load is taken off the entire machine and the taps when the spindle reversal takes place, making the tapping of blind holes an easy operation and eliminating all shock to the machine from the spindle reversal.

The head of the machine is provided with a power feed in either direction equal to the lead of the taps that are being used, the direction of the feed being controlled by the direction of the spindle rotation. This machine may also be furnished with rotary tables so that loading can proceed at the same time that drilling is being done under the head. This also makes possible the performance of successive operations on the same piece under the head, by indexing the table the required amount. The weight of this machine varies from 9000 to 12,000 pounds.

OLIVER SWING CUT-OFF SAW TABLE

The Oliver Machinery Co., Grand Rapids, Mich., has recently designed and placed on the market a swing cut-off saw table which is illustrated herewith. It is 16 feet long by 19½ inches wide, and 30 inches high. This table is intended for use with an overhead swing cut-off saw. The top is made of kiln-dried rock maple, with angle-iron girths and one-piece cast-iron legs. From the illustration it will be seen that the table is composed of two parts or sections. On the rear of the right-hand section, there is mounted a scale rail graduated in eighths of an inch from 0 to 96 inches. On the left-hand section, there is mounted an Oliver No. 419 automatic swing cut-off saw gage, which comprises a square rod graduated in eighths of an inch from 0 to 96 inches. Four automatic malleable iron stops, one center and two end-rod holders are mounted in place. This automatic saw gage is said to be a saver of considerable time where a number of parts are to be cut off to the same length. After the gage has been set, it is unnecessary to measure any board which is to be cut off to the length designated by the stop. Rollers are inserted in both sections of the table in every other opening for the full length of the table. A dust-chute is fastened between the two sections, having a 6-inch pipe opening connecting to the exhaust system.


Cut-off Saw Table built by the Oliver Machinery Co.



Duplex Double Seamer built by the Niagara Machine & Tool Works

NIAGARA DUPLEX DOUBLE SEAMER

In making metal barrels, four men are employed, by some methods now in use, to provide for double-seaming both ends. A noteworthy saving of labor is accomplished by a horizontal duplex double seamer recently developed by the Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y., which enables one man to successfully take care of this operation. Outstanding features of this machine are that the barrel heads may be readily inserted; barrels can be delivered to and removed from the machine by means of runways; the barrel heads are automatically driven into place; both ends of the barrel are seamed simultaneously; and the rolls are fed automatically. These features result in increased output.

In operating this machine, a barrel with the heads in place, ready for performing the seaming operation, is rolled in on the horizontal bars. The barrel is located on the supports by means of stops, and is raised into line with the chucks by a foot-treadle. The column is then moved into position by the hydraulic cylinder which is controlled by a hand-lever. Pressure thus exerted clamps the barrel between the two chucks, forces the heads into their proper positions, and holds the body during the performance of the seaming operation.

Another hand-lever releases a positive instantaneous clutch and starts the same operation by setting the two camshafts into motion. The curling rolls are automatically brought down to the work to provide for curling the seams, after which these rolls recede and the flattening or finishing rolls move into position and complete the seams. A predetermined number of revolutions allows sufficient time for the proper performance of the work, only about forty revolutions of the chuck or barrel being required to complete the seams. This machine will handle barrels from 18 to 36 inches in diameter, and from 20 to 45 inches in height. Material up to No. 12 gage can be worked in this machine.

NORTON AUTO-PART REGRINDING MACHINE

The Norton Co., Worcester, Mass., has recently placed on the market a special type of grinding machine, adapted for the regrinding of crankshafts, pistons, piston-pins, valves, etc. This machine is illustrated in Fig. 2 and is arranged so that various set-ups required on automobile regrinding work can be easily and quickly made. Both large- and small-diameter grinding can be performed on the machine.

The base of the machine is heavy and rigid, and is supported at three points, which makes it unnecessary to provide special foundations for the machine. The wheel-slide is of extra heavy design, weighing about 900 pounds, and is equipped with a 26-inch diameter grinding wheel which gives ample clearance when grinding crankshafts for long-stroke motors. This heavy slide is moved one-eighth of a thousandth inch for every space that the feed index-pin is moved. Except for the heavier construction, the headstock and footstock are of standard Norton design; they also have longer bearing surfaces on the table. The machine is equipped with a large-capacity coolant pump. The wheel-feed mechanism of the machine is of standard Norton construction and consists of a 3½-inch diameter feed-screw engaging with a half-nut underneath the wheel-slide. The wheel-slide is supported on generously proportioned ways.

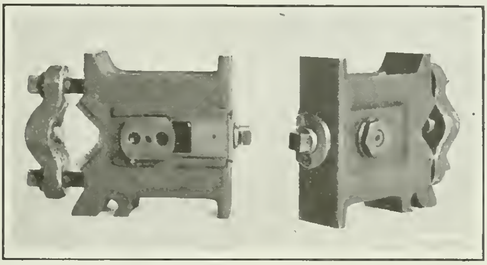


Fig. 1. Type of End-block furnished with Norton Grinding Machine shown in Fig. 2

In order to provide for the many types of crankshafts which the automobile repair shop handles, an adjustable end-block, as shown in Fig. 1, is furnished with the machine, and by the use of blocks of this type no bushings are required for fastening different diameters of shafts in the fixture. A combined center and valve-face grinding attachment is also furnished as a part of the regular equipment of the machine. The attachment is adjustable, permitting the regrinding of the faces of valves of different types. This

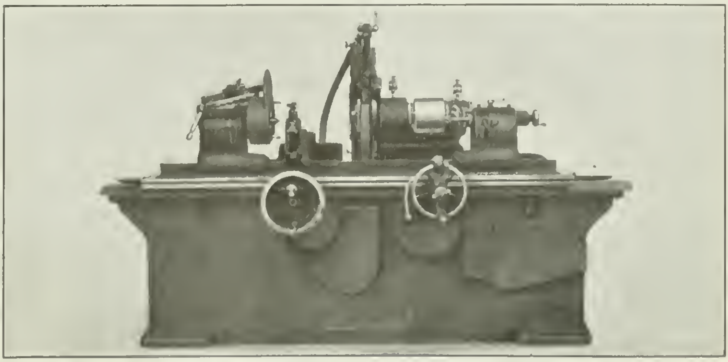


Fig. 2. Grinding Machine for Automobile Regrinding Work, made by the Norton Co.

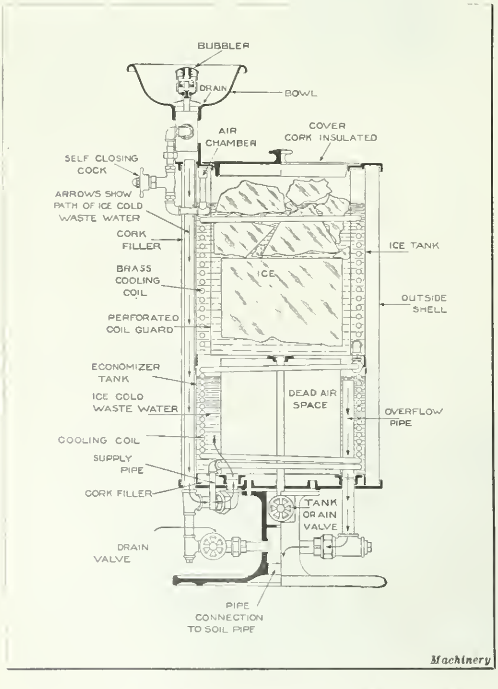
grinding attachment is also used for regrinding the machine centers.

The distance between centers of the machine is 55 inches; the swing, 18 inches; length of bearing ways, 24½ inches; dimensions of large bearing, 3½ inches in diameter by 8 inches long, and of the small bearing, 2 inches in diameter by 6 inches long. There are twelve work-speeds, ranging from 20 to 207 revolutions per minute, and the table of the machine is operated by a two-speed hand-feed apron. The machine weighs 7600 pounds.

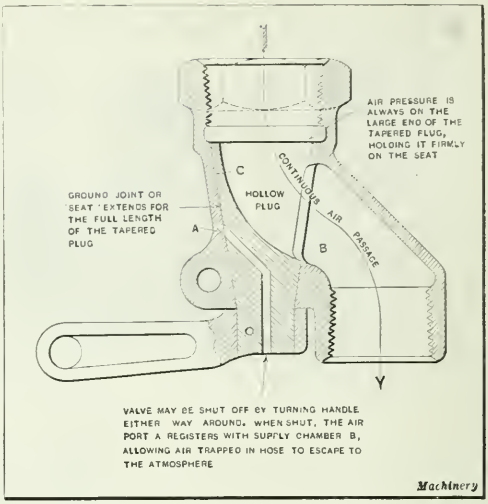
"ECONOMIZER" FOUNTAIN

The "Economizer" combination ice- and water-cooled fountain shown in section in the accompanying illustration has recently been perfected by the Manufacturing Equipment & Engineering Co. of Boston, Mass. The novel feature of the "Economizer" fountain is that there are two coils provided for the circulation of the water, and two cooling compartments. One of the coils is cooled by the direct contact of the ice, and the other by the cold water which is wasted during drinking. This water returns to a lower compartment in which the water-cooled coil is contained. It is stated that by using the waste water to pre-cool the water before it passes to the ice-cooled coil, a considerable saving in ice is realized.

As a means of assuring long usage, the coils are made of copper rather than of brass. Either the inclined or vertical stream or bubbler can be used in connection with this fountain. The bowl may be of varied design, but the type usually furnished with the fountain is an elliptical one with provision for delivering an inclined stream, and a cowl guard provided for sanitary purposes. The design of the "Economizer" makes provision for adapting the attachment to various designs of ice-cooled fountains already in use. The matter of establishing sanitary conditions for supplying drinking water for the accommodation of a considerable number of employes is an important hygienic consideration.



Sectional View of Water-cooler, made by the Manufacturing Equipment & Engineering Co.


AIR PRESSURE IS ALWAYS ON THE LARGE END OF THE TAPERED PLUG, HOLDING IT FIRMLY ON THE SEAT
C
CONTINUOUS AIR PASSAGE
GROUND JOINT OR SEAT EXTENDS FOR THE FULL LENGTH OF THE TAPERED PLUG
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VALVE MAY BE SHUT OFF BY TURNING HANDLE EITHER WAY AROUND. WHEN SHUT, THE AIR PORT A REGISTERS WITH SUPPLY CHAMBER B, ALLOWING AIR TRAPPED IN HOSE TO ESCAPE TO THE ATMOSPHERE
Machinery

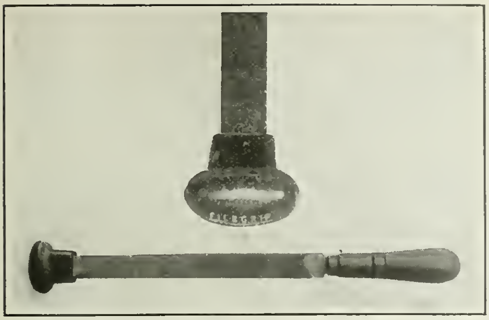
"Cleco" Pressure-seated Air Valve made by the Cleveland Pneumatic Tool Co.

"CLECO" PRESSURE-SEATED AIR VALVES

The Cleveland Pneumatic Tool Co., Cleveland, Ohio, has recently brought out an air valve for general service, which contains new features of interest to all users of compressed air. The sectional illustration shows this new valve, which is designed to eliminate air losses through leakage in transmission. The destructive action of compressed air upon valve seats, packing, and gaskets is well known, and there has been for some time a demand by air users for a valve that would stand up in high-pressure pneumatic service. In view of this fact, it was decided by the engineers of the Cleveland Pneumatic Tool Co. to design a valve in which the air could not come into contact with the seat, thus avoiding replacement of this part, and also to utilize the air pressure as a seating agent to hold the valve plug down. This design eliminates the use of packing, gaskets, stems, and springs, and reduces the valve parts to three, namely, the body, plug, and handle.

This was successfully accomplished by using a hollow tapered plug with the large end uppermost, the air entering at the top, and passing through and out of an opening in one side of the hollow plug into the supply chamber which connects directly with the air hose, without coming into contact at any time with the valve seat, which is the outer wall of the plug, as indicated by the letter *C* in the illustration. The long arrow shows the direction of the air in its travel through the wide unobstructed air passage of the valve, which is free from any angular turns to impede its progress. The short arrow indicates the point on the large end of the plug where the air pressure is constant, forcing the tapered plug against the walls of the valve body and forming a perfect seat.

The valve is provided with a waste arrangement, to allow the accumulated pressure in the air hose to escape when the valve is shut off, consisting of air ports *A* and *B*. This is to safeguard the operator, who, when disconnecting the hose from the valve, often receives a gush of air in the face and accidentally gets scale or grit in his eyes. This new valve has been subjected to very severe service tests under both high and low air pressures, the high pressure being 500 pounds, as well as submerged water tests, and it is said to have successfully passed the most exacting tests that could be devised on liquids under pressure and on acetylene gas lines.



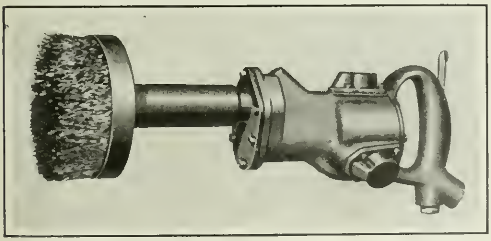
Safety File-grip made by the J. L. Osgood Tool Co.

OSGOOD SAFETY FILE-GRIP

To afford a convenient means for a machinist to hold the outer end of a file, the J. L. Osgood Tool Co., 45 Pearl St., Buffalo, N. Y., has recently placed on the market a pliable rubber grip which can be slipped on the end of a file and prevents the left hand from being cut or becoming sore by constant pressure on the teeth. It is also claimed that this grip assists in holding a file flat on the work, thus improving the quality of filed surfaces. Attention is called to the fact that a file equipped with one of these grips is found useful as a soft-faced mallet for lightly hammering finished surfaces; also, this grip prevents injury to finished surfaces if a file is accidentally dropped on the work. These grips are made to fit files of all shapes and sizes.

INGERSOLL-RAND AIR-OPERATED WIRE BRUSH

The use of a wire brush for cleaning metal surfaces offers an opportunity for effecting a considerable saving of time and labor over that required to do such work by hand. A brush is adapted for removing paint, rust, scale, and dirt from metal surfaces. However, it has been difficult to obtain a wire brush of proper design and made of the right materials to work effectively on an air motor and not wear out too rapidly. A wire brush of very rugged design has recently been placed on the market by the Ingersoll-Rand Co., 11 Broadway, New York City, for use with its standard No. 6 "Little David" pneumatic drill. It is a brush with a face diameter of 5 inches, and is made up of wires of a special heat-treated steel that has been found to have very good wearing qualities. It is sturdily constructed and will stand up under severe service.

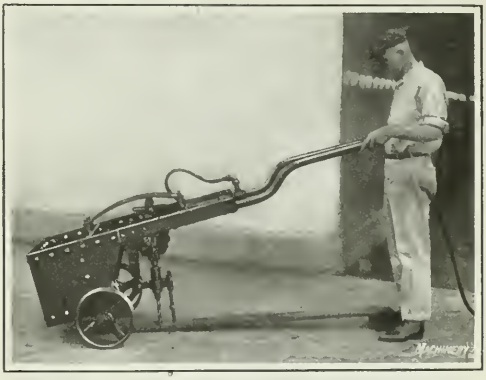


"Little David" Air-operated Wire Brush made by the Ingersoll-Rand Co.

This brush is manufactured particularly as an attachment for the No. 6 drill (as illustrated), this type of machine being especially suited for work of this nature. The drill has liberal bearings to take up all the end thrust when pressing down on the work; and it is furnished with a high-speed motor. Moreover, it is of light weight and small over-all dimensions, and can be used in sharp corners and other cramped spaces. The whole unit weighs only 11½ pounds. The wire brush outfit is very useful for cleaning iron, steel, and aluminum castings.

PORTABLE PLATE DRILLING MACHINE

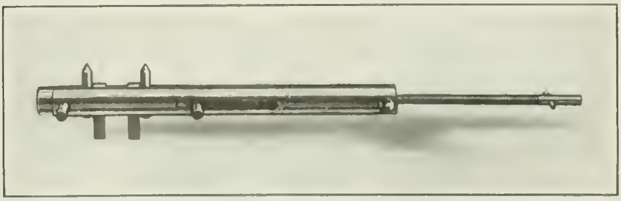
The portable plate drilling machine shown in the accompanying illustration is the patented product of E. L. Fogleman, Box 245, Balboa, Canal Zone. While the illustration shows quite clearly the construction of the machine and its method of operation, it should be mentioned that it has a capacity for drilling holes to any depth up to 6 inches, and the design is such that the drill will always be maintained in a position at right angles to the surface of the work, regardless of whether or not the work is held in a horizontal position. While the machine is intended primarily for drilling and countersinking holes with the tool held at right angles to the base of the work, it is a simple matter to drill holes at any desired angle by adjusting the screw shown in contact with the work at the right of the drill.



Portable Plate Drilling Machine designed by E. L. Fogleman

VAN KEUREN MICROGAGE ACCESSORIES

The addition of a set of accessory measuring tools, for use with the combination microgages manufactured by the Van Keuren Co., 362 Cambridge St., Allston, Boston, Mass., completes and greatly adds to the utility of this company's line of measuring tools. As shown in the accompanying illustration, these accessories are designed to secure rigidity, simplicity of parts, accuracy, and utility. The microgages, which are round in shape, permit the use of a light yet strong and rigid steel tubing for the frame or clamp to hold the microgages and the accessory jaws. They are inserted in the lower or open end of the tube, and the jaws



Microgage Accessories made by the Van Keuren Co.

are inserted in ¼-inch slots as shown. The three sets of staggered slots, instead of one long slot, retain the rigidity of the steel tube, and assure perfect alignment of the measuring jaws. Pressure on the clamping screw releases a button at the top of the tube and permits the clamping screw to be moved quickly to accommodate any combination of gages or jaws. The clamp has a range up to 7 inches. Small dimensions are secured with the jaws in the central slot; and for long combinations, the two end slots are used.

The measuring jaws include two flat jaws 0.300 inch in thickness, two plain 0.250-inch plugs, and two 60-degree–0.250-inch scribing plugs. A base block 1.000 inch in thickness, which is held in place by one of the 0.250-inch plain plugs, permits measurements to be established at a definite height above a surface plate. The two flat jaws are of a definite thickness, and when separated by the desired combination of gages, they may be used for making either inside or outside measurements. The plain 0.250-inch plugs are likewise used for the measurement of diameters of holes or of the smallest or largest distance between parallel holes. The 60-degree—0.250-inch plugs are used for trammel points, for checking the lead of threads, and for scribing lines and locating height dimensions. As all of the measuring parts are of extremely simple construction, embodying plain flat or cylindrical surfaces, they are claimed to be as accurate as the microgages themselves. This simplicity of construction also facilitates manufacture and thus reduces the cost of production.

NEW MACHINERY AND TOOLS NOTES

Steam Tractor Crane: Locomotive Crane Co. of America, Champaign, Ill. A small steam tractor crane for operating a ¾-cubic yard clam-shell bucket. The steam engine is of a double-cylinder, throttle, reversing type. The weight of the crane is 29,000 pounds.

Line-reamer: New Britain Tool & Mfg. Co., Inc., New Britain, Conn. An expansion reamer known as the "line-reamer," intended primarily for use in garages and automobile repair shops in reaming the worn holes of pistons and other engine parts to standard over-size dimensions.

Flexible Coupling: Ajax Flexible Coupling Co., Westfield, N. Y. A flexible shaft coupling consisting of two flanges into which are fitted bolts that project from one flange to the other and pass through flexible members, the heads of the bolts being placed alternately on opposite sides. The coupling is insulated to make it suitable for electric drives.

Rotary Oil-pump: S. F. Bowser & Co., Inc., Fort Wayne, Ind. A motor-driven rotary oil-pump intended for unloading tank cars, supplying oil to furnaces, and transferring oil from one floor to another in a plant. A foot-valve is furnished with each outfit, and a gage indicating pressures up to 100 pounds is mounted on the upper end of the air chamber.

Grinders: J. L. Austin Mfg. Co., Milwaukee, Wis. Three sizes of power-head grinders which can be furnished either with or without a pedestal and with either a single or double pulley drive. The rest arms are equipped with both an angle and a bevel tool rest. The dimensions of the wheel on the various sizes are 8 by 1 inch, 10 by 1½ inches, and 12 by 2 inches.

Reamer Grinding Attachment: G. L. Wood, 61 Stafford St., Worcester, Mass. A grinding attachment particularly adaptable to hand expansion reamers with pilots, but applicable as well to machine reamers, pin cutter bars, boring-bars, and taps. In grinding expansion reamers, the reamer is expanded from 0.001 to 0.002 inch according to the dullness, and then ground to size.

Rotary Indexing Table: Rhodes Mfg. Co., Hartford, Conn. An 8-inch diameter rotary indexing table, intended primarily for use with the shapers built by this firm, but which may also be used on milling and drilling machines, etc. Three index-plates are provided to permit any number of divisions up to 360 to be obtained. The rotary table is graduated in degrees to facilitate making angular settings.

Tool-hardening Furnace: Advance Furnace & Engineering Co., Springfield, Mass. A small furnace designed for tool-hardening and for the heat-treatment of small parts. It is of the semi-muffle type with the flame chamber located below the floor of the heating chamber, the latter being heated through flues. The burner, which is located in the rear of the furnace, may be adapted for burning either oil or gas.

Electric Crane Truck: Elwell-Parker Electric Co., Cleveland, Ohio. The low-bed electric industrial truck manufactured by this concern has been fitted with a crane to adapt it for loading, hauling, and tiering. The crane can lift pieces weighing up to 2000 pounds and can stack material to a height of eight feet. The power unit for the crane consists of a motor, controller, hoisting mechanism, and battery.

Shaper: Rhodes Mfg. Co., Hartford, Conn. The shaper manufactured by this concern has been provided with a knee that may be swiveled to any angle, and has been made an independent unit by providing brackets on the column for supporting a ½-horsepower driving motor. The machine and motor are prevented from injury due to accidental stalling by the interposition of a countershaft between the motor and the machine.

Electric Storage-battery Tractor: Atlas Car & Mfg. Co., Ivanhoe Road, Cleveland, Ohio. An electric storage-battery tractor, 7 feet long and 40 inches wide, which may be equipped with either a two- or four-wheel drive and has three speeds in either direction. The battery equipment consists of forty-two alkaline or twenty-four lead storage batteries. The weight of the tractor with the batteries is approximately 3900 pounds.

Drafting Outfit: Simplex Tool & Instrument Co., 820 N. Third St., Camden, N. J. A drafting outfit consisting of a frame supporting a drawing board on which is mounted a parallel ruling device to which scales are fastened. The drawing board may be placed in either a horizontal or a vertical position. A sliding horizontal board beneath the main board forms a table to hold reference drawings and also serves as a desk for clerical work.

Scrap-baling Press: Reeves-Boggs Machinery Co., 2926 Grand Ave., Chicago, Ill. A line of four machines for baling scrap, the two smaller sizes of which make bales 5 by 5 by 10, and 5 by 5 by 12 inches, respectively. These machines are intended for baling skeleton punchings of sheet brass, copper, aluminum, and other soft metals. The two larger presses make bales 12 by 12 by 12, and 14 by 14 by 16 inches, respectively, and are suitable for sheet-metal scrap of No. 14 gage and lighter.

Rebabbitting and Reboring Outfits: Detroit Garage Equipment Co., 268 Jefferson Ave., Detroit, Mich. A line of equipment for rebabbitting and reboring the crankshaft bearings of automobile and other gasoline engines. A two-quart combination blow-torch and melting pot is included. This company also makes a cylinder reboring outfit, intended for reboring and burnishing the cylinders of Fordson and Ford Model T motors; this outfit is used in connection with upright drilling machines.

Wheel-bushing Chuck: Commercial Welding & Machine Co., Inc., 21 Commercial St., Worcester, Mass. A chuck developed to facilitate the bushing of grinding wheels. The design embodies two independent chucks, one of which holds the bushing arbor, and the other, the wheel or part to be bushed. It is claimed that the chuck is centered accurately and that the hole is produced at right angles to the side of the wheel. The chuck is made in an 18-inch size and mounted on three legs. A lathe chuck is also built for use in turning abrasive wheels.

Double-crank Press: Toledo Machine & Tool Co., Toledo, Ohio. A large double-crank press developed especially for use in the manufacture of automobiles. It may be used for blanking, forming, and perforating side rails and running boards, for blanking and forming certain kinds of cross-members and rear axle housings, fenders, aprons, doors, etc. A cam-actuated stripper and clamping device is provided for use in connection with perforating dies, while a spring-pressure drawing attachment is also provided for use with forming dies. A power elevating device raises and lowers the slide when setting the dies.

Horizontal Boring and Drilling Machines: Jones Machine Tool Works, Philadelphia, Pa. Two machines, one for horizontal drilling and the other for horizontal boring and drilling. The No. 3 drilling machine is driven by a 3½-horsepower variable-speed motor. The spindle has a horizontal traverse of 20 inches, the forward feed being by hand or power and the reverse by hand only. The saddle has a vertical traverse of 30 inches, and the column a transverse movement of the same amount. The table can be tilted 45 degrees from the horizontal, either toward the spindle or away from it. The No. 3 boring and drilling machine is similar to the drilling machine, except that the base is lengthened to provide for supporting the boring-bar and facing head when cylinders, etc., are being machined.

NEW BOOK ON MATHEMATICS FOR THE SHOP MAN

Arithmetic, Elementary Algebra and Logarithms. By Erik Oberg. 121 pages, 6 by 9 inches. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

In the present volume the subjects of arithmetic, algebra, and logarithms have been dealt with in a manner quite different from that found in ordinary text-books. It has been the object of the author to give to the practical man engaged in the industries an elementary text-book from which he may gather such information on the subject as will enable him to solve the everyday problems encountered in machine design and shop practice. Theoretical discussions of the mathematical principles upon which the methods of arithmetic, algebra, and logarithms are based have been avoided, and an effort has been made to impart simply a working knowledge of the use of the processes involved. By an hour's study each day for a brief period anyone familiar with the first principles of arithmetic should be able to acquire a sufficient knowledge of the mathematical subjects dealt with in this book to enable him to apply to his daily work the simple methods of mathematics explained. In the chapters on algebra, as well as on logarithms, numerous examples are given for the student to work out, in order that he may acquire sufficient practice to enable him to use the methods in everyday practical shop problems. Logarithmic tables, in large clear type, are also included. No attempt has been made to prove the rules given. Instead, the rules and formulas are stated as matters of fact—like tools to be used by the practical man. In other words, the book is a text-book, not on mathematics, pure and simple, but on the application of arithmetic, elementary algebra and logarithms in machine design, shop practice, and industrial work in general.

* * *

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of Machinery, published monthly at New York, N. Y., for April 1, 1921.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Matthew J. O'Neill, who, having been duly sworn according to law, deposes and says that he is the treasurer and general manager of The Industrial Press, Publishers of Machinery, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Industrial Press	140-148 Lafayette St., New York
Editor, Erik Oberg	" " " " "
Managing Editor, None	
Business Managers:	
Alexander Luchars, President	" " " " "
Matthew J. O'Neill, Treasurer and General Manager	" " " " "

2. That the owners of 1 per cent or more of the total amount of stock are:

The Industrial Press	140-148 Lafayette St., New York
Alexander Luchars	" " " " "
Matthew J. O'Neill	" " " " "
Louis Pelletier	" " " " "
Erik Oberg	" " " " "
H. L. Ketchum	" " " " "
E. Y. Urban	" " " " "

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MATTHEW J. O'NEILL, General Manager

Sworn to and subscribed before me this 31st day of March, 1921.

WILLIAM E. BACON,
(SEAL) Notary Public, Kings County No. 411
Kings Register No. 3109
New York County No. 79
New York Register No. 8047
(My commission expires March 30, 1923.)

MATCH PLATE DRILLING MACHINE

The special drilling machine illustrated herewith was recently designed and constructed by the Langelier Mfg. Co., Providence, R. I. This machine is intended for drilling hundreds of holes in plates used for holding matches while they are being dipped in a phosphorus bath. The machine is of the column-and-knee design, and has a box-type base to which the column is bolted. It is belt-driven and is provided with hand feeds throughout. The knee carries the saddle, supported by flat cross-ways *A*, Fig. 2, the table of the machine being adjusted transversely by the hand-lever *B*. The shaft to which the hand-lever is attached is supported in bearings from the saddle. These bearings are located far enough apart to allow the required longitudinal travel of the table, during which movement the shaft slides through bearing *C*.

The saddle also carries a double-tooth pawl *D* which limits the longitudinal movements of the table, this pawl being connected by a vertical bar to the foot-treadle, by means of which the pawl is disengaged. By designing the pawl with two teeth, the amount of wear caused by its frequent use in indexing the machine table is distributed over twice the area that would be in engagement if a pawl having but one tooth were used. A steel rack *E*, in which saw-teeth are cut at the desired intervals, is attached to the table of the machine by bolts, and its position may be longitudinally adjusted as required when setting up the machine.

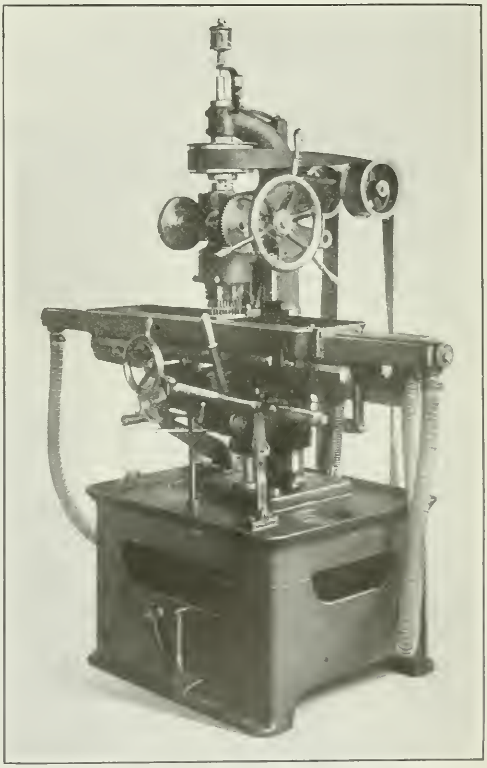
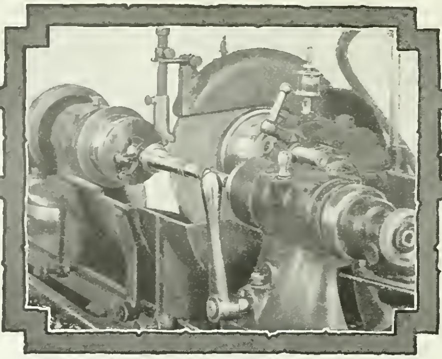


Fig. 1. Langelier Match Plate Drilling Machine

The machine has two special features—the multiple drill head *F*, and the coolant system. The multiple drill head is a special Langelier product. The spindles are located on fixed centers in a hard phosphor-bronze bearing head. These spindles are made from alloy steel bar, hardened, heat-treated, and ground to size. They are provided with special chucks for taking straight-shank tanged drills. There are

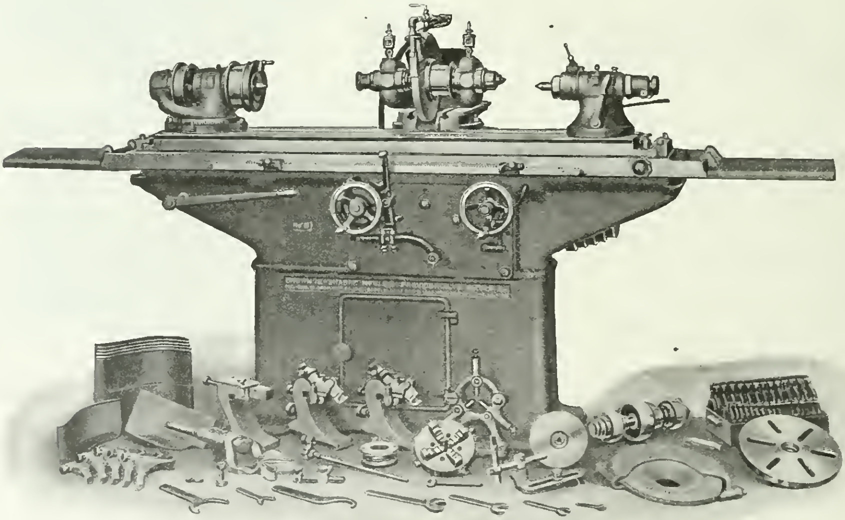


GRINDING TWO TAPERS AT ONE SETTING

BROWN & SHARPE

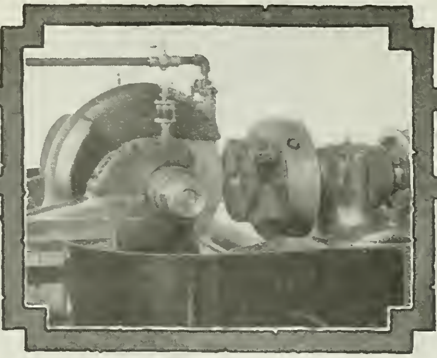
Universal For Diverse

The usefulness of a Brown & Sharpe Universal Grinding Machine is soon apparent in the shop having a wide variety of work at hand. The handiness of any one of the four sizes is such that they prove profitable in every shop. The quick setting up features make these versatile machines valuable on the manufacturing floor as well as in the tool-room.



BROWN & SHARPE MFG. CO.

GRINDING MACHINES

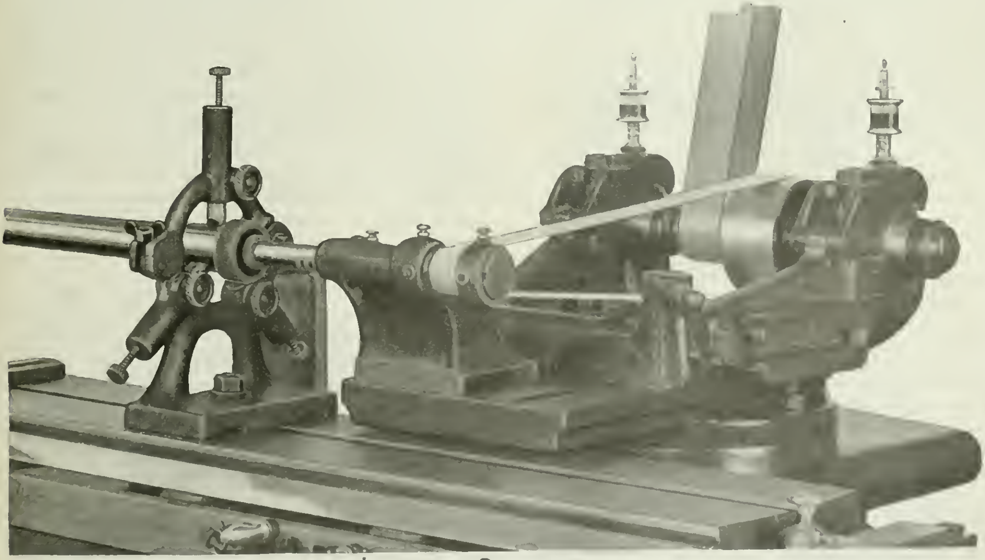


DISK GRINDING

Machines Set-Ups

The wide range of work to which they are readily adapted not only includes straight and taper grinding but internal and external grinding and such operations as shown in the illustrations, as well as tool and cutter grinding.

Send for our General Catalog No. 137 listing these machines.



INTERNAL GRINDING

PROVIDENCE, R. I. U.S.A.

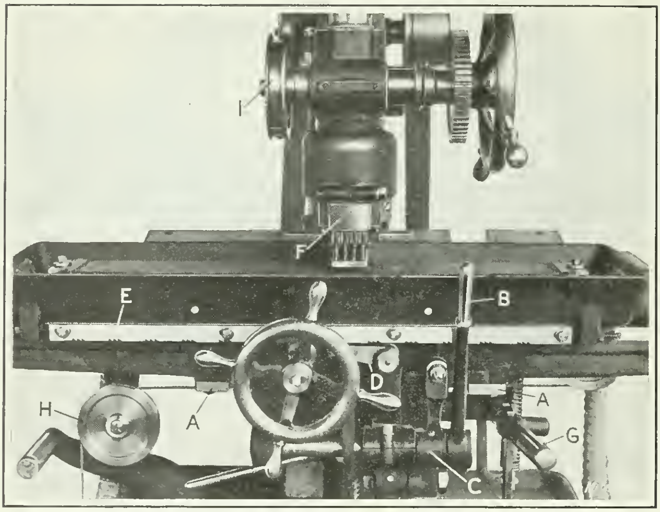


Fig. 2. Close-up View of Langelier Drilling Machine, showing Special Features

no gears of any kind used in the construction of these drill heads, the spindles being of the crank type, driven from a phosphor-bronze driving plate. This spindle driving plate is carefully balanced to eliminate practically all noticeable noise and perceptible vibration when the drills are operated at their recommended speeds. The drills are arranged in straight rows and in quantities to suit the convenience of the special jobs for which they are constructed. For the work here considered, there are three sizes of heads used, having eighteen, twenty-four, and thirty-two spindles, respectively. The spindle of the machine is drilled eccentrically to receive the straight shank of the drill head, and this eccentricity gives the throw to the driving plate by means of which the spindles are operated. The drill head is furnished with thrust ball bearings, and the ends of the drills are guided by a jig plate which may be adjusted vertically to suit the length of drills used.

The other special feature is the coolant system. The coolant is contained in an enclosed sheet-metal tank attached to brackets at the rear of the column. These brackets may be swung upward to tip the tank, by operating hand-lever *G*. The tank is connected by a hose which permits the coolant to flow into the table tray and flood the work. There are screened openings at each end of the table, to which the hose is connected for returning the coolant to the supply tank, but the liquid will not flow back until the hand-lever *G* has been raised, thereby swinging the tank down below the level of the fluid in the table tray. As soon as this level has been passed, the table is quickly drained, allowing access to the work for removing it.

Four examples of the type of work for which this machine is used are shown in Fig. 3. In the first plate at the top the 576 holes are arranged in twelve rows of forty-eight holes each, and a twenty-four spindle drill head, having four rows of six drills each, completes the drilling of the plate in twenty-four settings of the machine table. The holes in the second match plate are in twelve rows, seventy-two to a row, and an eighteen-spindle drill head drills this plate in forty-eight settings of the table. The third match plate, containing 832 holes arranged in rows of 104, requires twenty-six settings of a thirty-two spindle drill head. The fourth plate is made of steel instead of cast iron and is drilled similarly to the plate above it, in twenty-six index movements of the table.

A separate fixture is required for each plate. These fixtures are of extremely simple design, being provided with a tongue that fits the slot in the machine table, and having spring stops to engage the end of the work. The work is prevented from springing under the pressure of the tools by knurled adjusting nuts placed quite close together in the base of the fixture. After the plate has been clamped down on the fixture, the table is run to the extreme left, at which point the pawl *D* is engaged with the two notches at the extreme right-hand end of the index rack *E*. The hand-lever *G* is then lowered, and becomes locked in this position while the coolant is permitted to flow on the work and cover it.

As soon as one cluster of holes has been drilled, the foot-lever is operated, withdrawing the pawl from the index rack, and the table is fed to the right a distance of 3/10 inch, which in this case is the spacing between holes in the work. This center-to-center distance of the holes is so short that it is impracticable to drill successive holes at once; therefore the head is so designed that the distance between the drills provides for drilling every other hole at each setting. Located in the second position, the operation is repeated on the second quantity of holes, and then the table is indexed to the first of the next three index notches, and from then on to the end of the table travel the operations are repeated. When the table has been indexed, step by step to the right, and all the holes in a row have been drilled, hand-lever *B* slides the table forward 3/10 inch, thus relocating the work for its second lengthwise traverse.

The table is returned by a weight hanging over sheave *H*, which operates as soon as the pawl is released, and brings the table against a spring buffer at the left of the machine. After one table traverse is completed, lever *G* is raised, lowering the coolant tank and permitting the flooded work to be drained. The spindle is raised by a spring attached to flanged pulley *I*, carried on the feed-shaft. This shaft has a spur gear near the handwheel, for use with power feed. The machine weighs approximately 2600 pounds.

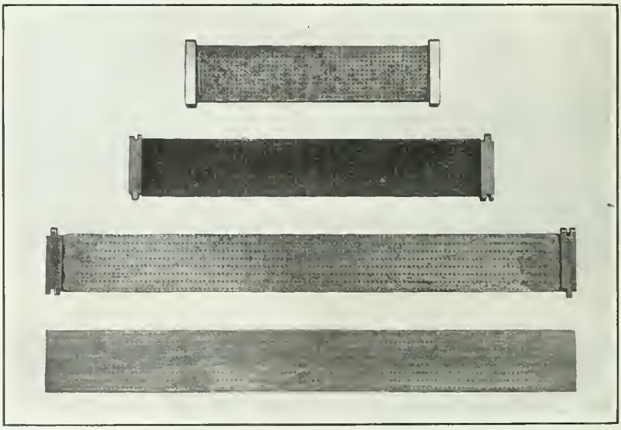
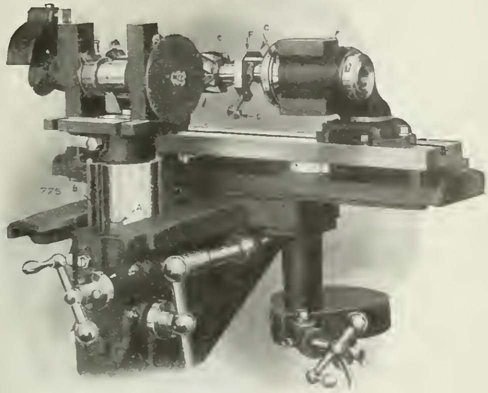


Fig. 3. From Top to Bottom: 3/16 Iron Plate—576 Holes—No. 41 Drill—8 Minutes; 3/16 Iron Plate—864 Holes—No. 36 Drill—14 Minutes; ½ Iron Plate—832 Holes—No. 38 Drill—18 Minutes; 1/4 Steel Plate—832 Holes—No. 38 Drill—12 Minutes



Method of setting for clearance

It has been demonstrated that the correct clearance angle to suit the work to be milled, is the most important thing about cutter sharpening. The Cincinnati Clearance Setting Dial is the only device that will produce the correct clearance angle in every-day cutter grinding practice.

The Cincinnati Patented Clearance Setting Dial

Patents Sustained by the Courts

There is a graduated dial on the work head spindle, from which the clearance angle may be read direct. This eliminates the use of tables and formulas. You can always duplicate exactly the correct clearance at repeated grindings.

You avoid the inaccuracy of determining clearance by the old method of measuring vertical adjustment. It is simple to use, and insures accurate results. No other Grinder provides a setting dial. Our patents have been sustained by the Courts. This feature alone gives our machines unusual value over all others.

Grind your cutters the Cincinnati Way and you will get more work, of a better quality from your Millers.

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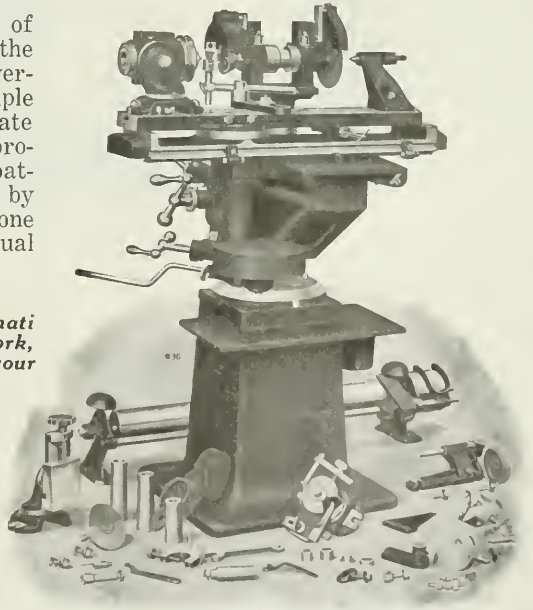

The No. 1½ Cincinnati Universal Cutter and Tool Grinder

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CINCINNATI, OHIO

PERSONALS

Dr. Albert Sauveur, professor of metallurgy at Harvard University, has been elected an honorary member of the American Society for Steel Treating.

Glenn Muffly, formerly sales manager of the Lees-Bradner Co., Cleveland, Ohio, has become sales manager of the Miller Shock Equalizer Co., of Cleveland.

C. Earle Smith of the National Twist Drill & Tool Co., Detroit, Mich., has recently been elected a member of the board of directors, and is now secretary and sales manager of the company.

B. Fortuin, formerly secretary and treasurer of the Duke Steel Co., Inc., 191 Pearl St., New York City, is now president and treasurer, succeeding W. B. Dukeshire, who is no longer connected with the company.

D. W. Patten, formerly connected with the New Britain Machine Co., New Britain, Conn., in the capacity of salesman in the northern Ohio district, is now associated with the Hess-Schenck Co. of Cleveland, Ohio, in a similar capacity.

A. E. Hackett has been placed in charge of the Detroit office (1724 Dime Bank Bldg.) of the Federal Machine & Welder Co., of Warren, Ohio. This office was formerly in charge of Arthur E. Meyer, who resigned on account of ill health.

Clyde E. Dickey has resigned his position as general manager of the Hammond Steel Co., Inc., Syracuse, N. Y. Mr. Dickey is president of the Dickey Steel Co., Inc., 233 Broadway, New York City, and will devote all his time to this company in the future.

Edward C. McSheehy, formerly manager of the David A. Wright Machinery & Equipment Co., Chicago, Ill., is now representing the Steel & Tube Co. of America, and the Mark Mfg. Co. of Chicago, in the Colorado, Wyoming, and Montana oil fields, with headquarters in Denver.

Stanley Mazurek, Jr., has been placed in charge of the Chicago office at 15 S. Clinton St., of the Federal Machine & Welder Co., of Warren, Ohio. Mr. Mazurek has been assisting in the selling organization for some time, but now assumes full control of the Chicago office.

John J. Swan, formerly associated with the Prest-O-Lite Co., Indianapolis, Ind., has become connected with the Engineering Business Exchange of New York City. Mr. Swan was for a time one of the editors of the *Engineering News*, and later held engineering and executive positions with the Ingersoll-Rand Co., Chicago Pneumatic Tool Co., Keller Mfg. Co., and the American Arms Corporation.

D. C. Paul, formerly with the Gaul, Derr & Shearer Co., Philadelphia, Pa., is now representing the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., in Pittsburg, Pa., with headquarters at 303 Penn Ave. The Pittsburg branch, of which Mr. Paul is manager, includes western New York, western Pennsylvania, and the northern part of West Virginia. A completely equipped service station is maintained at this branch, with a factory trained service man in charge. Mr. Paul is assisted by Frank E. Marrion and J. A. Miller.

Homer J. Forsythe, manager of the construction division of the engineering department of the E. I. Dupont de Nemours & Co., Inc., Wilmington, Del., has been transferred to the position of assistant general manager of the Hyatt Roller Bearing Co., at Newark, N. J., a subsidiary of the General Motors Corporation. He had been with the engineering department of the company since August, 1906. During the war he was made manager of the combined Wilmington shops, one of the major divisions of the Dupont Engineering Co., which was engaged in the construction of materials for the war plants. At the end of the war he was promoted to the position of manager of the construction division of the engineering department, which he held until his recent transfer.

Frederick M. Feiker, vice-president and chairman of the editorial board of the McGraw-Hill Co., Inc., New York City, has been appointed personal assistant to Herbert Hoover to organize and develop those branches of the Department of Commerce which relate directly to commerce and industry. Mr. Feiker is an electrical engineer by profession, and has been especially interested in aiding Mr. Hoover in the development of his plan for the elimination of waste in industry, which was undertaken by the Federated American Engineering Societies at Mr. Hoover's suggestion. He is a graduate of the Worcester Polytechnic Institute, and was for several years chairman of the editorial board of the A. W. Shaw publications of Chicago. He has been managing editor of *Factory*, and editor-in-chief of the *Electrical World*, and in 1916 established *Electrical Merchandising*. Mr. Feiker hopes to be able to assist Mr. Hoover in the development of the statistical and research branches of the Government in such a way as to provide information and help for the needs of the average business man and the small manufacturer.

NEW PRESIDENT OF MANNING, MAXWELL & MOORE, INC.

J. M. Davis, formerly vice-president of the Baltimore & Ohio Railroad, has been elected president of Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City, to succeed the late A. J. Babcock. Mr. Davis has served as superintendent of the Great Northern Railway, of the Erie Railroad at Scranton, Pa., and of the Allegheny Division, as well as of the Oregon short line and the Central District of the Southern Pacific. He entered the service of the Baltimore & Ohio Railroad in January, 1914, and later in the same year was appointed general manager of the Baltimore & Ohio, Southwestern - Cincinnati, Hamilton, and Dayton lines. In 1916 he was appointed vice-president in charge of operation and maintenance of the Baltimore & Ohio System, and held that position until July, 1918, when under federal control of the railroads he was appointed manager of the New York properties of the Baltimore & Ohio Railroad, including the Staten Island lines. In September, 1919, he left the Baltimore & Ohio Railroad to become president of the Rock Hill Iron & Coal Co. and associated corporations, with headquarters in New York.

* * *

OBITUARIES

Robert L. Bridgman, New England representative of the L. S. Starrett Co., Athol, Mass., died suddenly at his home in Belchertown, Mass., May 7, aged sixty-seven years. Previous to 1908, when he became connected with the L. S. Starrett Co., he served for over thirty years as representative of the Athol Machine Co., traveling over a large portion of the United States.

Thomas L. Smith, founder of the T. L. Smith Co., Milwaukee, Wis., manufacturer of tilting mixers, excavators, crushers, etc., died April 29 at his home in Milwaukee, aged sixty-six years. Mr. Smith was born in England in 1855, and came to this country with his parents at the age of four. He graduated from the Iowa State College at Ames, Iowa, in 1877, and later took a supplementary course in engineering at the Massachusetts Institute of Technology. The early part of his career, immediately following his college life, was spent in drafting and engineering work with a number of large manufacturers in Milwaukee, including the Allis-Chalmers Co., Pawling & Harnischfeger Co., and Kempsmith Mfg. Co. In 1899 he invented the Smith tilting mixer, which was later put on the market by the T. L. Smith Co.

* * *

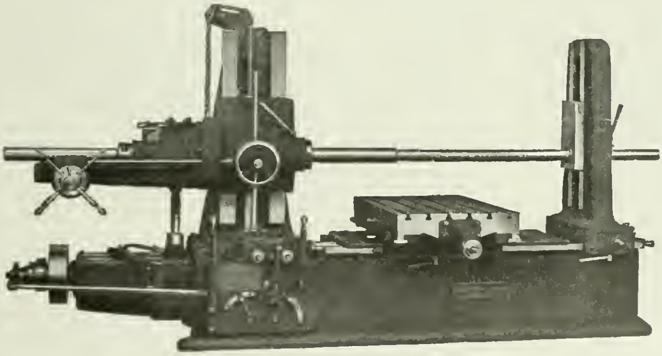
REGIONAL MEETINGS OF THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

Regional meetings have been held by the National Machine Tool Builders' Association in the west during the early part of May, which have developed a great deal of interesting material. This material will be presented to the members of the eastern section at a similar series of regional meetings, which will be held in Boston, June 1; Worcester, June 2; Hartford, June 3; and New York, June 7.

"In the majority of cases, the fewer words used, the better; let the goods talk for themselves."

The "PRECISION"

Boring, Drilling and MILLING MACHINE



IS "THE GOODS" and
DOES talk for itself

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U. S. A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

COMING EVENTS

June 15-16—Annual convention of the American Railroad Association (Section III-Mechanical) at Chicago, Ill.; headquarters, Hotel Drake.

June 20-24—Annual meeting of the American Society for Testing Materials, in Asbury Park, N. J.; headquarters, New Monterey Hotel. Secretary, C. L. Warwick, Philadelphia, Pa.

June 22-24—Annual joint convention of the American Drop Forge Association and the Drop Forge Supply Association in Chicago, Ill. Secretary, American Drop Forge Association, E. B. Horne, 1516 Helen Ave., Detroit, Mich.

September 14-16—Annual convention of the National Association of Cost Accountants in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary's address, 233 Woolworth Bldg., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

September 28-October 8—New York Electrical Exposition at the 71st Regiment Armory, Park Ave. and 34th St., New York City. For information relating to exhibits, apply to Norman Maul, the Electrical Show Co., 130 E. 15th St., New York City, Room 828.

The sectional meetings of the American Society of Mechanical Engineers for June are as follows: **June 13-14**—Cleveland Section at Hotel Statler, Cleveland, Ohio; **June 17**—Inland Empire Section at Spokane, Wash.—joint meeting with engineering societies of Spokane; **June 28**—Atlanta Section at Georgia School of Technology, Atlanta, Ga.

SOCIETIES, SCHOOLS AND COLLEGES

Case School of Applied Science, Cleveland, Ohio. Booklet containing the presentation addresses of Worcester R. Warner and Ambrose Swasey of the Warner & Swasey Co., Cleveland, made upon the occasion of the presentation to the Case School of the Warner & Swasey astronomical observatory.

Manchester Municipal College of Technology, Manchester, England. Volume X of the Journal of the College of Technology, entitled "Technology," containing a record of investigations undertaken by members of the college during the year 1916. In the material presented are included articles on dynamo-electric machinery, distribution of frictional losses in internal combustion engines, strength and properties of cast iron, and trisecting an angle.

NEW BOOKS AND PAMPHLETS

Pyrometric Practice. By Paul D. Foote, C. O. Fairchild, and T. R. Harrison. 326 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 170 of the Bureau of Standards. Price, 60 cents.

Sweet's Engineering Catalogue. Seventh edition. 1251 pages. 8½ by 11½ inches. Compiled, edited, and published by Sweet's Catalogue Service, Inc., 119 W. 40th St., New York City.

This book represents a compilation of the catalogues of about 700 manufacturers. The field it covers is that of engineering and power plant equipment, and it lists materials, equipment, and supplies relating to the practical construction, equipment, and maintenance of all projects of an industrial or engineering nature. The material in the present edition is arranged more logically than in previous editions, and the products index has been revised and simplified, to enable any desired information to be more easily located.

Turret Lathe Practice. By Joseph G. Horner. 276 pages, 5½ by 8½ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 12s 6d.

The increasing importance of turret lathe practice has called forth the present treatise, which deals with the details of construction of the tools and various types of turret lathes. The machines shown are of English manufacture, and the author has attempted to select the best and most commonly used types. All the illustrations are line drawings, supplied by various concerns, it being considered that a better idea of the construction can be given by drawings than by halftone illustrations. The book discusses turret lathe operations in the following order: Turning, drilling, reaming, boring, screw-cutting, and work done from the cross-slide. One chapter is devoted to tool equipments, showing typical arrangements for different classes of work. The last three chapters deal with capstan and turret details, the headstocks, and collet chucks and wire feeds.

Descriptive Geometry Problems. By F. G. Higbee. 81 pages, 9 by 12 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $1.50.

This book contains a collection of 218 problems in descriptive geometry to be worked out by the student. It is intended to be used as a supplement to any of the standard texts on descriptive geometry. Each proposition appears on a separate page, and these pages are arranged in loose-leaf form, so that they can be removed from the book, pinned to a drawing board, and the problem solved as indicated by the data given. The problems have been carefully selected to cover the general and special cases on which students need to be drilled. It is expected that the problems presented will provide the experience needed by students to master the fundamental principles of the subject. The author is professor and head of the department of descriptive geometry and drawing of the University of Iowa, and it is his belief that much is to be gained by the solution of problems given by descriptive data, and that sufficient work of this kind should be included as a part of a course in descriptive geometry to enable students to translate from descriptive to graphic form.

Questions and Answers Relating to Modern Automobile Design, Construction, Driving, and Repair. By Victor W. Page. 701 pages, 5¼ by 7½ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.50.

This is a new revised and enlarged edition of a book treating of the construction, operation, and repair of automobiles. The material is presented in the form of a series of thirty-nine lessons covering over two thousand questions and answers, relating to all branches of automobiling. The book has been written in a simple form with special reference to the requirements of the non-technical reader. The arrangement is logical, the discussion starting with the principal parts of the automobile, and continuing with the construction and operation of the engine, fuels, carburetion, etc., ignition systems, methods of lubricating, and typical cooling systems. Then follows a description of the transmission, clutch, gears, rear axles, etc., after which are taken up wheels and tires, bearings, and driving instructions, the remainder of the book being given up to repairing, and consideration of the troubles usually encountered in operating automobiles, with suggestions for their remedy. A separate chapter is devoted to electric starting and lighting systems.

Gas Torch and Thermit Welding. By Ethan Viall. 442 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $4.

The subject of welding as presented in this book, is divided into two parts, the first discussing gas torch welding, and the second thermit welding. The material relating to gas torch welding covers seventeen chapters treating of the history and uses of the gas torch; the production of welding gases; acetylene and medium-pressure generators; low-pressure acetylene and thermalene generators; gas torches used for welding; gas cutting torches; gas-pressure regulators and working assemblies; gas torch welding and cutting outfits; learning to weld with the gas torch; making allowance for expansion and contraction; welding various metals and the fluxes used; examples of welding jobs; welding jigs and fixtures; welding machines; cutting with the gas torch; cutting machines; and welding shop layout, equipment, and work costs. The part on thermit welding contains eight chapters covering the following subjects: Thermit welding: its history, nature, and uses; making plastic process welds; fusion welding of heavy sections; welding crankshafts, mill pinion teeth, etc.; welding new necks on large pinions and other heavy work; rail welding for electric systems; welding compromise rail joints; and welding cast-iron and other parts.

NEW CATALOGUES AND CIRCULARS

Genesee Mfg. Co., Rochester, N. Y. Circulars illustrating and giving specifications for Genesee inserted-blade, adjustable, face milling cutters, hollow-mills, and spot-facers.

Hergi Mfg. Co., 250 Fifth St., Bridgeport, Conn. Circular illustrating and describing Hergi flexible shaft equipment, especially adapted for grinding, chipping, and screwdriving.

United States Blueprint Paper Co., Chicago, Ill. Circular of Richter drawing instruments, containing price lists of compasses, ruling pens, bow pens, bow pencils, bow spacers, dividers, etc.

Meldrum - Gabrielson Corporation, Syracuse, N. Y. Circular announcing the new Syracuse adjustable limit snap gage, containing descriptions, illustrations, and a table giving range of sizes and list prices.

Northern Engineering Works, Detroit, Mich. Bulletin 508, descriptive of the Northern Type E three-motor electric traveling crane. The circular also contains illustrations showing applications of this crane.

Tomkins-Johnson Co., Jackson, Mich. Circular giving dimensions of the different sizes of Melling universal vise, which can be set at any angle from 0 to 45 degrees, in any direction, either simple or compound.

H. M. Lane Co., Owen Bldg., Detroit, Mich., industrial engineers and foundry specialists, are issuing a monthly publication entitled "The Foundry World," containing material relative to foundry methods and equipment.

Madison Mfg. Co., Muskegon, Mich. Circular descriptive of the Madison adjustable boring tool for both rough- and finish-boring, which is so designed as to be quickly adjusted to size, and which operates with a heavy feed.

Steel Products Engineering Co., Springfield, Ohio. Circular illustrating and describing the Averbeck back-geared balanced ram shaper, which is made in two types, each of which are furnished in 17- and 21-inch sizes.

Hart Roller Bearing Co., Orange, N. J. Circular entitled "Value Versus Competition," describing in detail the construction of the Hart staggered roller bearings, and outlining the advantages of this type of construction.

General Electric Co., Schenectady, N. Y. Bulletin 42201-B, treating of Curtis steam turbines of from 100 to 3500 kilowatts capacity, which have been developed for driving 60-cycle generators at 3600 revolutions per minute.

Denver Rock Drill Mfg. Co., Denver, Col. Circular illustrating and describing the "Waugh-hoist," an air-driven portable hoist for use in building operations, mining operations, shaft-sinking operations, contracting work, foundry work, etc.

J. H. Williams & Co., 61 Richards St., Brooklyn, N. Y. Circular containing tables of capacities, dimensions, prices, etc., of "Vulcan" pipe fitters' tools, including drop-forged chain pipe wrenches, pipe vises, pipe-vise mounts, pipe-vise clamps, etc.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Pamphlet SX, containing data relative to the construction of a new shovel attachment made for use with Pawling & Harnischfeger Types 205 and 206 excavator cranes.

Franklin Machine & Tool Co., Springfield, Mass. Circular descriptive of the Franklin universal grinder, which is a portable repair shop unit, especially adapted for grinding valves, reseating cutters, reamers, breaker contacts, screw points, and similar parts.

Baker R & L Co., Cleveland, Ohio. Bulletin 10, descriptive of the Baker Series C industrial tractors and trucks with duplex compensating suspension. This feature of the design is described in detail and illustrated with both halftone and line illustrations.

Root Co., Bristol, Conn. Catalogue 31, entitled "Census Takers of Industry," illustrating the various types of automatic counters made by this company and their application for counting the product in a wide variety of industries. Copies of the book will be sent upon request.

Osborne & Sexton Machinery Co., Columbus, Ohio. Circular listing the features of construction of the Osborne-Sexton shaper, which is equipped with double-face main driving gears so that in case one gear is broken it will still be possible to operate with the other.

Sprague Electric Works of General Electric Co., 527-531 W. 34th St., New York City. Bulletin 48967, containing an outline of the features of Sprague electric hoists, and tables of ratings and weights of the different sizes. The hoists shown range in capacity from ¼ ton to 6 tons.

Schatz Mfg. Co., Poughkeepsie, N. Y. Catalogue 6, containing descriptions, tables of load capacities, mounting instructions, and other data relating to the line of "Commercial" annular ball bearings made by this company, which includes the less expensive grades of annular ball bearings.

Golden Co., 405 Lexington Ave., New York City. Catalogue 7, of R. B. F. ball bearings made by the Cie d'Applications Mecaniques, Societe Anonyme, of Paris, France. The book contains a tabulated list of ball and roller bearings, and thrust bearings in English and metric sizes.

Cincinnati Lathe & Tool Co., Oakley, Cincinnati, Ohio. Circular entitled "Guaranteed Service at a Fair Price with Cincinnati Lathes," containing description and illustrations of the cone type and geared-head lathes made by this concern, which are furnished in 16-, 18-, 20-, 22-, 24-, 26-, and 28-inch sizes.

Birmingham Tool & Gage Co., Grove St., Winson Green, Birmingham, England. Export catalogue for 1921 covering the line of small tools made by this concern, which includes high-speed steel milling cutters, reamers, drills, hack-saw blades, gages, gear-cutters, saws, etc. Illustrations and tables of dimensions and prices are included for each tool.

Fox Machine Co., Jackson, Mich. Circular illustrating and describing the details of construction of the Fox No. D-22 multiple tapping and

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drilling machine, which consists of the Fox D-22 type of multiple-spindle drilling machine equipped with a tapping attachment. The same type of construction is used on the Fox D-12, D-32, and D-42 machines.

Syracuse Belting Co., 406 S. Franklin St., Syracuse, N. Y. Circular of "Nu-bilt" belting, which is made from scrap leather belt. By the process employed by this concern old oil-soaked belting is reclaimed by extracting the oil and grease, repairing and reinforcing with a solid woven cotton backing, securely cemented, thus making a double belt.

John Bath & Co., Inc., Worcester, Mass. Bulletin 10, descriptive of the Bath internal micrometer and master reference gage, a new tool for the rapid measurement of holes in production work, and for the accurate inspection of gages. The circular contains twelve pages of information relative to hole measurement and covering the stock sizes of micrometers.

Lima Drill Press Co., Lima, Ohio. Pamphlet containing a detailed description and specifications covering the design and construction of the new Lima multiple-spindle magazine drilling machine, which is equipped with a magazine having sixteen spindles that acts as a drill rack for sixteen different sized drills, each of which can be quickly brought into position for immediate use.

Ingersoll Milling Machine Co., Rockford, Ill. Circular showing some representative Ingersoll planer type milling machines, including three-head adjustable-rail machine, six-head double-faced fixed-rail machine, horizontal-spindle machine, and three-head single-faced fixed-rail machine. This circular also shows the Ingersoll cutter grinder, which grinds milling cutters at a single setting.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. Circular illustrating and describing the precision thread lead variator made by this company, which is intended to be used in conjunction with the company's thread grinder, for producing threads with precision leads. The leaflet is intended to be inserted in the loose-leaf catalogue of the multi-graduated precision grinder.

Expanding Gage Co., Dayton, Ohio. Pamphlet entitled "Hole Precision," descriptive of the expanding plug gages made by this concern, which are marketed in a standard set of twenty-four instruments, ranging from ½ inch to 2 inches, or for any range of measurements. These gages are particularly useful for locating two or more holes in a piece of work, but may also be used for any purpose for which a solid gage is used.

Alfred Box & Co., Inc., Philadelphia, Pa. Bulletin 3000, containing tabulated data covering dimensions, capacities, etc., of Box electric traveling cranes, as well as descriptive material relating to the details of design, materials, shop practice, and safety appliances. The latter part of the book contains illustrations showing installations of these cranes that give an idea of the variety of industries for which they are adapted.

Frank G. Payson Co., 9 S. Clinton St., Chicago, Ill. Bulletin R 12 containing descriptions, illustrations, and specifications of the Logan air-operated chucks, which are made in two-jaw, three-jaw, and collet types. This bulletin also shows other air-operated equipment produced by the concern, including air-operated drilling vise, compensating piston turning equipment, double-acting air cylinders, and special air-operated milling fixture.

Carlyle Johnson Machine Co., Manchester, Conn., has published a stock list covering a comprehensive assortment of sizes in which the Johnson friction clutch can be obtained immediately from stock. The company announces that it is now in a position to supply Johnson friction clutches in either single or double type, for any dimensions of pulley or shaft, and for any horsepower requirements within the range ordinarily covered.

Norton Co., Worcester, Mass Catalogue (printed in two colors) of Norton grinding machines. General descriptions, illustrations, and specifications are given for Norton Types A and B cylindrical grinding machines; open-side surface grinding machines; car-wheel grinding machines; universal tool and cutter grinding machines; multi-purpose grinding machines; roll grinding machines; running balance indicating machines; and grinding wheel stands.

Porter-Cable Machine Co., Syracuse, N. Y. Catalogue illustrating and describing in detail the Porter-Cable lathe for intensive manufacturing and the rapid production of duplicate parts. The various attachments made for the machine, such as the facing attachment, taper attachment, screw-cutting attachment, flat center tailstock, and milling attachment, are also illustrated and described. Examples of multiple tooling for different classes of rapid production work are illustrated

Diamond Chain & Mfg. Co., Indianapolis, Ind. Pamphlet containing charts, formulas and rules compiled for engineers and designers as an aid in the selection of chain drives, Diamond sprockets, and sprocket cutters. The tables presented give dimensions, revolutions per minute, weight, average breaking strength, and other data for roller chains and block chains; maximum horsepower for Diamond chains at different velocities; maximum working loads at different velocities; and allowable chain velocities for different numbers of teeth.

Haynes Stellite Co., 30 E. 42nd St., New York City, is issuing a series of books designated as a reference library, containing data on stellite practice. The books are published in convenient pocket size and contain specific facts concerning the qualities of stellite as a cutting metal and production records established with stellite tools. The properties, uses, and applications of this metal, the principal characteristic of which is that it cuts at a red heat, are fully explained, and cutting speed charts and considerable other useful tabular material are included. Volumes 9 and 10 of the series, which have just been issued, deal, respectively, with stellite bar stock and stellite welded-tip tools. Copies of these books may be obtained upon request.

Joseph T. Ryerson & Son, 16th and Rockwell Sts., Chicago, Ill., have published a book on the heat-treatment of alloy steels entitled "Ryerson Handbook on Alloy Steels." The book is written by G. Van Dyke, manager of the alloy steel department, and covers the manufacturing methods, heating, drawing, annealing, casehardening, etc. An idea of the treatment will be gained from a list of the following chapter headings: Quality (Analysis not the only Factor); Method of Manufacture; Elements and the Part they Play; How to Buy and Select Alloy Steels; Shop Equipment; Furnaces; Quenching Equipment; Heat Measurement; Heating; Cooling and Quenching; Drawing; Annealing; Testing Heat-treated Steel; and Casehardening or Carburizing. This book is not generally circulated, but will be sent without charge to buyers and users of alloy steels upon request.

TRADE NOTES

International Nickel Co., has removed its offices to 67 Wall St., New York City.

Pittsburg Stamp Co., Inc., has moved its office and factory from 316 Penn Ave. to 811-817 S. Canal St., N. S., Pittsburg, Pa.

Nelson Tool & Machine Co., Inc., has moved from 82 Llewellyn Ave., Bloomfield, N. J., to new quarters at 52-56 Lafayette St., Newark, N. J.

Motch & Merryweather Machinery Co., Cleveland, Ohio, has taken over the sales of the Gordon cam turning lathe, which is now being manufactured by the Willard Machine Tool Co., of Cincinnati, Ohio.

Monitor Controller Co., Baltimore, Md., manufacturer of the Monitor system of automatic control for motor-driven apparatus, has established a Cleveland office at 420 Permanent Bldg., in charge of Robert Notvest.

Mesta Machine Co., Pittsburg, Pa., announces the removal of its Chicago office from the temporary location in the Railway Exchange Building to permanent quarters in the McCormick Building, Michigan Boulevard.

Wickes Bros., Saginaw, Mich., manufacturer of heavy-duty engine lathes, blueprinting machines, plate-working tools, and special production machinery, has opened a New York office at 501 Fifth Ave., New York City, with Albert E. Braun as manager.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., has established a direct factory branch at 327 Second Ave., Pittsburg, Pa., which will be under the management of the Machinists' Supply Co. of the same address. A complete stock of leather belting and belting accessories will be carried by the Pittsburg branch.

Superior Die Casting Co., Cleveland, Ohio, has opened a branch sales office at 1250 Book Bldg., Detroit, Mich., under the management of F. L. Neward and M. F. McManus. The company has also opened a branch sales office at 1405 Real Estate Trust Bldg., Philadelphia, Pa., under the management of D. B. Wilson and C. D. Ensign.

Reed & Prince Mfg. Co., Worcester, Mass., has opened a new store and warehouse at 121 N. Jefferson St., Chicago, Ill. The stock carried at the new warehouse will comprise a full line of wood screws, machine screws, cap-screws, set-screws, stove bolts, nuts, and small rivets. The Chicago branch will be under the management of J. V. Banks.

Green Engineering Co., East Chicago, Ind., announces the opening of an eastern office at 85 Liberty St., New York City. This office will be under the management of W. S. Burke, who has been elected eastern manager. Mr. Burke has been with the company for more than nine years. He will have supervision over all the eastern and foreign business.

Jas. Clark Jr., Electric Co., Inc., Louisville, Ky., announces that out of twenty-three bids submitted to the Air Service Division of the War Department at Washington, D. C., the Jas. Clark, Jr., Electric Co. was awarded an order for 145 "Willey" portable electric drills. The Department required samples to be submitted for test as to design, material, workmanship and weight.

Societe Anonyme Belge Alfred Herbert, Brussels, Belgium, has moved into new quarters at 34 Rue Melsens. The new premises have liberal showroom accommodation. The building was originally erected for A. H. Schutte, and since the armistice has been occupied by the Allied Machinery Co. of America. The managing director is R. H. Lowe, and the sales manager, J. Bourdouxhe.

Hauck Mfg. Co., Brooklyn, N. Y., manufacturer of oil burners, oil forges, oil burning appliances, and allied equipment, elected the following officers at a recent meeting of the stockholders and directors: President, Henry T. Gerdes; first vice-president, M. C. Hauck; second vice-president, A. B. Hauck; third vice-president, H. H. Kress; treasurer, A. H. Stein; and secretary, J. Lutz.

J. Horstmann, 81 Rue Saint-Maur, Paris, France, machine tool dealer, has been succeeded by the Etablissements Horstmann. The following are the officers of the new concern: President, J. Horstmann; managing director, J. Welter; director, H. Nourry, manager of the machine tool department; director, E. Barbier, manager of the small tool department. No change has been made in the organization of the firm.

H. C. Giles Corporation, 303 Cox Bldg., Rochester, N. Y., has been organized to engage in the manufacture of a trip-hammer staking machine, designed for use on cupped or drilled rivets, studs, screws, etc., for staking or riveting them to parts, or in fastening two or more parts together. The firm will also manufacture cupped rivets, studs, screws, etc., which can be furnished in connection with the staking machine.

Cincinnati Grinder Co., Cincinnati, Ohio, has recently placed the sale of its line of grinding machines on an exclusive basis with the Marshall & Huschart Machinery Co. in the Chicago district; Motch & Merryweather Machinery Co. in the Cleveland, Cincinnati, Pittsburg, and Detroit district; and Henry Prentiss & Co. in the New York and New England district. The company will also maintain its own grinding specialists in the respective territories.

Philadelphia Gear Co., Philadelphia, Pa., has moved into a new plant at Tioga and Richmond Sts. This move became necessary because of the expansion of the company's gear business. The new building is of modern, one-story construction, having a total of approximately 20,000 square feet of floor space. The plant is equipped with a 15-ton crane and has a railroad siding within the building. The office of the company will still be retained at the Vine St. address.

Uehling Instrument Co., 2000 Empire Bldg., New York City, manufacturer of fuel-saving equipment, has moved its Chicago office to the Great Northern Bldg., at 20 W. Jackson Blvd. Uehling carbon dioxide recording equipment and other boiler room instruments will be on display at this office. Walter C. Lange has been appointed manager of the Chicago office. Mr. Lange was formerly stationed at the New York office of the company, and has had considerable experience in this field.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., has opened a Kansas City branch at 1711 Grand Ave. This branch includes Kansas, Nebraska, Oklahoma, Texas, Arkansas, western Louisiana, and western Missouri. J. N. La Belle, formerly assistant manager of the Chicago branch, will have charge of the Kansas City branch, and will be assisted by Emery Harris, who will make his headquarters in Omaha, Neb., and R. Brice Shipley, who will cover the territory of Oklahoma, Texas, Arkansas, and western Louisiana.

Post Tractor Co., Cleveland, Ohio, and the **Whitney Tractor Co.**, Upper Sandusky, Ohio, have been consolidated under the name of the Post-Whitney Co., of Cleveland, Ohio. The company is capitalized at $10,000,000, and the officers are as follows: President, E. B. Cassatt; vice-president, A. B. Whitney; vice-president, C. B. Post; treasurer, A. J. Tuscany; and secretary, F. R. LePage. The company will maintain the plant at Cleveland, where the Post tractor will be manufactured, as well as the Whitney plant at Upper Sandusky where the Whitney tractor is being built.

Manufacturers' Exhibition Co., Inc., has been established at 45 W. 18th St., New York City, to offer manufacturers of machinery and mechanical appliances the advantage of a permanent display and sales room, where their machines can be shown in operation. The building occupied is that formerly known as the Greenhut Bldg. Each floor contains approximately 85,000 square feet of floor space, and has a floor load of 190 pounds per square inch. A general information bureau and reading room will be maintained, where trade journals and technical papers, as well as catalogues, will be kept on file. The president and general manager of the company is L. R. Duffield.

VOLUME 27

MACHINERY

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JULY, 1921

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The Editor's Monthly Talk

THE wide diffusion of mechanical knowledge through the technical press has done more to facilitate the rapid industrial progress of the past half century than any other single factor. Advances in design and practice made in a shop in one part of the country may be known a thousand miles away within a few weeks; whereas, a century ago, years passed before a definite knowledge of developments in New England shops got as far as Philadelphia. In those days there was no technical press, and information was transmitted by word of mouth when mechanics moved from shop to shop and place to place.

This is what gives the serious mechanical journal so keen a sense of responsibility in its chosen field. It must gather its information from all over the world, and must effectively circulate it again to all quarters of the globe. Take July MACHINERY, for example. This number will contain the usual broad range of mechanical articles and industrial and trade news—not counting the smaller news items such as Personals and Trade Notes, etc.—collected from 38 cities and towns in the United States in addition to letters from MACHINERY'S correspondents in London, Paris, and Amsterdam; and July MACHINERY—like all other numbers of the journal—will go to 46 different countries in the New and Old World outside of the United States—Alaska, Argentine Republic, Australia, Belgium, Brazil, Bulgaria, Canada, Canal Zone, Chili, China, Cuba, Czecho-Slovakia, Denmark, Dutch East Indies, England, Finland, France, Germany, Greece, Hawaii, Holland, Hungary, India, Italy, Java, Japan, Mexico, New Zealand, Norway, Peru, Philippine Islands, Poland, Portugal, Portuguese East Africa, Roumania, Russia, Scotland, Serbia, Spain, Sweden, Switzerland, Syria, Turkey, Union of South Africa, Uruguay, and West Indies.

Non-metallic Gearing

In the early days of engineering the only non-metallic material for gears was wood, but wooden gears have now passed out of existence, except in a few isolated instances where wooden teeth are still used in large bevel gear transmissions between an old-fashioned water-wheel and the main shaft. The non-metallic gears now used have either animal hides or cotton for their base material, and are known either as rawhide gears or as fabric-base material gears.

Much has been published about the methods for producing metal gears, but very little relating to non-metallic gearing. The leading article in July MACHINERY takes up this subject and deals comprehensively with both the design and manufacture of rawhide and fabric-base material gears. All the data for this article were gathered right in the shops where the gears are designed and made, and all the statements are backed by the experience and responsibility of a well-known manufacturer.

There has been a need for a simple self-contained instrument for testing the accuracy of gear tooth profiles and the spacing of teeth. The odontometer, described in July MACHINERY, was designed to meet this need, and is equally applicable to spur and bevel gears and can be applied to a gear in place on the machine.

The Crank-driven Planer

The so-called "crank-planer" has proved its value in many shops for work that comes within its range. It is capable of producing both a satisfactory quality and a sufficient rate of output to make a respected place for itself in the machine tool field. The crank drive affords positive control of the stroke, and the stroke is easily adjusted for different classes of work. The article in July MACHINERY "Results Obtained with Crank-driven Planers" deals with a number of operations performed on machines of this type in half a dozen different plants throughout the country, and shows its application to tractor engine work, machine forgings, railway work, and machine tool parts. This article is another addition to the series on modern planer practice, the publication of which began in January MACHINERY, and has covered various phases of the entire field for which different types of planers are employed.

The August Number of MACHINERY

In August MACHINERY will be presented a great variety of articles, some on subjects seldom dealt with in the technical press. One of these—"Automatic Machines in a Watch Factory"—is the first of three articles describing the "almost human" machines employed in the making of the world-famous Waltham watch. Another article will deal with the design and manufacture of drop-forging dies, a subject of definite value and real interest to mechanical men at a time when drop-forging is being employed to an ever-increasing extent.

In the series on the planer class of machines, the August article will deal with production work done on slotters, covering this subject in the same complete manner that the operations on planers have been dealt with in preceding numbers.

For the man who has to do with the organization of a shop and the methods whereby records and systems are kept, there will be articles dealing with the records of materials used in machine construction and on the organization of a large contract plant. The tool designer will find an unusual collection of inspection gages and fixtures in the fourth article dealing with the inspection system of the Dayton Engineering Laboratories Co.; and the article on "Instructions for the Design of Fixtures" will interest him because it contains specific rules and advice relating to his work.

JULY MACHINERY 1921

Design and Manufacture of Non-Metallic Gears

Characteristics of Gears Made from Rawhide and Fabric-base Materials—Methods Employed by the Van Dorn & Dutton Co., Cleveland, Ohio, in the Manufacture of Non-metallic Gears

By FRED R. DANIELS

VARIOUS materials are used in the construction of non-metallic gears, but in the practice of the Van Dorn & Dutton Co., Cleveland, Ohio, whose methods of manufacture are here described, the materials mainly used are rawhide and micarta. The present article, therefore, deals specifically with the design and manufacture of gears made from these materials.

Preparation of Rawhide and Fabric-base Gear Materials

The raw material from which rawhide gears are made is the green packer hides, cured and treated by processes that leave mainly a fibrous structure. These processes reduce each hide to a thickness of approximately 1/16 inch, the hide being then blanked into circular disks, the outside diameter of which varies from 2 to 40 inches, or into rings or segments according to the requirements of the gear manufacturer. These blanked-out hides are then dipped into a vat of special-quality glue and assembled between steel end-blocks until a thickness of about 8 or 10 inches has been reached. Hydraulic pressure is next applied to squeeze out the surplus glue, after which the blank is kept compressed until dry, which may require several days. The pressure is increased as the drying process progresses, by drawing up the nuts on the bolts passing through the end-blocks which are employed to hold the blanks together.

Gears made from various fabric-base materials closely resemble each other in physical characteristics. One of these gear materials is manufactured under the trade name of "Bakelite Micarta" by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., and another under the trade name of "Condensite-Celeron" is manufactured by the Diamond State Fiber Co. of Bridgeport, Pa. Both materials are manufactured from fabric of even weave and thickness, which is first impregnated with compositions (condensation products of formaldehyde and phenol) after which a number of the blanks are bonded together under great pressure and the application of heat. These materials are furnished either in large sheets or boards, up to 36 inches square and 2 inches thick, or in such forms as the gear manufacturer may specify, by cutting rings or segments from the impregnated fabric and placing them in a suitable mold before the pressure and heat are applied. The rings or segments are used in special designs where a spider or bushing is the main support, such construction being employed where the stress on the key is likely to be greater than the material itself would be able to withstand if the gear were made of one solid blank. Micarta is frequently molded on a hub center in such a manner that no additional mechanical retaining means are required. This type is most commonly used in timing gears. A few of the many and varied designs, which have been successfully applied to service will be referred to later. The rawhide gear blanks before being machined and the sheets of impregnated gear material as they appear when received from the manufacturer are shown in Fig. 1.

> Non-metallic gears are used primarily where quietness of operation at high speed is the first consideration. Rawhide was the earliest material used for this class of gearing; later numerous other materials such as micarta, condensite, formica, fabrico, fabroil, and Egyptian fiber were introduced. These materials are more economical than rawhide, and are used by many gear manufacturers when the gears are not subjected to severe stresses. The present article deals with the practice of the Van Dorn & Dutton Co., in the manufacture of non-metallic gears.

Physical Characteristics and Strength of Rawhide

Rawhide gears should not be subjected to a higher temperature than 225 degrees F., as otherwise the material will become dried out and permanently injured, because dried out rawhide cannot be revived. Furthermore, the gear blanks must not become wet, as moisture destroys the bonding material, and the blanks become distorted when again dry. Hence, much care must be taken to provide suitable storage space for rawhide gears, so that they are not exposed either to too much heat or to moisture. When not in use, the rawhide should be coated with shellac and kept in a cool dry place. The life of the gear is greatly prolonged, in service, by the use of a lubricant consisting of a thin mixture of lard oil and graphite. This lubricant covers the face of the gear teeth with a thin metallic film which protects the rawhide. Mineral oils should never be used as a lubricant for rawhide.

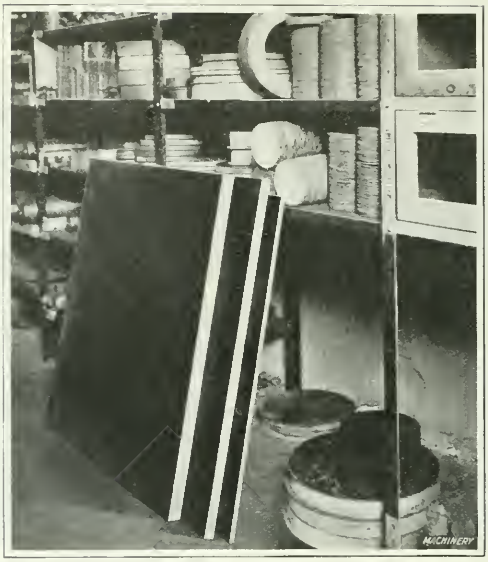


Fig. 1. Raw Material in the Form of Rough Laminated Rawhide Blanks and Large Sheets of Bakelite

In considering the strength of any gear material, the velocities at which the gears operate must be taken into consideration. Although rawhide is not as durable as steel, it is often used for gears having peripheral speeds of from 1700 to 2000 feet per minute or more. The material is as strong as cast iron at high speeds, although weaker when subjected to a static test. The life of gears made from rawhide is greatly prolonged by virtue of the cushioning effect of the rawhide gear teeth operating in mesh with a metallic gear. Rawhide is a successful competitor of bronze from the viewpoint of ultimate cost, owing to its comparative length of service, but is somewhat higher as regards first cost. Rawhide loses its flexibility when subjected to continual bending, and should never be used with cast tooth gears. The inaccuracy of the cast tooth outline and spacing produces a destructive strain on the teeth of the pinion.

A safe working load for rawhide pinions is 150 pounds per inch width of face for gears of one inch circular pitch. The working load for other pitches should be in proportion, but should never exceed 250 pounds per inch of face width. An allowance of from 20 to 25 per cent should be made for overload, sudden impact, and varying working conditions. This statement relative to strength applies only to pinions constructed without flanges. When the pinions are provided with flanges, usually made of bronze and cut to form a part of the working face of the teeth, the strength values may be increased from 10 to 25 per cent.

Physical Characteristics and Strength of Fabric-base Materials

For silent operation, fabric-base materials are undoubtedly superior to rawhide. They are self-supporting and rarely, if ever, require the use of shrouds to maintain the shape of the teeth. They are not affected by water or oil in a destructive sense and, on an average, absorb only about 1½ per cent of moisture in a period of fifty hours. These gear materials are not attacked by rodents, and are not susceptible to the action of acids or alkaline solutions. They are easily machined, will take a high finish, and consequently present a smooth working face which wears well and furnishes even tooth contact. The fact that a material is self-supporting makes it possible to obtain a greater factor of safety for gears made from it, which are to be keyed to the shaft. In some cases end plates are used, but these are in special designs only, as will be described later. The length of service obtained from gears made of fabric-base materials is claimed to be superior to that of cast iron or brass. These materials do not shrink at temperatures under 200 degrees F.

The specific gravity of these fabric-base materials is 1.4, the weight 0.05 pound per cubic inch, and the Brinell hardness, from 30 to 40. The raw material has a tensile strength, parallel to the laminations, of 10,000 pounds per square inch; a compressive strength of from 35,000 to 47,000 pounds per square inch perpendicular to the laminations, and from 17,000 to 24,500 pounds per square inch parallel to the laminations; and a transverse strength, both parallel and perpendicular, of 17,000 pounds per square inch. In figuring the strength of gear teeth by the Lewis formula, however, a safe working load greater than 5000 pounds per square inch should not be used.

The diametral pitch of gear teeth recommended for service is as follows: For smaller loads up to and including ½ horsepower, 10 pitch; for 1 horsepower, 8 pitch; 2 horse-

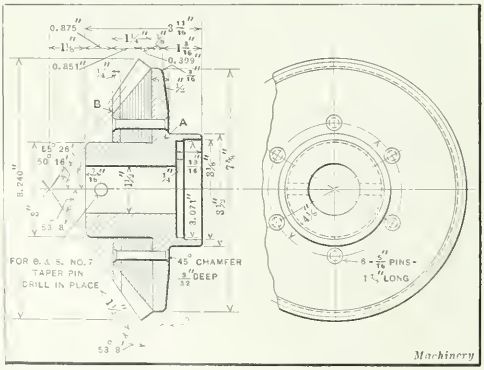


Fig. 2. Rawhide Bevel Gear with Cast-iron Center and Brass Side Plate

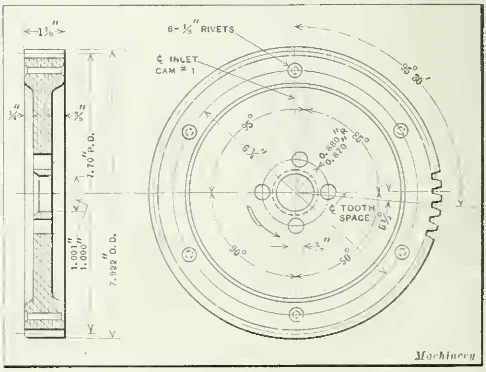


Fig. 3. Camshaft Spiral Gear made from Blank cut from Solid Stock

power, 5 pitch; 10 horsepower, 4 pitch; 15 horsepower, 2 pitch; 25 horsepower, 2½ pitch; 50 horsepower, 2 pitch; 75 horsepower, 1¾ pitch; and 100 horsepower, 1½ pitch. When heavier service than 100 horsepower is encountered, the design of the gears should receive special consideration. The maximum recommended pitch line speed is 2500 feet per minute. The greatest length of service for gearing is obtained when there is a good rolling contact; consequently, the most desirable condition in non-metallic gear design is where there is a comparatively large number of teeth. Gears having less than fifteen teeth do not furnish good rolling contact, and they wear faster and vibrate more than when a finer pitch tooth is used. It may even be good engineering to redesign the entire gear train in order to use gears of smaller pitch.

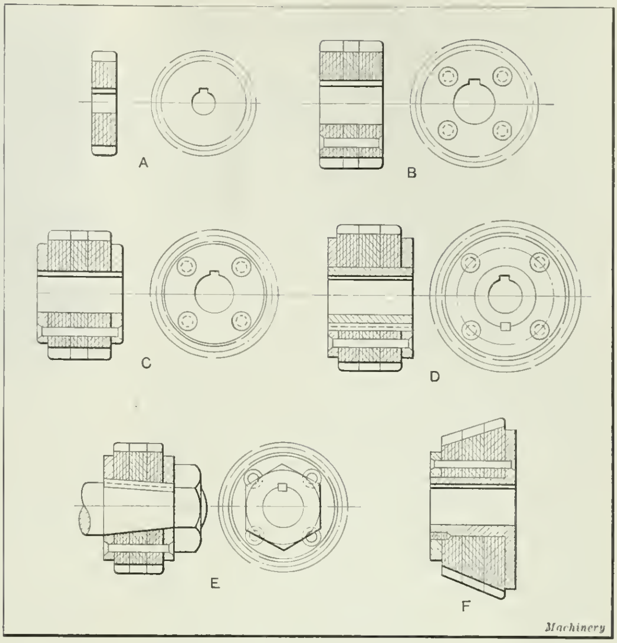


Fig. 4. Different Designs of Micarta Gears

Design of Rawhide Gears

Gears and pinions made of rawhide are generally furnished with side plates or shrouds made of bronze or brass, with the teeth cut through them. These support the material and add considerably to its strength. Such a design applied to the construction of a bevel gear is illustrated in Fig. 2, in which the cast-iron spider *A* has a large flange that supports the rawhide on one side, and a side plate *B* on the opposite side, assembled by six pins. Another construction in which the sides of the gear teeth are not supported is shown in Fig. 8. The cast-iron spider *A* is suitably flanged to support the rim of rawhide in which the teeth are cut. These two gears will be recognized in the collection shown in Fig. 6.

In the application of rawhide gears it is generally practicable to make the pinion of rawhide. The number of teeth should, if possible, be about 15 or 18. It is necessary to construct only one gear in a pair from rawhide in order to obtain the desired quietness of operation. On account of the high cost of rawhide, the smaller member is the one usually so constructed. Shrouded pinions of the design in which the flanges reach to the top of the teeth are not to be recommended from the manufacturing point of view. This construction involves extra machining.

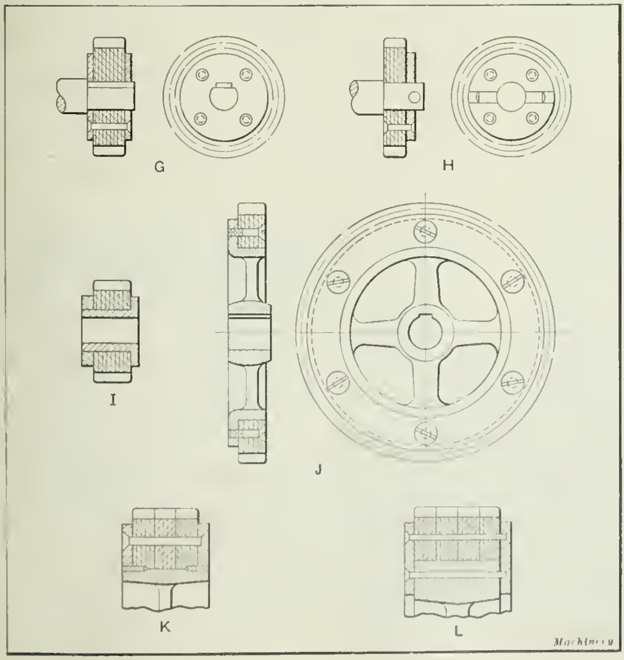


Fig. 5. Other Micarta Gears of Special Construction

Large pinions are usually designed with a cast-iron spider or central bushing which is a means of reducing the cost and increasing the strength, particularly at the hub where shear is encountered owing to the use of keys or set-screws for attaching the gear to the shaft, but this construction is not recommended when directly applied to severe intermittent motions. Excessive wear is often caused by insufficient consideration being given to the machine supports, and by unsuitable bearings, either of which will result in misalignment of the meshing teeth. Under proper working conditions, however, the service furnished by rawhide gearing has been generally satisfactory. Rawhide has been successfully employed for both spur and bevel gears, but not generally for other types.

Design of Fabric-base Material Gears

Gears made from fabric-base materials are cut from solid blanks for sizes under 6 inches in diameter; larger sizes are made either solid or by setting rings on metal spiders and attaching them by the use of rivets or bolts. Shrouds are rarely required, except where the service is unusually severe or where the diameter of the gear is more than four times the width of face.

Figs. 4 and 5 show a number of designs commonly used in the construction of micarta gears. The style shown at *A* is for light service, where not more than five horsepower is to be transmitted. This design may be provided with either a straight or a tapered hole as required. The maximum width of face is 2 inches, pitch diameter not over 8 inches, and the root diameter not less than twice the shaft diameter. The style shown at *B* is for transmitting not more than fifteen horsepower, where the speed and torque are constant. The blank is constructed of layers, which is a common practice where the width of face makes it necessary, and these layers are assembled by round or flat-head rivets, using washers if the space between the bore and the root of the teeth permits. The number of rivets required is usually four, although this may vary. The diameter at the bottom of the teeth should not be less than two and a half times that of the shaft.

The design shown at *C* employs side plates to furnish additional strength at the keyway; it is intended for heavy duty, and may be used where the service is intermittent. Rivets and washers are used, the same as in style *B*. The design shown at *D* makes provision for easy replacement. The end plates are attached to a cast-iron bushing by means of a key, the rivets locking the entire arrangement together and enabling the bushing to be easily removed when the keyway, by means of which it is keyed to the shaft, becomes worn.

The construction commonly used for tapered shafts is shown at *E*, while for bevel pinions, style *F* may be used. This design may be constructed either with or without a central bushing; the illustration shows a gear with a central bushing, and it will be seen that it is provided with a wide flange for withstanding the axial thrust at the large end of the gear. As in the other designs, rivets are used in the assembly, and washers, if the space permits. The designs shown in Fig. 5 are all of a special nature. Styles *G* and *H* are the constructions often used when the pinion is attached to a shaft extension. Style *H* may be employed when it is not convenient to use a key, the drive being by means of a pin engaging the end plate. In both these designs, rivets or screws may be used in the assembly. For drives in one direction, the shaft extension may be threaded and the pinion shrunk on a washer. The end of this washer should have a diametral slot in which the lugs of a special flanged nut may fit to drive in the direction of the hand of the thread. This construction is used when the distance between the root of the teeth and the bore will not permit the use of a key.

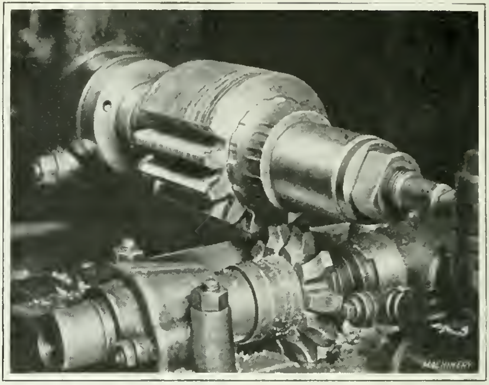


Fig. 7. Gear-cutter Set-up for cutting the Teeth in a Flanged Rawhide Pinion

At *I* a knurled flanged cast-iron bushing is used as a center for the micarta. The exterior of the bushing has a tendency to prevent the material from turning on the bushing. The parts may be fastened together in any desirable way. Style *J* employs a flanged cast-iron spider, and this construction is used for gears from 6 inches to 1 foot in pitch diameter. The maximum width of face for gears of this construction is 2 inches. The flange may be attached either by screws or rivets. This design is sometimes made by molding the gear material on a spider, the outside diameter of which is knurled, and which has no flange. A coarse diamond knurl is utilized in machining the outside of the spider. The customary screws and rivets are used in gears of this type. Whether or not it is advisable to follow this construction depends largely on the quantity involved and the expense of making a mold and a pattern. If the width of face is more than 2 inches, two flanges should be used. The constructions shown at *K* and *L* are for large gears and enable replacements to be readily made. The non-metallic rims are shrunk on the cast-iron spider and the flanges fastened by screws or rivets in the manner indicated. The quantity of rivets required varies with the size of the gear and the service to which it is to be subjected.

More than one thickness of micarta is required when the width of face exceeds 2 inches, and care should be taken to have the outside pieces at least ¾ inch thick. The end plates may be made either of cast iron, steel, or bronze. The thickness of plates for gears 2 inches in diameter is ⅛ inch; for gears 3½ inches in diameter, 3/16 inch; 8 inches in diameter, ¼ inch; 10 inches in diameter, 5/16 inch; and for gears over 10 inches in diameter, ⅜ inch. The outside diameter of the end plates need not necessarily be more than 2 inches greater than the diameter of the circle on which the rivets are located. End plates should not extend beyond the root of the teeth. Solid pinions may be shrunk on the shaft or spider by heating them to approximately 200 degrees F., or if the bore is 2 inches or more in diameter, by immersing in boiling water before assembly. An allowance for shrinkage of 0.001 inch per inch of bore diameter should be made. The face of the pinion should not be greater than that of the mating gear.

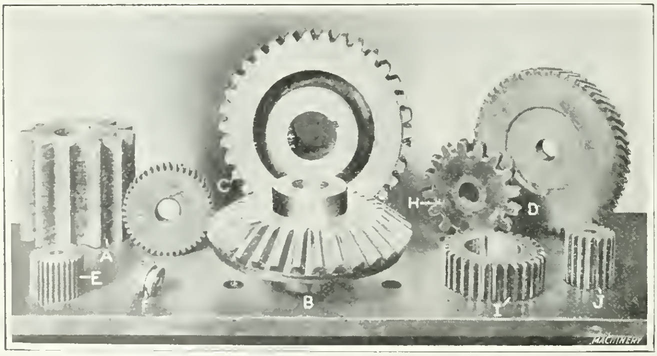


Fig. 6. Collection of Rawhide and Micarta Gears

Machining Rawhide Gear Blanks

The rawhide blanks, such as are shown on the shelves in Fig. 1, are first split into the width of face required for the gear, after which the metal flanges, if these are used, are bolted on through holes previously drilled in the blanks. The gear blanks are then turned to the proper outside diameter, which is done in an ordinary lathe, using similar turning tools to those used in metal working. The speeds and feeds of the lathe should be about double those used for turning cast-iron gear blanks. In cutting the gear teeth, the process is exactly the same as in cutting metal gears, so far as machines and methods are concerned, but it has not been found advisable to use a standard gear-cutter when machining this material. The gashes between the teeth become clogged with the soggy, glue-laden chips so that it has been found good practice to use a worn cutter, ground with an abundance of chip space, or even one in which some of the teeth are broken out. The speeds and feeds are faster than on cast iron in about the same proportion as for turning.

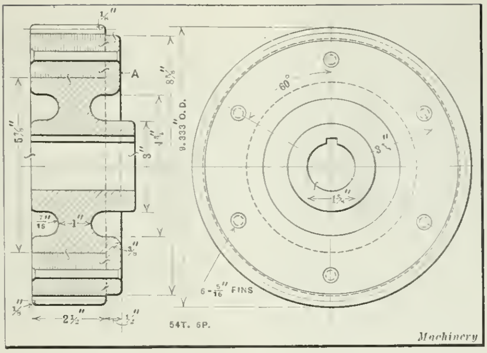


Fig. 8. Spur Gear with Cast-iron Flanged Hub on which a Ring of Rawhide is shrunk and fastened

The gear shown at *A*, Fig. 6, has fourteen teeth, 3 diametral pitch, flanged at both ends, and has a face width of 4½ inches. The teeth are cut on a Newark gear-cutting machine, the set-up being shown in Fig. 7. Attention is called to the previous reference to excessive chip clearance which may be plainly seen in this illustration. The cutter speed used in performing this operation is 110 revolutions per minute, and the feed 8 to 10 inches per minute. The production time is thirty-five minutes per gear.

The bevel gear *B*, Fig. 6, has thirty-two stub teeth, 4/5 diametral pitch, and a face width of 1½ inches; the detailed dimensions of this gear are shown in Fig. 2. The teeth are cut on an 18-inch Gleason bevel gear planer set up as shown in Fig. 9. The cutting speed is 127 strokes per minute, and the feed used, 56 seconds per stroke. The time required to cut the teeth is two hours per gear, both for gashing and for finish-planing.

Of the other rawhide gears included in the collection shown in Fig. 6, gear *C* is shown in detail in Fig. 8. This is a motor pinion and has fifty-four teeth, 6 diametral pitch, and a pitch diameter of about 8 15/16 inches. The other gears shown in this collection are various designs of micarta gears and pinions.

Machining Fabric-base Material Gears

The plates from which fabric gears are cut, together with some of the rough blanks, are shown in Fig. 1. In cutting out the blanks, the material may be sawed, or a trepanning tool such as is shown in Fig. 12 may be employed. The operation is performed on a drilling machine in the manner indicated in Fig. 11. This method of cutting out the blanks is preferable to the use of a band saw in that a more accurate blank can be obtained. The shank of this tool has a regular standard spindle taper, and is hardened and ground; the cold-rolled steel pilot, which is also hardened and ground, centers the tool in a hole drilled to accommodate it. The cutters have hardened and ground tool-steel cutting edges and soft shanks, and are designed so that one will cut on the outer circumference of the groove, and the other on the inner circumference. The design of the cutters is also shown in Fig. 12. By making the tools in this way, the cutting action is balanced and clogging of chips obviated.

It has been found that a 14-inch diameter circular saw having from 110 to 120 teeth, hollow ground, will give a good clean cut, if properly sharpened and operated at 2500 revolutions per minute, or at a surface speed of about 9000 feet per minute. The saw should not be set for clearance, and should be resharpened every fifteen or twenty minutes when in constant use. In general, the sawing of fabric-base materials is similar to the sawing of wood, and the speeds and feeds used are also about the same. The best results for band-sawing will be obtained with a 5½ point saw, 19 gage, running at about 4000 lineal feet per minute, which is equivalent to 425 revolutions per minute with a wheel 36 inches in diameter. The width of band-saw blade may be anywhere from ¼ inch to 1¼ inches as required. A band saw will last from one to two hours, depending on the grade and thickness of the material being cut.

It is good practice to round off the gears at the periphery to a radius of 1/16 inch or less, depending on the pitch of the teeth. If the gear blank is to be supported by plates of the same outside diameter as the gear, during the cutting of the teeth, this rounding of the corners should not be done until after the completion of the gear-cutting operation. For drilling, high rotative speeds should be used; ¼-inch diameter drills and under will stand speeds of from 2500 to 10,000 revolutions per minute, and larger sizes in proportion. It is safe to state that the best results will be

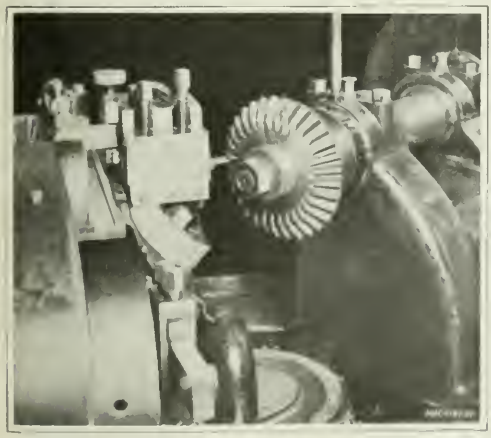


Fig. 9 Gear Planer on which the Teeth in the Bevel Gear shown in Fig. 2 are cut

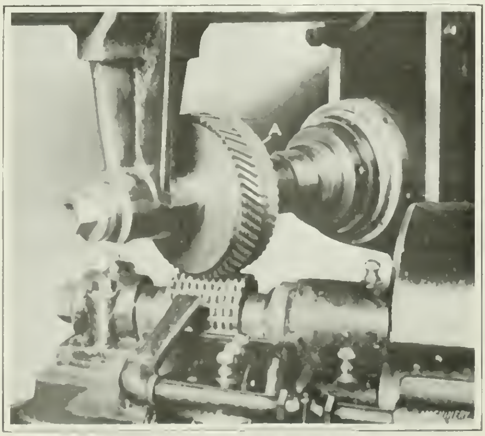


Fig. 10. Using a Backing Plate when hobbing the Teeth of a Spiral Gear

obtained by running the drill at the highest speed that can be used without burning the tool. To prevent excessive heating, the drill should be removed from the hole as quickly as possible after the drilling operation has been finished. Drills should not be forced, and if kept sharp, they will require but slight pressure to feed them through the material. Owing to the resiliency of the material, the expansion that takes place immediately after the hole has been drilled, produces a hole which will be approximately 0.003 inch over size, so that if it is desired to have the hole up to standard, it is necessary to make allowance for this characteristic of the material.

In milling, the cutting angle of the cutter should be ground with a slight front rake amounting to about 3/32 inch on a 3-inch diameter cutter. High speeds and coarse feeds should be used in general, and an effort should be made whenever possible to remove all the material during one cut. In turning fabric-gear blanks, the work should be turned to size whenever possible in one cut, but where two cuts are found desirable, the finishing cut should remove at least 1/8 inch of stock. The material should be turned at a surface speed of from 75 to 100 feet per minute, which is about 25 per cent faster than used on medium grade cast iron. The speed at which the gear blanks are turned will, of course, be governed by the depth of cut taken. A coarser feed than is ordinarily used in turning cast iron should be employed. A wide-nosed tool, without top rake and with plenty of side clearance, will give the best results. Care should be taken to keep the tools sharp, and it will be necessary to regrind the tools frequently, as the turning of this material dulls the cutting edge very quickly. In turning, it is unnecessary to use any lubricant. On account of the resiliency of the material, it is good practice to turn the outside diameter slightly under size to allow for the increase in diameter which occurs at the completion of the cut. It is this characteristic of the material which will give a shrink fit in holes drilled to standard dimensions. For the more accurate surface-finishing operations, grinding is to be preferred. Water should be used in the grinding operation to keep the wheel clean.

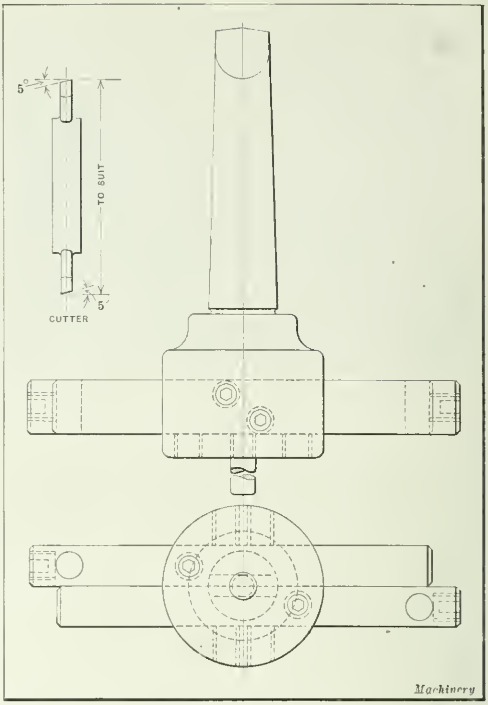


Fig. 12. Trepanning Tool by Means of which the Gear Blanks are cut from Stock

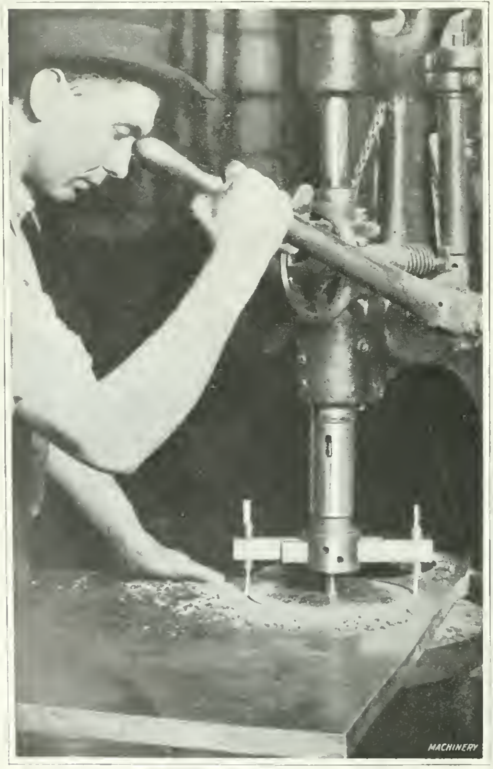


Fig. 11. Cutting the Blanks from Micarta Sheets

The maximum cutting speed permissible for hobbing teeth in micarta gear blanks is 180 surface feet per minute, which is much higher than is permissible on metal gears. The most suitable feed will be from 0.03 to 0.08 inch per revolution of the work, these limits being somewhat lower than ordinarily used for cast-iron gear hobbing.

A gear of similar design to that shown at *D*, Fig. 6, is illustrated in Fig. 3. This is a camshaft gear made of solid micarta cut from a sheet, and has sixty teeth, 9 diametral pitch, with a 15½-degree pressure angle. The teeth are right-hand helical, the angle being 30 degrees 2 minutes, and the lead, 41.8425 inches. The operation of hobbing the teeth is shown in Fig. 10, using a No. 12 Barber-Colman machine with a hob of standard design. The hobs, like the milling cutters used on this and similar material, must be provided with liberal chip clearance, but otherwise the equipment is not special in character. In order to prevent the edges from being frayed, the work is located on the arbor against a back-up plate which may be seen at *A* in the illustration. The feed used on this job was 0.037 inch per revolution and the speed 200 revolutions per minute, which is the highest of which the machine is capable. The hob is 9 diametral pitch, 4 inches outside diameter, and 3½ inches long, so that the speed of 200 revolutions per minute is equivalent to a surface speed of 160 feet per minute, which is much higher than would ordinarily be used for machining cast iron. In general, the tools used in cutting fabric-base materials, such as micarta and condensite, should be kept sharp and have plenty of chip clearance. Gear teeth may be cut in a number of blanks mounted together on one arbor, which is advantageous in that each adjacent blank serves to back up the one next to it.

Only a few of the many designs of non-metallic gears are shown in Fig. 6, but these should be sufficient to show the general construction, and in some measure, the variety. In addition to the gears already mentioned, there is a double-faced solid micarta gear *E* having a face width of 2 inches, an outside diameter of 1⅞ inches, and a ½-inch bore. Gear *F* is a special steel flanged micarta pinion for an automobile oil-pump. The other four gears *G*, *H*, *I*, and *J* are all made of solid micarta and are of varying designs and sizes.

* * *

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, June 9

The period of uncertainty in France continues, but there are indications of an urgent need for considerable quantities of various products, and the general feeling is that business will shortly improve appreciably. During the past month an industrial exhibition was held at Paris, and this was attended in great numbers. There were numerous inquiries and many sales were made. All the machine tool manufacturers were represented, and in this section visitors were particularly interested in vertical boring and turning mills and grinding machines. The iron and steel market seems to have become stabilized, as no decreases in prices have occurred for several weeks.

New Process of Manufacturing Steel

A French engineer, Mr. Basset, has invented a furnace for the manufacture of steel, which utilizes pulverized coal for fuel instead of coke. An experimental furnace has been erected and steel produced with excellent results. The outstanding feature of the new process is the economy effected. It is claimed that steel can be made at even lower costs than before the war. A company has been formed with a capitalization of 60,000,000 francs ($4,750,000 present exchange) for the purpose of manufacturing steel by the new process. Most of the large steel manufacturing concerns of France are connected with this firm, including La Ste. Longwy, Les Trefileries du Havre, Saulnes, and Ougree.

New Cotter-pin Machine

The firm Royer, of Paris, has just built a machine for manufacturing cotter-pins. This machine is said to have shown marvelous results, producing cotter-pins at the rate of 25 per second or 90,000 per hour, 8 kilometers (about 5 miles) of wire being required per hour to feed the machine. It has been estimated that four of these machines will be sufficient to supply the entire French market with pins of this type. It is intended to place the machine on sale upon the completion of a plant for producing wire to suit the machine.

Wage Reductions

The cost of living has become noticeably lower, and manufacturers show a tendency to reduce wages in proportion. The large automobile concerns have lowered wages from 15 to 20 per cent, and these reductions have been generally received without protest, due, no doubt, to the fact that many of the firms in this industry are closed down entirely. At La Rochelle and La Pallice the workmen in the iron and steel industries have accepted a reduction of 15 centimes (1.2 cents) per hour. In consideration of the sacrifice made, and because the cost of living in this vicinity has only been reduced to a slight degree, the workmen have asked the authorities to control the prices of foodstuffs, reduce the profits of retail merchants, and allow the publication of prices without charge by dealers who sell their foodstuffs reasonably low.

Continued Idleness of Plants and Workmen

The number of plants closing down has decreased, and there are less idle workmen in Paris than formerly. The latter condition, however, is due to the fact that a great number of idle men have moved from this city. Another cause for less idleness is the calling of the 1919 military conscripts to the colors. This has resulted in many vacancies in plants which have been filled from the idle ranks. Business conditions in the iron and steel industries have not improved, and in some sections the situation is even worse, but, in the clothing and textile industries a slight improvement is apparent. The automobile field also shows some improvement, Renault producing forty cars per day, and Citroen, sixty cars per day. It is believed that the high cost of gasoline is one of the principal reasons for the depression in this industry.

New Companies Formed

Les Etablissements Horstmann, Paris, has just been organized with a capitalization of 5,000,000 francs (approximately $400,000) for the manufacturing, purchasing, and selling of machine tools. Another firm, Les Etablissements Coulaux & Cie, has been capitalized at 4,000,000 francs (approximately $320,000) for the manufacture of steel and tools. This concern is affiliated with Forges et Acieries de Firminy. Les Etablissements Henri Gras has also been capitalized at 1,700,000 francs (about $135,000) for the manufacture of metals, particularly copper, bronze, and aluminum.

La Société d'Outillage Mecanique et d'Usinage d'Artillerie Souma, has obtained from the city of Paris, an order for sweepers, sprinklers, and steam rollers, the total order amounting to 10,000,000 francs ($792,000). This firm has also received an order from La Ste. Industrielle des Transports Automobiles for 230 automobile truck chassis. The amount of this order is reported to be about 15,000,000 francs ($1,190,000).

* * *

CONDITIONS IN THE SWEDISH IRON AND STEEL INDUSTRIES

The Swedish steel and machinery industries have experienced extreme difficulties during the past year, owing to the general business depression in Europe, the cutting off of the former trade with Russia—which was a large factor in the Swedish export trade in machinery—and the high prices prevailing in the world's markets, which enormously increased the cost of manufacture. The exceedingly high prices of fuel make it difficult for the industry to meet foreign competition. The export trade of Swedish pig iron and steel has also been made much more difficult by the conditions created during the war, when a number of English purchasers of Swedish pig iron and steel were forced to use raw materials obtained from other sources, and it has been found difficult for the Swedish iron and steel industry to regain this former export market.

* * *

MACHINE INDUSTRY IN ARGENTINA

In a recent Commerce Report, it is stated that the machine shops of Argentina are usually well equipped, there being a number that are in a position to take any class of work. They are divided into several large groups, according to whether they handle marine construction, automobile and general repairs, or actually build machinery and parts. The principal articles built are the following: Machinery for meat-packing plants; punch presses and other can-forming machinery; boiling vats and general apparatus for candle- and soap-makers; dairy, bakery, macaroni and oil-mill machinery; and in addition to these, a number of specialties such as wool-washing cisterns, rock crushers, centrifugal pumps, shoe machinery, etc.

The Problem of Accurate Thread Cutting

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

When I entered a machine shop to learn the rudiments of mechanics, one of my first jobs was to tap a number of holes. The tools used for this purpose at that time were of the same kind and as good as they are today. For drilling holes, we had to make our own drills, and it was considered an accomplishment to be able to forge and twist a good drill; after hardening, we had to straighten the tool the best way we could. Drills of that kind are not used nowadays. A drill would not be accepted as a gift unless it is finished to size after hardening, and has the proper relief. But even so, we do not expect a modern drill to drill a hole exactly to size, and we do not expect that the hole will be perfectly straight.

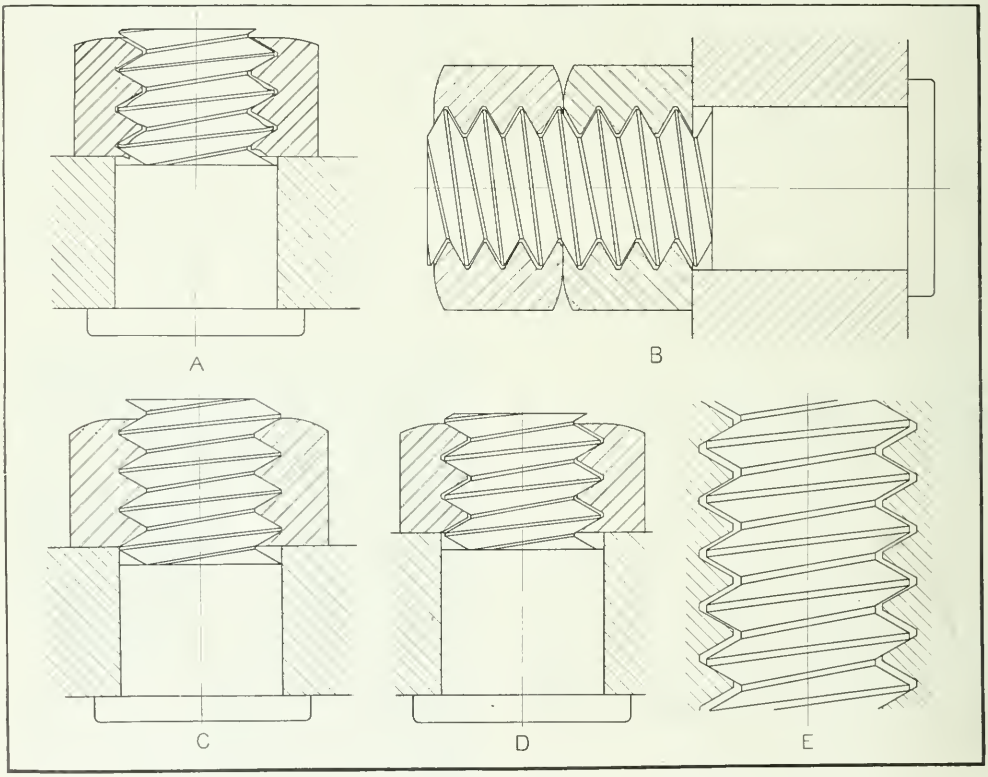


Fig. 1. (A) Distortion of Threads when those of Nut and Screw are not of Same Lead. (B) When Leads of Threads of Nut, Lock-nut, and Screw are Different, only about One Thread has Contact in Each Nut. (C) Ideal Condition of Contact with Correct Lead, Diameters, and Thread Angles. (D) Uniform Contact on Pulling Side of All Threads with Correct Lead in Nut and on Screw, although Screw is a Loose Fit in Nut. (E) Nut of Standard Diameter with Inaccurate Lead, differing from Lead of Screw; Screw must be Under-sized to enter Full Length of Nut

When it is desired to produce an accurate hole, a reamer is made, which is ground and relieved after hardening. A reamer is expected to cut a hole to a predetermined size, and it is not very difficult with modern methods to produce such a reamer. To fit a piece accurately into a reamed hole is rather an easy task, where modern grinding machines are available, and the amount of freedom or tightness of the fit is determined by the size of the piece that enters the hole.

Requirements to Fulfill in Fitting Threaded Parts

When it comes to fitting threaded parts together, we have made very little progress. On large diameter screws, such as those used in machinery for moving slides and other parts where accuracy is required, we still chase the nut in a lathe and cut the thread of the screw either in a lathe or a thread milling machine. The principal reason for this is that exactly the same lead is required in the nut and on the screw, so that the threads on the screw will have contact throughout the length of the nut, thereby affording a good wearing surface and ample strength. If nuts of this kind were tapped, each nut would have the same error as the tap has after hardening, and the screw would only fit on a very small portion of the thread; it would not have a good contact until the threads on the screw and in the nut had become sufficiently worn to make the leads in these two members more uniform with each other.

In tapping holes for ordinary screws, such as those used in holding machine parts together, good fits are chiefly dependent upon the accuracy of the tap. As the tap is generally a rigid tool and non-adjustable, it will tap a hole approximately to its own size; but when the lead has been found to be inaccurate, due to distortion in hardening, there has been in the past no practical means of correction to bring the tool back to its original condition of accuracy. Dies used for threading screws are generally adjustable as to diameter, and because their chasers are short, they are easier to control in hardening. For this reason screws with fairly accurate leads can be cut with commercial dies.

Absolute accuracy of the lead in taps is unknown, and even the diameter and shape of thread is very hard to maintain. Tolerances are therefore established on fits between the threaded parts. By the use of such equipment as the Hartness comparator, made by the Jones & Lamson Machine Co., of Springfield, Vt., which was described in MACHINERY for January, 1920, it is a simple matter to determine the accuracy of the leads of threaded parts. The diagrams and illustrations shown in connection with the present article clearly show what happens when the lead in a nut and a screw are not alike.

Lead of the Screw

When the lead in a nut varies from the lead in a screw, as shown at *A* in Fig. 1, there is hardly more than one thread in contact. When the nut is tightened, this one thread yields until one more thread is in contact, and by further tightening, it may be possible to get a number of threads to assist in carrying the load. However, the engagement between the threads of the nut and the screw extends over only part of the length of the thread in the nut; and where there is contact, the threads have been distorted. When the screw is exposed to the load, due to the pressure brought upon it by the machinery parts that it is supposed to hold together, it is liable to work loose, because of insufficient contact between the threaded parts.

It is often attempted to overcome this difficulty by employing lock-nuts as substitutes for accuracy in the threads. Diagram *B* shows the ineffectiveness of a lock-nut. Fine-pitched threads are easier to force into contact with each other than coarse-pitched ones; but the finer threads are also easier to destroy, and when the two parts are hardened, these finer threads are often broken off altogether. The original trouble of the wrong lead of thread has never been fully overcome by the employment of any substitute. On the other hand, if the lead in the nut and the screw are the same, all the threads in the nut are in contact with the screw. In tightening the nut, no yielding will take place, and the friction obtained throughout the length of the thread will keep the nut from vibrating loose or the thread from yielding. (See diagram *C*). Even if a nut fits loosely on the screw, but has the same lead as the screw, it will hold tightly with moderate pressure; this condition is indicated by diagram *D*.

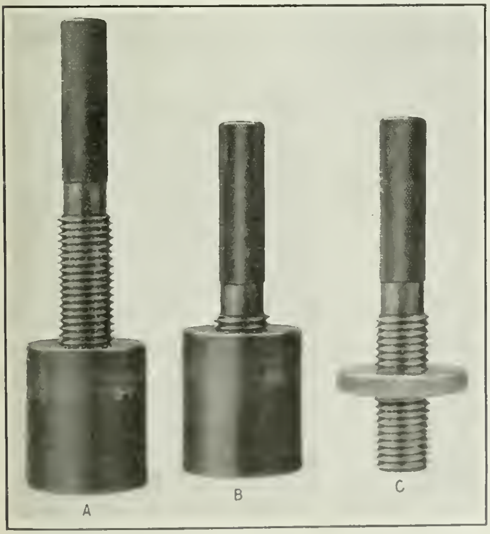


Fig. 2. (A) Nut tapped with 1-inch U. S. Standard Tap; the Screw has an Accurate Thread of Same Lead as Nut and is screwed in only One Thread, yet there is no Shake. (B) Same Nut and Screw shown at A. Nut is 2½ Inches Long and the Screw may be easily run right through and fits uniformly for the Full Length. (C) Thin Nut threaded with Tap finished after hardening; an Accurate Screw fits this Nut easily but without Shake

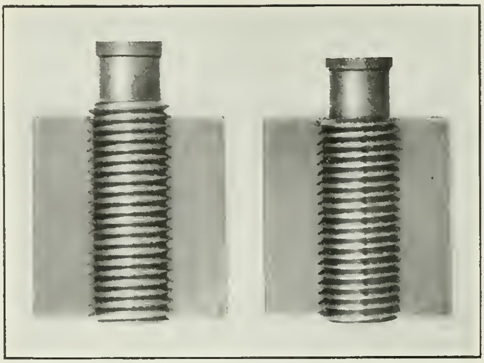


Fig. 3. (View to Left) Threaded Plug with a 1-inch U. S. Standard Thread laid in a Half-nut tapped with a Precision Tap, showing Perfect Contact: (View to Right) Threaded Plug of Accurate Diameter but 0.003 Inch per Inch Long in Lead will not go into the Same Half-nut shown in Right-hand View

Every experienced engine-, locomotive-, or turbine-builder has had trouble in fitting studs into cylinders and similar parts. The stud is screwed into a tapped hole. Generally it fits loosely in the first threads and tightens after being screwed in further. The tightening is due to the difference of the lead in the two members, and it is taken for granted by the workman that he has a good tight fit. When the cylinder head is mounted and the nuts tightened on the stud, the threads of the stud in the casting will yield under the pressure; but when the cylinder head is to be removed and the nuts are to be taken off, it is often found that the stud will come out with the nut instead of staying in the tapped hole in the cylinder. If the lead of the thread in the hole and on the stud were the same, the stud could be made to fit throughout the length of the hole and every thread would then do its part in holding the stud firmly in place.

Care in Making Fine Thread Gages to Control the Size of Screws

The methods for making gages for measuring and inspecting screws have developed considerably during the last fifteen years. When good work is required, the screw maker is held down to very close limits. In many cases not even a maximum and a minimum gage are used for testing a screw thread. The screw in that case is expected to fit with an even friction in only one gage. As the die is adjustable, it is possible to meet this requirement. But is it not incongruous when you stop to consider the matter, that after having made all of these fine screws and inspected them with this very fine gage, they are put into holes that are tapped with a tap that often has a thread with an inaccurate lead, and that has a fairly large tolerance on its diameter? Furthermore, all of the holes for these fine screws are not always tapped with the same tap, and when screws are made to fit fairly satisfactorily in a hole tapped with one tap, they will not fit a hole tapped with another tap, although the taps are supposed to be of the same size.

Furthermore, taps are often slightly bent in hardening, the lead being a little longer on the convex side than on the concave side; and although the diameter may be fairly close to size, as measured with a ball micrometer, it will not tap a hole of the same size as its own diameter on account of being bent. I have had experience with taps measuring very nearly the same in diameter, yet one tapped a larger hole than the other. This was due to one tap being straighter than the other. After a long experience with and study of this problem, I have come to the conclusion that the majority of difficulties in thread fitting are due to the inaccuracy of taps, and if taps are made accurate in lead and diameter, most of the troubles experienced in fitting threaded parts are likely to be overcome.

Work of Engineering Committees

Great efforts have been made by committees of experienced men to eliminate the errors in the various types of thread-cutting tools; and great strides have been made in establishing tolerances that would be within so-called "commercial limits." If the market can be supplied with an accurately made tap, this problem will solve itself; and if screws and threaded holes can easily be held to a predetermined size, according to standards in vogue, the committees will be relieved of the task of establishing tolerances that will suit everyone's requirements.

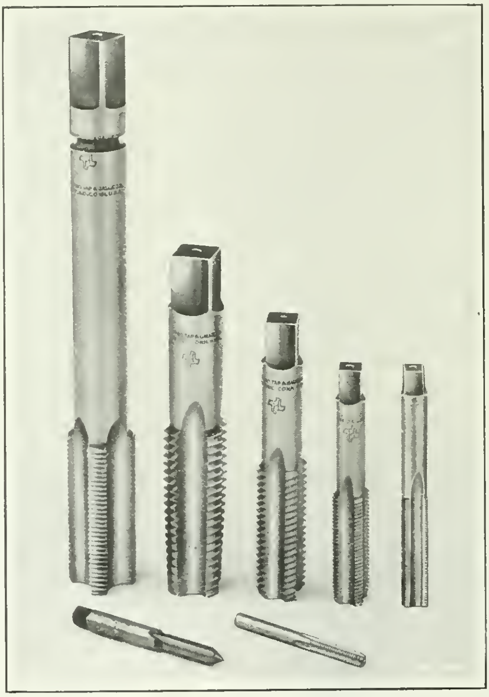


Fig. 4. Taps with Threads finished after hardening; at the Right is shown a ⅜-inch Tap with 100 Threads per Inch

In order to illustrate the effect of differences in lead on the diameter of the screw in relation to the nut, a carefully conducted series of experiments was recently made by the Hartford Tap & Gauge Co., Hartford, Conn., who is now producing taps for the market with threads finished after hardening by a process developed by them. A 1-inch tap with eight U. S. standard threads per inch, 2½ inches long, was made and finished after hardening. This tap was carefully measured and found to be correct in the lead within 0.0001 inch in three inches. A nut 2½ inches long was tapped with this tap. A plug was then made 0.0003 inch smaller in diameter than the tap, but of exactly the same lead. In screwing this plug into only one thread in the nut, as shown at *A* in Fig. 2, there was no shake, yet the plug could be screwed in the whole length of this long nut with two fingers, so as to occupy the position shown at *B*. The engagement between the threads of the nut and the screw is shown in diagram *D*, Fig. 1.

Another plug was made with the lead about 0.0035 inch long to the inch, and this was also accurately finished after hardening. This plug would only go in one thread in the nut and would then stick. Probably by applying a wrench it could have been screwed in two more threads which would, of course, have distorted the thread in the nut. The plug was then reduced until it would just go through the whole length of the nut, and by that time it was 0.013 inch smaller in diameter than the first plug made to the correct lead. The last plug fitted partly on one side of the first thread and on the opposite side of the last thread in the nut, as shown in diagram *E*, Fig. 1. In all the intermediate threads there was no contact. After this, the nut was carefully split longitudinally so that exactly one-half of the nut remained. By taking the two plugs and dropping them into the half-nut, as illustrated in Fig. 3, it was shown very plainly what actually takes place when a screw is fitted to a nut where the leads of the respective parts do not correspond with each other.

Solution of the Difficulty in Fitting Threaded Work

Owing to all the difficulties encountered in making and fitting threaded parts, engineers have carefully considered how much of this evil can be tolerated, and many discussions have taken place as to how this evil could, so to speak, be standardized within reasonable limits. I believe it is better to do away with the evil than to standardize it. The screw makers and the tap makers have been brought together, and are both well acquainted with the difficulties connected with the manufacture of each other's products. They have made honest efforts to minimize them as far as possible, but in my opinion they will not be overcome until methods are used for making taps of a predetermined diameter and lead, and that can be done only by finishing them after hardening.

In 1891 I started to make accurate taps for a special purpose and at a very great expense, but they were beyond commercial reach. From time to time I succeeded in making improvements in the method of producing such tools; but today I can state that this problem of producing accurate taps has been solved on a commercial basis. Fig. 4 shows examples of these precision taps as manufactured by the Hartford Tap & Gauge Co.

After making several tests as to the wearing qualities of taps that are corrected after hardening, I was surprised at the increase in the life of the taps. These taps were also corrected on the chamfered part after hardening, so that the taper was uniform, and each tooth made to take its proportionate part in cutting the thread; hence the increase in the life of the tap.

* * *

THE WASTE OF GASOLINE

Dr. A. C. Fieldner, supervising chemist of the United States Bureau of Mines, Experiment Station at Pittsburg, Pa., has found as a result of extensive investigations that nearly one-third of the gasoline used in automobiles is wasted. The experiments were conducted to ascertain the pollution of the atmosphere of the vehicular tunnels now under construction in New York City, by motor vehicles. The experiments were made under the same conditions as apply to actual traffic. The chief cause of the waste is a too rich gasoline mixture. An improved form of carburetor should be devised, which should be practically automatic in operation. On the basis of 34 cents per gallon, American automobilists are using about $115,000,000 worth of gasoline a year, of which, according to Doctor Fieldner, about $34,000,000 could be saved by improved methods, largely in better construction and operation of carburetors.

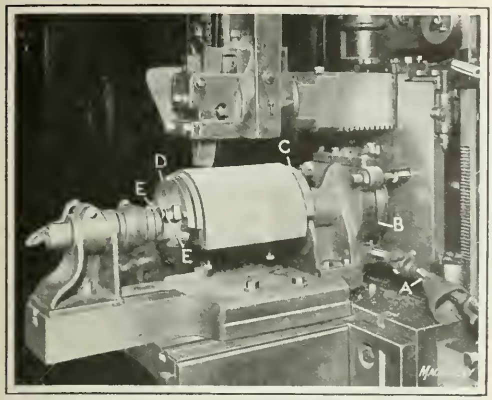


Fig. 1. Draw-cut Shaper equipped with a Special Rotary Fixture for machining the Outside of Driving-box Brasses

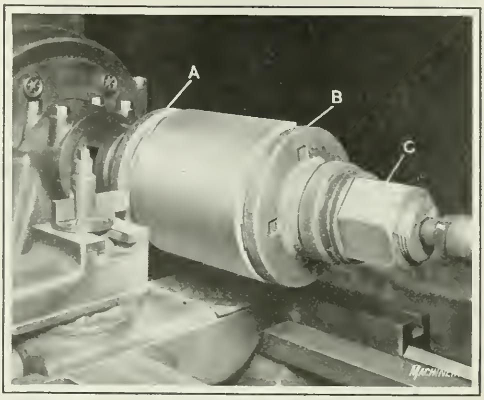


Fig. 2. Special Mandrel with Serrated Collars for holding Driving-box Brasses while turning the Outside Surface

Railway Machine Shop Practice

Methods Used in Machining Crown Brasses, Driving-boxes, and Shoes and Wedges

Fourth of a Series of Articles

It is always interesting and instructive to compare the methods used in different shops for performing the same operation on any given class of work. As a case in point, consider the work of machining the outside of crown brasses for locomotive driving-boxes. One would scarcely expect to find the same operation successfully performed on either an engine lathe or a shaper, but such is actually the case. By referring to Figs. 1 and 2 it will be seen that a draw-cut shaper and an engine lathe are each shown engaged in finishing the outside of a crown brass ready for it to be pressed into the box.

The machine illustrated in Fig. 1 is a draw-cut shaper built by the Morton Mfg. Co., of Muskegon Heights, Mich. It is shown in use in the Burnside shops of the Illinois Central Railroad Co., in Chicago. To adapt this equipment for the required service it will be seen that from the feed gears power is transmitted through a universal-joint horizontal shaft *A* to a worm and worm-wheel contained in case *B*. Connected to the worm-wheel there is an arbor on which the work is set up, so that as the shaper tool is reciprocated back and forth the work may be rotated under it at a uniform rate of speed, thus providing for the generation of an accurate cylindrical surface. It will be seen that this arbor has a fixed collar *C* and a collar *D* that is held in place by two bolts *E*. On their inner side these collars are serrated so that as the bolts are tightened, the serrations can bite into the work and enable the collars to obtain a secure grip.

In performing this same operation of machining the outside of crown brasses for driving-boxes, the Chicago & Northwestern Railway Co.'s shops in Chicago make a practice of setting this work up in an engine lathe, as shown

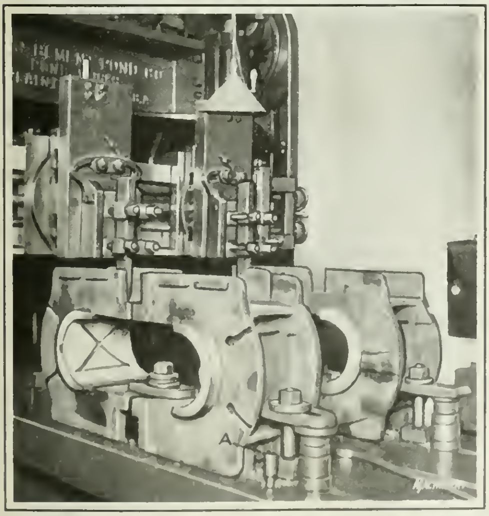


Fig. 3. Method of setting up Four Driving-boxes for replaning after pressing in the Bearing Brasses

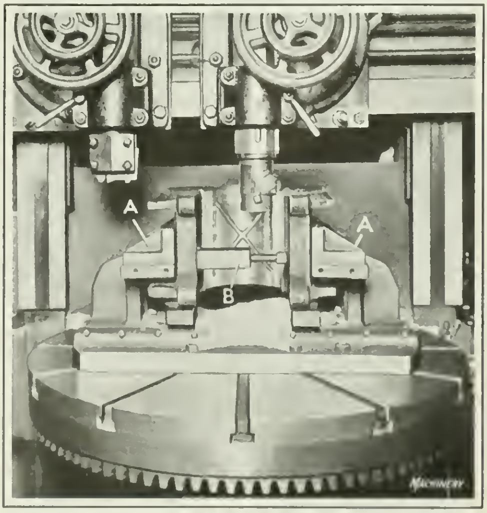


Fig. 4. Method of boring the Bearing Brass, after pressing it into Place in the Driving-box

in Fig. 2, and it will be seen that an arbor is provided on which the casting is held between centers. This arbor is furnished with a fixed collar *A* and an adjustable collar *B*, these collars being serrated on their inner sides in the manner just described in connection with the draw-cut shaper job. It will be seen that there is a nut *C* on the threaded end of the arbor, which is tightened with a long-handled wrench to provide for holding the work with the required degree of tightness.

Method of Assembling Brasses into Driving-boxes

Regardless of whether crown brasses are being pressed into new driving-box castings or whether they are being replaced in old ones, the method of procedure is to press the brass into place with a hydraulic press. During this process, the forcing of the brass into position tends to spread the sides of the box, so that even in the case of an old one which has already had the fits planed to receive the shoes and wedges, it is necessary to replane the work to bring it to the required degree of accuracy. In performing this operation, the object is to make the two sides of the driving-box exactly parallel and still to remove a minimum amount of metal.

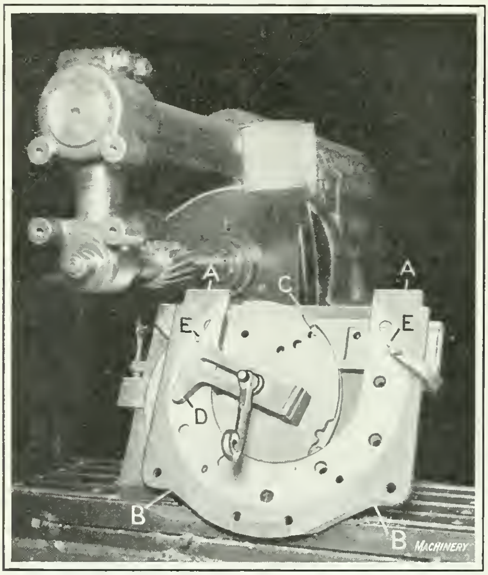


Fig. 5. Milling the Tapered Clamping Surfaces of a Removable Lateral Bearing Plate for a Driving-box

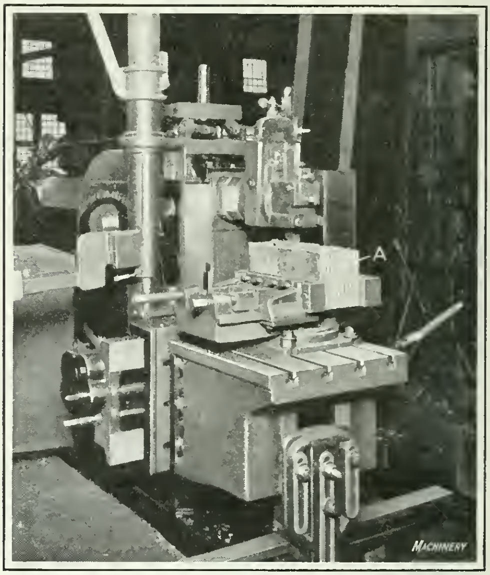


Fig. 6. Draw-cut Shaper used for planing Edges of Sheet-steel Shims for adjusting Worn Driving-boxes

The method of procedure in handling this work in the shops of the Chicago & Northwestern Railway Co. is to first take a light cut over one side of the box to clean up the surface, then to turn the work over and place this previously planed face on a parallel strip *A*, Fig. 3, on which the driving-box is strapped down ready for planing the other side, thus assuring parallelism of the fits for the shoe and wedge. In Fig. 3 is shown a planer built in the Pond Works of the Niles-Bement-Pond Co., Plainfield, N. J., on which two pairs of driving-boxes are set up side by side, so that tools carried by the two rail-heads of the planer can operate simultaneously. This saves time through taking advantage of economies of production that result from applying the multiple method of setting up work.

Boring the Driving-box Bearing Brass

After the sides of the driving-box have been planed on the machine shown in Fig. 3, the work is transferred to a vertical boring machine built in the Bement-Miles Works of the Niles-Bement-Pond Co., in Philadelphia, Pa., on which each driving-box is chucked from the previously planed shoe and wedge fits, for boring the inside of the bearing brass, as shown in Fig. 4. It will be seen that the fixture by which the driving-box is carried is furnished with two jaws *A*, and in order to prevent the pressure of these jaws from springing the work inward, and thus causing the accurately bored bearing to be sprung out of shape when the jaws are released, a jack *B* is placed inside the box in the position shown. There is nothing unusual about the actual method of performing the boring operation.

On driving-boxes for engines owned by the Chicago & Northwestern Railway Co., there are two methods of applying lateral bearings. One of these is to apply babbitt to the face of the driving-box, while the other is to employ a separate bearing plate which is made as a self-contained unit, so that it may be removed and a new bearing substituted without the necessity of taking off the driving-box and sending it to the shop to have the bearing rebabbitted. But regardless of which type of lateral bearing is employed, the driving-box, as it comes to the boring mill shown in Fig. 4, has had the lateral bearing repaired, if necessary, and a facing operation is performed on the babbitted surface of the lateral bearing while the driving-box is set up on the boring machine.

Milling Lateral Bearing Plates

Where detachable lateral bearing plates are employed, it is the practice of the Chicago & Northwestern Railway Co.'s shops to have an under-cut bracket at each corner of the driving-box, by which the upper end of the lateral plate is held; and there are sliding clamps that are under-cut to fit over the lower corners of the plate, these clamps being held in position by means of suitable bolts. In Fig. 5 is illustrated a No. 4 heavy-duty milling machine built by the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, that is furnished with a fixture to provide for milling the inclined corners *A* and *B* of the lateral plate, to fit under the brackets and clamps that hold this plate in position on the driving-box.

It will be evident that the fixture is furnished with an inclined plate *C* on which the work is held by means of a strap *D*, so that by feeding it under the plain milling cutter on the machine, the edges *A* and *B* of the corners of the work are milled to the required angle of inclination with the face of the plate. In the fixture there are two pins *E* which enter holes in the work to locate it in the position shown; these pins also provide for obtaining the required second and third settings of the work for milling the lower corners *B* that are engaged by the clamps which hold the lateral bearing plate in place on the driving-box.

Planing Shims for Worn Locomotive Driving-boxes

There are various methods of procedure in refinishing worn driving-boxes of locomotive engines that come to a railway machine shop to be overhauled. At the Burnside shops of the Illinois Central Railroad Co., it is occasionally necessary to use packing shims made of sheet steel, to compensate for wear that has developed on the shoe and wedge faces of driving-boxes. These shims are of rectangular form, and after the rough blanks have been sheared out of a sheet, a practice is made of setting up ten blanks *A* between the jaws of a vise mounted on the table of a draw-cut shaper built by the Morton Mfg. Co., as shown in Fig. 6, to provide for accurately planing the edges of these blanks, so that each edge is smooth and parallel to the opposite side of the shim. By setting up a number of blanks in this manner, a saving of time results from having the non-productive time required for setting the cutting tools distributed over a number of pieces of work.

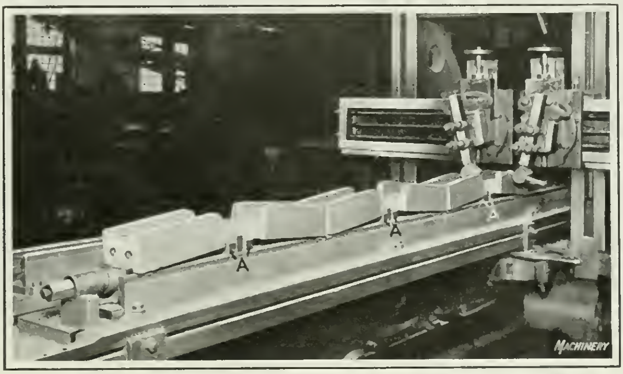


Fig. 7. Method of setting up a String of Six Wedges for planing the Tapered Surfaces

Planing Driving-box Wedges

Most mechanics who have done any work in railroad shops or locomotive building plants, know that the driving-boxes are held in place between the jaws of the engine frame by means of two members known as a "shoe" and a "wedge," respectively. One of the frame jaws is straight, and the shoe goes between the driving-box and this jaw. At the other side, the jaw is tapered and the wedge is placed between this jaw and the driving-box, so that by adjusting the position of the wedge, it is an easy matter to take up lost motion between the driving-box and the frame of the engine. With an arrangement of this kind, the driving-box is free to move vertically between the jaws, but it cannot have lateral movement which would be undesirable.

Fig. 7 illustrates a planer built at the Niles Tool Works of the Niles-Bement-Pond Co., which is equipped for the planing of wedges in the Burnside shops of the Illinois Central Railroad Co. It will be seen that the work is strung up along the planer table, with suitable sized blocks *A* under one end of each wedge, so that the work is held in the proper position for planing the inclined side to the required taper. The sides of the wedges are also planed at this setting, as shown in the illustration, but aside from the method of setting up the work for the taper planing operation, and the fact that the work is done at one setting, there is nothing in any way unusual about the performance of this job.

* * *

According to United States Geological Survey reports, the total world output of coal in 1920 was about 1,300,000,000 metric tons, as compared with 1,342,000,000 metric tons in 1913.

HOLDING THIN WORK FOR MACHINING

By F. E. CHACE

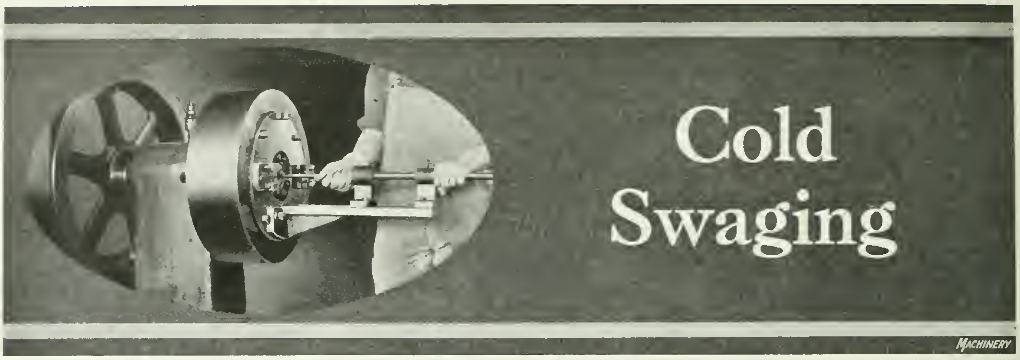
The problem of holding thin and delicate work while it is being machined frequently taxes the ingenuity of the machinist. While the magnetic chuck is now in great demand for holding thin work, and is used on grinding machines, lathes, and planers, for this purpose, there are nevertheless instances in which it cannot be employed and some other means must be provided. For many years instrument makers and other metal workers have made a practice of attaching thin brass work to a flat plate, or directly to a lathe faceplate, by means of soft solder. This method of fastening work is exceedingly useful in some instances, and would no doubt be employed to a greater extent if more generally known. A disk or block of brass or steel, if it has one flat side of sufficient area, can be soldered to a faceplate, thus eliminating danger of distortion from chuck jaws. Work attached in this way can often be finished completely in one setting; for instance, in the case of a thin disk, a hole may be bored in the center, the face finished parallel with the back, and the outside diameter turned concentric with the hole at one setting of the disk.

This method can also be used to advantage for certain kinds of planer work. The writer once employed this method in making a long, thin, tapered gib of steel. The stock for the gib was soldered to a square steel bar, and the three sides were planed in this position, thus finishing the gib to the required size and angle without changing the setting of the bar or work. One advantage of this method which the magnetic chuck does not have is that brass may be held as effectively as steel. Another advantage is that work set up in this manner may be taken from one machine to another; for instance, from a planer to a drilling machine or grinding machine. Often this permits the work to be completely finished while fastened to the metal holder.

Thin cast-iron pieces cannot be fastened in this manner, because soft solder will not readily adhere to cast iron. Cast iron may, however, be cemented to a faceplate. In this connection the writer has in mind a case in which rosin was used as a cement to fasten some thin cast-iron plates on a planer bed. The plates were quite thin, but they were of considerable area and were therefore easily cemented in place with the melted rosin and planed.

Another kind of work that is difficult to clamp and machine without distortion is a slender or delicate spider-shaped casting or any similar piece that offers no suitable chucking surface. Such work must be carefully handled in order to prevent the thin walls or slender arms from becoming broken or distorted. A casting of this kind can sometimes be immersed in molten lead in such a way as to leave the surfaces to be finished in the proper position for machining when the lead hardens. This will prove an effective method of holding many awkward shaped pieces.

A thin metal cylinder or tin can may serve as a container for the molten lead. This lead-filled cylinder with the work embedded in it may be gripped by the chuck jaws of a lathe. If antimony is added to the molten lead the metal will be harder when cold



Cold Swaging

Methods Employed by the Torrington Co., Torrington, Conn., in Making Swaging Dies

Second of Two Articles on the Subject of Cold-swaging

In the first article on cold-swaging published in the June number of MACHINERY, the application and the limitations of the swaging process were dealt with. The effect of swaging on the physical properties of the metal was explained, the principles of the swaging machine were outlined, and types of swaging work shown, together with rates of production. The present article will deal with the steel used for swaging dies and its heat-treatment, the machining of the die-blanks, and the use of the projectograph for swaging-die inspection.

Steel for Swaging Dies and its Heat-treatment

Experience governs the selection of the steel to use for swaging dies, and this automatically determines the heat-treatment that it is to receive, for it is the usual custom of steel manufacturers to furnish information regarding the heat-treatment of their several brands of steel used for various purposes. It has been determined by the Torrington Co., through trials of various steels and by the use of different methods of heat-treatment, that a brand of steel that is good for one size and service of dies will not necessarily prove the best for another type, no matter how it is treated.

The service to which swaging dies are subjected is somewhat different from that of forging or press-work dies, in that, in swaging, the dies are brought rapidly and repeatedly against the work so that the steel must withstand this destructive action without fracturing. At the same time, the dies must have a sufficient degree of hardness to insure a reasonable length of life. The heat-treatment department of the Torrington Co. is equipped for handling the die hardening work according to the highest degree of development which this branch of die manufacture has attained within the last few years. There are a number of Gilbert & Barker oil-burning furnaces in which the tool-steel swaging dies are heated for hardening; a Triad three-purpose oil-burning furnace manufactured by W. R. Bennett, Elmwood, Conn., in which the high-speed steel is heated; a cyanide bath furnace for tempering high-speed steel; and the customary oil-tempering furnaces, quenching tanks, etc. The furnaces are all equipped with electric pyrometers manufactured by the Bristol Co. of Waterbury, Conn.

The steel used in this plant for the medium-sized dies is the Crucible Steel Co.'s "Crescent" special cold-drawn steel, and for the small and the large dies the steel used is manufactured by Hobson, Houghton & Co. and is their "Warranted Best" brand. High-speed steel is used only in the manufacture of dies for hot-swaging. These three steels, properly heat-treated, have given the best service under the destructive battering-down action that the dies are subjected to in swaging work. Tool-steel dies are heated to 1460 degrees F., and are quenched in brine at an atmospheric temperature. They are then drawn in oil at 350 to 360 degrees F. For heat-treating high-speed steel dies, the Triad furnace is run at 2100 degrees F., and the work transferred to the bath-tempering furnace, which contains a solution of caustic soda, salt, and cyanide at a temperature of 600 degrees F. The work is removed from the cyanide solution and cooled on the floor, after which it is immersed in boiling water for a period of three or four minutes to remove the scale.

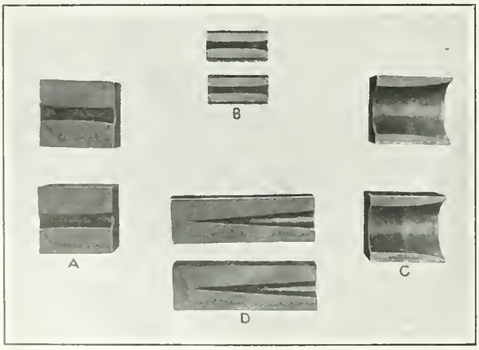


Fig. 1. Examples of Different Classes of Swaging Dies: (A) Straight Solid Stock; (B) Threaded Rods; (C) Tube Reduction; (D) Tapered Tubes

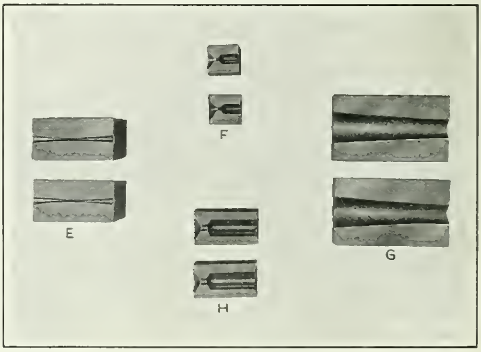


Fig. 2. Additional Examples of Swaging Dies: (E) Needle Work; (F) and (H) Dies used in Hot-swaging Process; (G) Tapered Solid Stock

Machining the Die Blanks

The methods employed in machining the die blanks are not unusual, but an outline of the general practice of the Torrington Co. will be given in the following. A collection of swaging dies used for various types of work is shown in Figs. 1 and 2. The dies shown at *A*, Fig. 1, are used for the straight reduction of solid work, for sizes 2 inches and under in diameter. At *B* is shown a pair of threading dies such as are used in threading rods. It should be mentioned, in connection with the production of threaded rods by swaging, that the work is positively fed through the dies and that it does not revolve, the thread being formed as the dies are rapidly advanced on the work during the course of their revolution. The dies shown at *C* are for reducing the diameter of tubes. It will be noticed that in all dies employed on straight reduction work, or for threading, provision is made for facilitating the entry of the work into the dies by bell-mouthing the blade, as clearly indicated in this illustration. The pair of dies shown at *D* was used in the production of the lightning-rod ends shown at *F*, Fig. 4, in the previous article published in the June number. These parts are made from copper tubing and have a uniform taper, the dies illustrated being typical of those used for the tapering of tubular work.

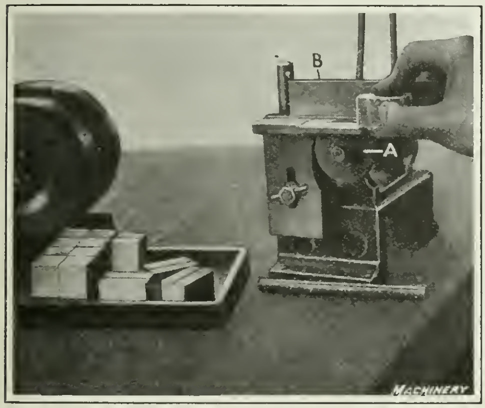


Fig. 3. Die-slotter which is employed for grinding Blades of the Smaller Size of Dies

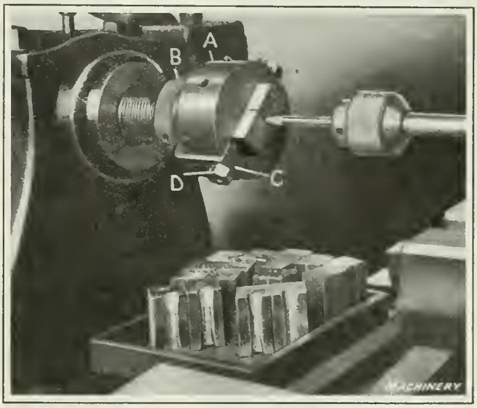


Fig. 4. Lathe equipped with Chuck for holding a Pair of Blanks Central while machining the Blade

A pair of dies used in the production of needles is shown at *E*, Fig. 2. Needle work may be classified as the straight reduction and pointing of small wire, and the work is invariably produced on machines having a maximum capacity of 3/16 inch. *F* and *H* illustrate the appearance of swaging dies used in the manufacture of certain classes of work by the hot process. The smaller pair of dies has a capacity for handling wire under 1/16 inch in diameter, and the pair shown at *H* for wire sizes not greater than 3/32 inch. The distinguishing characteristic of the dies used in the hot-swaging process is the short blade. The dies shown at *G* are for tapering solid work ¾ inch and under in diameter. Besides the types of swaging dies shown in these two illustrations, there is also the step die for swaging two diameters at a time. The use of dies of this type enables greater reductions to be made without the employment of separate dies, which, of course, results in considerably increasing the production rate.

After the blanks have been squared up, the die groove, which for straight reduction work is termed the "blade," is machined. For the smaller size of dies, this blade is produced by grinding on the special die-slotter illustrated in Fig. 3. This slotter carries a Waltham Grinding Wheel Co.'s 100-grain, grade E wheel for producing the blade in the smallest dies, such as shown in this illustration; and a Vitrified Wheel Co.'s 80-grain wheel for producing all other blades which are to be finished by grinding. The operation performed on the machine shown in this illustration is a simple one, and involves merely the passing of the blank back and forth over the wheel *A*, against the adjustable guide *B*, and repeating the operation with the work turned around. The object of reversing the work is, of course, to centralize the blade in the die-block.

For the larger size, the blade is first rough-machined by planing on an ordinary tool-room shaper. The practice of planing the blades of the larger dies assures that the blade will not run out during the subsequent reaming operation by means of which the planed blades are semi-finished. The varying hardness in the steel of mating dies may be sufficient to cause considerable difficulty in maintaining exact duplicate blade grooves, unless the preliminary operation is performed with the work rigidly supported and by the use of a substantial tool, as in planing. Before the blanks are planed, however, they are counterbored at the ends, as shown in Fig. 4. The machine used for this operation is a Blaisdell lathe, equipped with a holder *A* in which a pair of dies may be held and centralized. This holder fits the regular lathe spindle, and has a knurled adjusting collar *B* for opening and closing the jaws *C*. The provision for centralizing the work in the holder or chuck consists of two adjusting screws *D* carried in the jaws.

The radius of the counterbore thus produced determines the depth to which the blade is subsequently planed. All finishing operations on the larger size of dies are performed with equipment similar to that shown in this illustration, so that the mating members may be held in pairs during the machining operations, which consist of boring and reaming the straight blades (except where this is performed on the slotter, Fig. 3) and of reaming the taper recesses in dies of the type shown at *D*, Fig. 1, and at *G*, Fig. 2. The taper at the end of the straight blades is also produced by reaming. Ordinary tools, such as single-point boring tools, and straight and taper reamers, are used in the performance of these operations.

The blades, of course, are not a full semicircular recess, for if they were, the dies would be closed together in service and there would not be any provision for the flow of metal. Consequently the die blanks must be clamped in the holder (Fig. 4) during the machining of the blade and its tapered mouth, the adjacent sides of the dies being separated by a spacing block of the proper thickness, thus producing a circular recess not quite as deep as a semicircle. Naturally the amount that each blade is under a full semicircle increases with the size of the work, in order to make provision for the greater flow of metal in the larger sizes of dies.

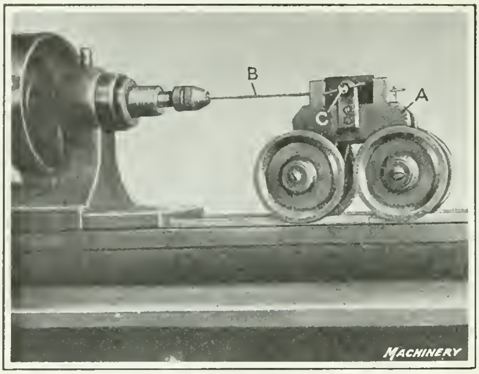


Fig. 5. Bench Lathe with Special Wheel Carriage in which the Dies are held during the Lapping Operation

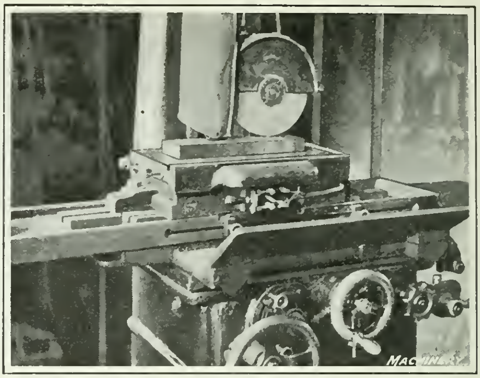


Fig. 6. Surface-grinding the Die Blanks to obtain Uniform Height. The Work is located on a Magnetic Chuck

Final Operations on the Dies

All blades and die grooves are finally finished by lapping. The lapping operation is performed on a specially constructed bench lathe, on the bed of which a special carriage mounted on wheels travels on a track. This equipment is illustrated in Fig. 5, from which it will be seen that the lapping fixture *A*, supported on the carriage, enables the lapping wire *B* to size the blades in mating dies as the carriage traverses back and forth on the lathe bed. The dies are clamped in place by a thumb-screw *C* during the operation. The lap consists of an ordinary piece of soft steel wire, and the lapping compound used is a mixture of flour emery and oil.

For dies used on the ordinary class of straight reduction or in the production of tapers, the practice is to lap the blade only after the heat-treating process. When the dies are to be used for swaging plated work or for solid gold, silver, or platinum wire, they are lapped both before and after heat-treating. This is a precautionary measure to safeguard against the possibility of imperfections in the finished blade surface, as any roughness or irregularity would tend to abrade the surface of the metals. It will be appreciated that only a slight surface defect would injure swaged work of this kind.

Hot-swaging dies, which are made of high-speed steel, are manufactured by a process similar to that described for the smaller cold-swaging dies. Mention has already been made in connection with the hot-swaging dies shown in Fig. 2, of the fact that the blade is comparatively short, the purpose of this being to reduce the likelihood of the stock cooling rapidly during the swaging operation. It will be appreciated that if this blade were as long comparatively as the blades of the cold-swaging dies, the additional metal in contact with the hot work would tend to dissipate the heat rapidly, causing the heated metal to drop below the correct swaging temperature before the operation was completed. As a general rule it may be stated that the length of this blade is equal to its diameter. These hot-swaging dies wear much faster than other dies, but the rapid increase in the diameter of the blade does not affect the serviceability of the dies as much as might be supposed, for after they become worn they are simply remachined and used for swaging larger sizes of wire.

The final machining operation on the die blanks consists of grinding the face of the dies on a B & S No. 2 surface grinder equipped with an O. S. Walker magnetic chuck and a Norton alundum wheel, 38 to 46 grain, grade G. This machine is illustrated in Fig. 6, in which a number of dies are shown on the magnetic chuck. This grinding operation is not for the purpose of producing any given gage thickness, but to assure uniformity in thickness for each pair of dies. In other words, the amount of stock removed is just enough so that the lowest top die surface (as the dies are held on a chuck) will be cleaned up.

The reason that mating dies must have the same thickness will be readily understood by again referring to Fig. 1 in the article in the June number. In this connection attention is directed to the method of setting up the swaging machine. Between the dies and the backers, suitable shims are used; the thickness of these shims is such that when the pulley of the machine is turned by hand and the dies are forced toward the center, there will be a space between the adjacent faces of the dies, which is sufficient to permit the metal to flow as it is being reduced, without producing a fin on the work. Therefore, if each die is not ground to an equal thickness it becomes difficult, if not impossible, to shim up the dies so that this space between them will be centrally located. If this is not accomplished, the resulting work will be unevenly and improperly swaged. It is evident that if this space is off center, blows of unequal

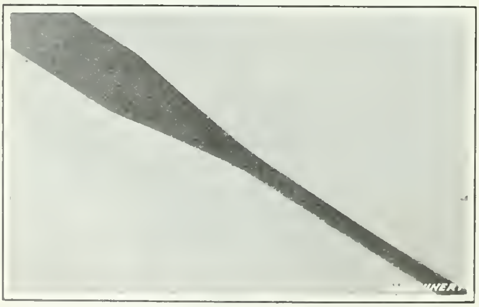


Fig. 7. Projectograph of a Needle of 0.07 Inch Diameter taken at a Magnification of 50 Diameters

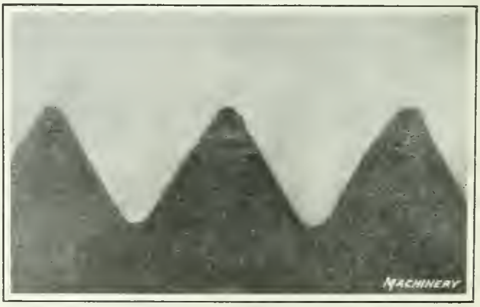


Fig. 8. Swaged Thread projectographed to show the Contour. The Magnification is 50 Diameters

force will be applied by the dies and the work will consequently be imperfect and its structure undependable.

Use of the Projectograph for Swaging Die Inspection

The lantern projector apparatus, shown at the right in Fig. 3 in the June number, is manufactured by the Greenfield Tap & Die Corporation for the National Physical Laboratory of Great Britain. An apparatus of similar design to that illustrated was described in the October, 1920, number of MACHINERY. Use is made of this projector in the laboratory of the Torrington Co. in connection with the manufacture of the swaging dies. The machine has a magnification of fifty diameters, so that the condition of the dies may be determined by inspecting a projectograph of the matrix of the die or of a piece of swaged work.

The projectographs reproduced in Figs. 7 and 8 emphasize the value of such an inspection means for detecting imperfections in the die surfaces. Fig. 7 shows a needle of 0.07 inch diameter after being swaged in a pair of dies, and enables the irregularities in the blade, produced either by wear or by improper machining, to be easily detected. Mention has been made in a previous paragraph of the quality of product which may be realized in the manufacture of threaded rods by swaging. The projectograph of swaged threads shown in Fig. 8 is self-explanatory. The thread form, it will be seen, is exceptionally good, although it is not in respect to thread form that the swaging process is most efficient, but rather in the lead.

On precision work such as the sizing of wire or for work encountered in needle manufacture, it will be appreciated that the existence of worn surfaces must be detected before it has advanced far enough to produce unsatisfactory work. The detection of this wear probably cannot be accomplished with such a degree of positiveness as by the use of the projectograph apparatus.

* * *

PRIZE FOR HARDNESS-TESTING APPARATUS

A prize has been offered by Sir Robert Hadfield, through the Institution of Mechanical Engineers of Great Britain, for the best design for an apparatus to determine the hardness of materials accurately, and which is suitable for application in metallurgical work for cases in which methods now in use are not fully satisfactory. The present fund amounts to £154 sterling (about $600, present exchange). The award or awards will be made by the council of the institution. A portion of the fund may be awarded for communications which advance the knowledge of methods of testing hardness. All communications should be accompanied by scale drawings or by models or examples of the apparatus; if likely to be of commercial value, provisional protection should be obtained before submitting them. Communications should be addressed to the Secretary of the Institution of Mechanical Engineers, Storey's Gate, St. James Park, Westminster, London, S. W. 1, and should reach him by December 1, 1921. They should be marked "Method of Determining Hardness."

* * *

RECONSTRUCTION IN FRANCE

The reconstruction work in France, especially in regard to railroads in the devastated regions, has been proceeding rapidly; 1500 miles of double-track line totally destroyed during the war have been completely reconstructed. Of the 1700 miles of single-track line destroyed, 1150 miles have been entirely reconstructed and opened for traffic; the remainder is being converted into double-track lines. Orders for 1200 locomotives and 2500 freight cars have been placed. The work of electrifying certain French roads, started last year, is making rapid progress. Two French railroads have started electrification plans that are said to include 4000 miles of road; in addition, the Midi Co. is planning to electrify about 2000 miles.

INDUSTRIAL CONDITIONS IN HOLLAND

By MACHINERY'S Special Correspondent

Amsterdam, June 12

Of late there has been a widespread movement in Holland for the rescinding of the law establishing the forty-five-hour week, due to its being considered, in some quarters, a menace to the industrial welfare of the nation. The government firmly opposes this, but it is inclined to issue special permits to firms having rush orders, allowing the concerns to operate over-time. The socialist movement has spread considerably, as shown by the municipal elections in the great industrial centers, and it is believed that these results forecast those of the general elections to be held next spring.

A number of articles have recently appeared in technical publications urging a much greater use of automatic and semi-automatic machines in the machine and shipbuilding industries, in order to eliminate the necessity of employing skilled workmen, as these are paid very high wages at present. The high cost of skilled labor in these industries is due to the inadequate supply and to the opposition of the labor unions to the training of unskilled workmen and the unemployed from other industries to meet this condition. However, as the unemployment in some industries ranges from 40 to 60 per cent and funds for the unemployed are becoming low, public opinion in general is supporting the government in its endeavor to train men for the industries that are short-handed in help.

Movement for Modernization of Manufacturing Methods

In pre-war days, labor in Holland was very cheap, as compared with the wages paid in Great Britain and the United States, but, while the cost of living has mounted so spectacularly during recent years, there has been no great increase in the efficiency of manufacturing methods, and so manufacturers and economists are aware that if methods are not modernized, Holland will be unable to continue to compete with foreign countries. A Bureau of Standards has recently been established by an organization of manufacturers for the purpose of standardizing all industries through the installation of new machinery.

Profits decreased considerably last year and stocks at present are low on the exchange, but the great majority of concerns set aside sufficient reserve funds during the war to enable the purchase of modern equipment. The feeling exists that if methods remain unchanged the various industries are likely to become paralyzed, and this is one of the reasons why the re-equipment of plants will no doubt be accomplished. Other reasons for the revolution of manufacturing methods are the interest displayed in lectures on scientific management, specialization, etc., and the desire to reduce the proportion of skilled workers necessary in a plant.

Latent Market for Machine Tools

Owing to present conditions, there are great latent possibilities for the sale of machine tools. However, there is also danger of all improvements ceasing if the labor unions obtain sufficient strength to bar mechanical progress. Manufacturers, of course, hesitate to invest money in plants threatened by such a condition. In considering the possibility of selling machine tools in Holland, it must be remembered that the Germans are always able to underbid British and American prices by from 10 to 20 per cent, so that British and American manufacturers can generally sell only such machines as either excel in quality or have special features. Besides this factor, German dealers always afford easier conditions of payment, usually giving credit until 30 days after delivery. The superior quality of American machines is generally recognized, but the distance of the United States from this country and the disinclination of American dealers to comply with the wishes of buyers with respect to the conditions of payment, are distinct hindrances to the sale of American machines

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WHAT IS NORMAL BUSINESS?

In 1914, according to the United States Government census, machine tools to the value of nearly $32,000,000 were produced in the United States. But 1914 was a quiet year in the industry, and many manufacturers say that the sales in that year were only about fifty per cent of the capacity of the existing machine tool plants. At full capacity, therefore, the value of the 1914 product would have been about $60,000,000, and as there was no over-expansion in the machine tool industry that year we may take that sum as representing what was then considered a normal business.

The United States census of 1920 gives the value of our machine tool production in 1919 as $212,000,000. For the month of January, 1920, it is estimated that our machine tool builders were producing at the rate of over $300,000,000 a year, and in that month the peak of machine tool production was probably reached.

When people now speak of a normal business in machine tools they usually make comparisons with the peak production, or with the high levels reached during the last two years of the war and the period of high-pressure business which began six or eight months after the armistice. The basis for comparison should be a figure between those obtainable for 1914 and 1919, and well below the figure for the latter year.

Statements that the machine tool business in certain lines at the present time is only 12 or 15 per cent of normal, convey an erroneous impression and are not only misleading, but unnecessarily discouraging. If a correct basis of comparison could be reached, it would doubtless be discovered that many machine tool manufacturers are not so far from a normal business condition as is generally thought to be the case.

* * *

FREE SERVICE FOR "SECOND-HANDS"

The marketing of a great number of slightly used machine tools since the war has brought up the question: To what extent should a manufacturer be expected to furnish free service to users of his machines who have bought them second-hand? In many instances the buyers of these second-hand machines request the manufacturer to send demonstrators to install them and train operators in their use. Having already originally rendered this service and not having made the later sale, manufacturers do not usually recognize any further obligation, and in most instances ask that the expense involved be met by the buyer of the second-hand machine.

This seems a reasonable position to take. The cost of many new machines bought directly from the manufacturer includes not only the machine, but also its installation and instruction in its operation. The greatly reduced price paid for a second-hand machine does not include this expensive service, but some purchasers are taking advantage of the present depression in machine tools and the eagerness of manufacturers to acquire their good will, to demand this service free, or make future purchases contingent on the satisfactory operation of the second-hand purchases, and some manufacturers, to insure the best results from their machines, are giving free installation service.

No one should blame a buyer under present conditions for getting as much as possible for his money. But the manufacturer is under no obligation to render this service for nothing, and if he pays out considerable real money for the buyer's good will, the latter should recognize and remember the obligation thereby created, for the buyer in this case really receives something for nothing.

* * *

STANDARDIZED MACHINE PARTS

An important saving can be effected in machine shop practice by extending the standardization of machine tool parts. If it were possible, for example, for lathe manufacturers to agree upon certain standards for toolposts, faceplates, spindle noses, and other parts, this standardization would result in considerable economies in all shops where machine tools are used. It would be comparatively easy to arrive at some common standard for T-slots for machines of similar type and size.

Another important extension of standardization concerns the motor builder rather than the machine tool builder. Motor manufacturers have not as yet been able to agree upon such standard dimensions for electric motors as will enable the manufacturer to place any make of motor of a given size and for a given current on his machine, without special provision for it. The motor manufacturers have made great progress in standardizing the electrical details, but apparently they do not yet fully appreciate the value of what may be called "mechanical standardization." By cooperation the motor manufacturers could agree upon certain frame designs that would place the shaft for the pulley at a given height above the support. The location of bolt holes should also be uniform, and the shaft diameter should be standardized so that the same pulley will fit on any motor of the same size and for the same current, irrespective of the make.

* * *

A SEVERE EXPERIENCE FORGOTTEN

One of the lessons that many manufacturers learned during the high-pressure period of the war and the busy years immediately following, was the necessity for training workers, because skilled men were almost unobtainable. Now that this necessity has passed and skilled labor is plentiful, the tendency is to let down on the efforts to train men which were inaugurated during the busy years, although there is far more time now available for work of this character.

Anyone can see how such a policy will affect the supply of our skilled workers in future years, and the executives of large concerns should push their training schools and apprenticeship courses. If they have none, let them give some of the time they can easily spare at present to making plans for such courses. Where there is a group of smaller shops it would be easy to establish one school for the entire number.

Young men who have been occupied as unskilled workers during the past six years and are eager to increase their earning capacity should be welcomed and taught as carefully as if there existed today the urgent demand for skilled labor which until recently handicapped every manufacturer. In a few years these men will be the skilled workers of our industries and constitute an asset of almost untold value, upon which the whole machine tool building trade will have an equal claim when our shops again resume their former operation.

The Present Situation and the Outlook

SAILING THE BUSINESS SHIP ON A STORMY SEA

By HENRY M. LUCAS, President, Lucas Machine Tool Co., Cleveland, Ohio

To think of a business as a ship sailing the seas is helpful now and then. A ship, to make a successful voyage on a stormy sea, must be sound and well handled. It is essential to have the right size cargo—balanced and trimmed; the machinery must be well cared for, the boilers kept clean, the engines well oiled and adjusted, and run at the right speed consistent with the amount of coal in the bunker and the distance to port. Then the captain must know what course he is steering and not change his mind too often on the way. We would rather take chances of successful passage on a small ship properly equipped and managed than on a leaky old derelict many times as large.

In our opinion, the machine tool business is not the business for the "opportunist," as some who might qualify for that title are now finding out. It is a business better suited to the steady, consistent "plugger," who has faith in himself and in his product and in the very definite service he can render. It is unfortunate that the latter type is so little appreciated and given so little support in times like the present. It is therefore up to him to so manage his affairs that he can survive so as to be on hand when his service is needed and wanted again.

In these timely letters representative men in the machine tool field express themselves on today's problems. The general outlook in the industry is considered, special attention being given to such important subjects as: Co-operation in the Industry, the Necessity for Statistical Information, Importance of Being Ready for the Return of Business, Quality versus Price, and many other problems now facing the machine tool industry. The letters have the definiteness characteristic of the practical business man, and contain the constructive thought and business advice now so much needed.

THE PRESENT SITUATION

By WINSLOW BLANCHARD
President, The Blanchard Machine Co.
Cambridge, Mass.

In regard to the future of the machine tool business, it seems to me that we have about struck the bottom and should experience a slight improvement from now on, but I do not look for anything but dull business for at least the remainder of this year. It will probably be many years before we can have the volume of business that we had in 1917, 1918, and 1919. The influence of the buyers' strike is still with us, and seems likely to prevail until the buyer is convinced that prices have reached the low point and that any changes will be in the direction of higher prices.

We should not, however, forget that in the long run everything points to the continually increasing use of machinery to replace manual labor in the factory, on the farm, and in the household. In the long run this calls for an increasing amount of machine tools, and the machine tool industry is always certain of its place in the economic structure.

MOST PRESSING NEEDS OF INDUSTRY

By HENRY D. SHARPE, President and Treasurer, Brown & Sharpe Mfg. Co., Providence, R. I.

Depression in the machine tool industry is only one symptom of the readjustment going on following the world upheaval of the last seven years. Generally speaking, its period of duration will depend upon world conditions for which we have no adequate measure. In particular, the great activity of the business during past years has been due, among other things, to three great factors—the abnormal preparation for war on the part of the nations; the industrial activity of the western European nations, creating the mass of our own foreign trade; and the repeated upbuilding of the automobile industry. We do not believe the trend of world affairs will permit the resumption of the first factor, while the second should gradually be resumed, and as for the automobile industry, our belief is that its progress is by no means at an end, but will be resumed with advantage to the machine tool industry.

In our opinion, the most pressing needs for the industry are the effecting of economies in our organizations, the still further perfection of design, and an unfailing confidence in its ultimate future following readjustment when the resumed demand for things mechanical will inevitably be felt. This is no time for discouragement as to the future. The present depression is no more or no less than is shared by industry in general.

MACHINE TOOL PRICES

By J. P. BROPHY, Vice-president and General Manager, Cleveland Automatic Machine Co., Cleveland, Ohio

Much has been said about the advisability of reducing machine tool prices. When the price of material and labor advanced during the last few years, machine tool manufacturers naturally found it necessary to advance prices periodically to meet the increased cost of material and labor, in order to keep the returns from their business on approximately the same basis as they were before the war. Few machine tool builders raised their prices beyond this point. This means, of course, that they are not able to lower prices at the present time to any appreciable extent, except as they are forced to do so by the action taken by some of their competitors. Reducing prices at this time will not improve business. As I have often stated in my talks to men in the trade, we have increased our prices from time to time as the cost of labor and material fluctuated, and prices were raised only enough so that our net earnings from our product would be the same as they were previous to the war—that is, we have never attempted to increase the price to the extreme regardless of the number of orders we received. The same holds true of the great majority of the machine tool manufacturers, and their customers are recognizing this fact.

If reducing prices to a minimum would help to a great extent in the return of business, many machine tool builders would probably do so without hesitation in order to move the stock they have on hand, but I am well satisfied that any further reductions at this time are not possible, advisable, or of any value as a business stimulator. Few buyers at the present time question the price of well-known machine tool builders, because they know that their prices were not unduly increased during the war period; and at no time before the war was the price of machine tools excessive, especially when compared with the earnings of many other lines of business. Of course, there are some types of machine tools that were increased more than others, and in those cases corresponding reductions have already taken place.

USING THE PRESENT TIME TO BEST ADVANTAGE

By WINTHROP INGERSOLL, President, Ingersoll Milling Machine Co., Rockford, Ill.

I agree with those who believe that industry has taken a turn for the better. Perhaps this is not so in the machine tool branch of industry, because the machine tool industry always has been the last to pick up after a depression. We realize, too, that machine tools are only a minor branch of the whole. I agree also that before long there will be a turn toward considerably better conditions. Just when this "before long" will come I am not predicting. It will not be a great detriment to the machine tool builders if this period of depression, or non-productive period, lasts for several months longer. We all need a period of quietness in which we can check over our designs and our methods of manufacture. The turn is coming. How far off it is for machine tool builders I would not attempt to say. A few more months of quietness will not hurt us in the least.

It is not at all cheering for any manufacturer to walk through his plant and see two-thirds of his equipment idle. It, perhaps, is less cheering to see a large number of men being laid off, who are just reaching a period where they are interested in their work and of value to the institution. However, this quiet time has compensations. The machine tool builder who is not looking into the possibilities of specializing on some class of tools which is going to decrease the cost of production is losing a great opportunity. Increased production is obtained principally by or through efficient machine tools, designed for single-purpose work. It is most likely that this thing has made itself evident to all machine tool builders. Big opportunities are not far off for the machine tool builder who has a line of machines for intensive production, because when the tide turns, it will be on greatly reduced cost. Machine tools are a large factor in cost reduction.

LOOKING FORWARD TO BETTER BUSINESS

By A. R. STEDFAST, Secretary, Hill, Clarke & Co., Inc., Boston, Mass.

My opinion is that the lowest point of business was reached last February, and that while there has been but slight improvements, we are gradually getting into better shape and looking forward to real improvement being manifested about August, with probably gradually increasing activity commencing in October. The last three months of this year will probably be fairly good months in the machinery line. Beginning in January, 1922, I am looking forward to good, normal, healthy business, which will probably last for several years.

As New England felt the depression first, no doubt this part of the United States will feel the improvement before the rest of the country. Inquiries are being received by us, which are very encouraging, and some sales are made. Our customers need machinery, so let us go and get the business.

WHAT THE FUTURE PROMISES

By B. B. QUILLEN, President and General Manager, Cincinnati Planer Co., Cincinnati, Ohio

We may not have any more wars during our time, and we don't want any more, even though we never build another machine tool. A good healthy, sensible business that takes care of the normal requirements of our people is what we want and is what we are going to have in the near future.

The railroads haven't bought any shop equipment to speak of for twenty years—they must buy very shortly. Our shipyards will soon be more active than ever before and will be constant buyers of tools. The truck business is still in its infancy, and will develop by leaps and bounds very shortly, and require millions of dollars worth of machine tools. We might say the same about tractors; they are an absolute necessity in modern farming, and the time is not far off when horses will be as much of a curiosity as a buffalo.

Thousands and thousands of miles of new and improved highways are now in contemplation and in process of building, which will require road-building machinery in great quantities, and these manufacturers will have to buy machine tools in the same proportion. Better roads mean more automobiles, and more automobiles mean more machine tools.

And there is the airplane, every bit as far along in development and usefulness as the automobile was twenty years ago. Everybody wants to fly, we want to move faster, we want to cross the Continent in twenty-four hours, and we will do it some day; so I think the airplane has a great future and will create another big field for machine tools.

Don't overlook the thousands of new devices that are being invented every year to replace hand labor, such as office appliances, household conveniences, sporting goods, toys, etc., all of which require machine tools in great quantities. In short, no improvement nor progress can be made in the world without the use of machine tools, and no one will believe that the human race is going to stand still very long.

Due to the war there may have been created more machine tool manufacturers than are needed to supply the demand for a long time to come, but that is a condition that can and will be remedied; some will be wise enough to get out of the business, others will consolidate, still others will sell out equipment and reduce their capacity, and a few will be unfortunate enough to be forced out. After this elimination has been completed, there will be a good steady business for those who remain, and as to who shall remain and who shall go is not for me to say, but unconsciously and automatically, we are already going through a weeding-out process.

I have been in the machine tool business for thirty years, have seen its ups and downs periodically, but I have never lost faith in the industry, and to those who can hold out through this readjustment stage I would say: "You are sure to find some good picking in the sweet bye and bye."

VALUE OF STATISTICAL INFORMATION

By ERNEST F. DU BRUL, General Manager, National Machine Tool Builders' Aeeociation, Cincinnati, Ohio

Secretary Hoover is quoted as saying, in effect, that "if all the facts can be gathered and studied, any problem can be solved." Many industries that were greatly affected by war conditions now face serious problems of readjustment. The machine tool industry is one of these, and realizing its condition, it has seriously buckled down to the arduous duty of gathering facts to help it solve its problems. Valuable statistics are now being compiled which show the economic situation in various economic cycles in the past. When these figures are complete, the machine tool industry need not go blindly into the future, as it of necessity would have to do if its past course were not pretty well illuminated. With no knowledge of present trends and developments of machine tool demand, the individual can only grope along in the light of his own limited experience. But when the total combined experience of all is made available by a well organized statistical service, each individual can set his own course much more safely than he could without such service.

Machine tools were so necessary to the national defense during the war that anything the industry can do to maintain a sound basis of free, well-informed competition will redound to the nation's benefit in any future emergency. But if the industry did not take stock of itself, and study out the safe course to pursue, the war reaction could easily end in disaster on such a scale as to deprive the country of very necessary facilities if another emergency arose.

QUALITY VERSUS PRICE

By A. H. INGLE, President, Betts Machine Co., Inc., Rochester, N. Y.

The relation of quality buying versus price buying to the present commercial situation is clearly shown by the position in which some manufacturers in the general industrial field now find themselves. In an effort to adjust their prices down to a point where their product will sell, a great many manufacturers already have sacrificed largely if not all their previous profits, and today they are studying in a most careful manner methods of reducing cost of production and the adjustment of overhead.

It is probable that if more careful study had been given the subject of quality versus price before buying production equipment, such as machine tools, the situation so far as they were concerned would be materially improved. They would not now be handicapped by machinery that produces only two-thirds or perhaps one-half as much as it ought to, while the operators' wages, cost of power, floor space, and other fixed charges remain substantially the same.

In buying raw materials, and certain finished products as well, price may well be the first consideration. But in buying a machine tool you are buying an intangible something known as production. Production such as you can buy in a machine tool is a combination of four very important factors—correct design, best material, first-class workmanship, and accuracy. Correctly proportioning these factors will produce what is known as a high-grade machine and one which can be depended upon for production. It is therefore economical to buy on a basis of quality rather than on a basis of price.

It isn't what is in a cheap suit of clothes that makes it cheap. Similarly it isn't what is in a machine tool that makes it cheap. *It's what isn't in it.* It isn't what is back of business today that is responsible for the present state of affairs. It is the confidence which is temporarily not back of it.

The situation today in some ways is even more difficult than that following the Civil War, because we are dealing with a world condition, not a domestic situation, and because our economic machinery is more intricate and less easy to adjust so that it will run without friction. However, we have much upon which to congratulate ourselves. Our difficulties are dwarfed in comparison with those of Europe. The danger point of a great crisis has been passed. The strength of our financial system has been proved, and we have passed safely through a commodity crisis without a panic. We have had a remarkably small ratio of failures. I am convinced that fundamentally we have turned the corner, and that before many months we will have the definite evidence of another era of prosperity. Perhaps the pessimists of today will then appreciate how much more fortunate we are and have been than other countries.

ENCOURAGING FOREIGN TRADE

By O. H. BROXTERMAN, President, John Steptoe Co., Cincinnati, Ohio

My ideas as to what may be done toward securing foreign trade are governed entirely by four principal factors: (1) Rate of exchange and duty on machines imported in the country with which we want to do business; (2) amount of credit and the terms of payment that we are willing to extend to the foreign country; (3) free lighterages and lower ocean rates from this country; and (4) ability to correspond in foreign languages, especially in the Spanish-speaking countries.

First: Everybody realizes that the exchange rate is a serious handicap, which will be overcome only when we become a purchasing agent as well as a selling agent. This is best illustrated by the fact that during the war, while we were purchasing raw materials and food supplies from some of the South American countries, the peso of these South American countries was at a premium, and as a consequence our trade in machine tools was very good and remained so until the American dollar was at a premium. Then all purchases of American machine tools ceased, and this business is undoubtedly now being turned over to some of the European countries where buying can be done on more favorable terms. It appears that the tariff is another serious obstacle. I am advised that in some countries the duty on machinery is being raised to almost a prohibitive level, so that it will be impossible to sell American machine tools there.

Second: Under the heading of credits, it is evident that we are going to be compelled to discontinue our method of demanding cash in New York. We must not only extend to the reliable foreign purchaser such credits as are usually allowed in America, but we must also compete with the manufacturer of machine tools in foreign countries in the extension of such credits as foreign manufacturers may be willing to allow.

Third: The transportation of goods from the factory to the foreign destination must be done promptly and at the lowest possible rate. We must therefore secure lower freight rates from the factory to the seaboard, with free lighterages and low ocean rates, so that our goods may be delivered to the purchaser at the lowest possible cost.

Fourth: Correspondence in foreign languages, especially in Spanish with the Spanish-American countries and Spain, together with literature printed in Spanish, is almost absolutely necessary.

THE INFLUENCE OF FEAR IN BUSINESS READJUSTMENT

By F. O. HOAGLAND, General Manager, Reed-Prentice Co., Becker Milling Machine Co., and Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Eliminating all the causes of the present business depression which have previously been brought up, such as the war, the labor situation, over-production, banking facilities, etc., my opinion is that the real reason is plain *fear.* There is a lack of confidence between individual men, between classes, between the people at large and the administration, and also between nations, and one *fears* what the other is going to do next.

If a man does not have more than one dollar and he does not see where the next one is coming from, he is very apt to hesitate about spending it; he may call it waiting for prices on labor and material to come down or what not, but the fundamental basis is that he is *afraid* to invest or spend his money, because he does not have full confidence in the man he is dealing with, and the only remedy I know for this is *time.*

After a great loss, whether it is a member of your family or part of your savings, you feel it very keenly immediately after it happens, and for some time afterward; but after awhile it will wear off and the pangs are felt less keenly—you gather yourself together, and proceeding with caution you are soon back to your old strides again.

I know of specific cases where money is available for purchasing commodities, but the decision to buy is being delayed, waiting for prices to come down, sufficient confidence not being placed in the seller's statement that prices have reached rock bottom—*fear* again of having to pay a higher price than the goods may be bought for later.

The machine tool industry is, as usual, the last to be affected by the return of good times, and unless the machine tool builders can devise improved machinery for manufacturing purposes which would plainly prove to the user that even with the present limited production he cannot afford to go along without them, it is apt to take some time yet before conditions within the machine tool industry return to normal.

When a man is under the influence of *fear,* his brain does not function normally and his planning ability is affected; this is a sufficient reason for ours not working to the best advantage at present.

THE TIME TO BRING EQUIPMENT UP TO DATE

By AUGUST MARX. Vice-president, The G. A. Gray Co., Cincinnati, Ohio

We feel that the present pause in industry affords an excellent opportunity to make plans for the future. The world demands cheaper but not inferior products. As far as the manufacturer is concerned this means greater economy in production.

How is this to be brought about? Surely not by using slow and inefficient tools, even though they may be low in first cost. Surely not by using tools whose output, even if satisfactory in quantity, is so inferior in quality that it must be improved or corrected by subsequent operations. To our mind the situation demands tools so simple, quick, and convenient that every moment of the operator's time will be utilized to the utmost; so high in quality that subsequent corrective hand operations, such as filing, scraping, fitting, etc., will be reduced to a minimum.

This is the time to bring one's equipment and methods up to date. The manufacturer who does that most effectually will have least cause for worry in the days of hard competition now pending.

GENERAL OUTLOOK IN THE INDUSTRY

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

I believe there will be very little activity in the machine tool business this summer, with perhaps a small improvement late in the fall; but I believe that in about a year from now business will be on a very sound basis, and will gradually reach normal by that time.

Our biggest customer—Europe—is not in a position to buy for some time to come, and we will have more severe competition from Germany than ever. France has always been a good and reliable customer of the United States, and the sooner she gets what is due her, the sooner she will be able to buy. And if Germany is made to pay what she should, she will have to charge more for machinery than she does now; therefore, the market price for machinery will not be so demoralized as at present.

All the European countries can only improve their condition by being busy, and if they are busy they will need machine tools. Nobody is in as good a position to furnish machine tools as the United States, with the exception of Germany. The recuperation of Russia, I believe, will be very slow; therefore, any business from that source cannot be counted on in the near future, but when it comes, I believe it will be of very large volume.

If it is possible for the United States to free the railroads from all the shackles that now hold them down, and put them on a sound basis, this will help the machine tool industries in this country more than any one thing that I can think of. The railroads, as well as any other industry, must be run on business principles and not by labor unions.

Prices of goods cannot be reduced until the cost is reduced, and no investments will be made in the industries unless there is a fair assurance that the industries will not be hampered by labor unions and government interference. People with capital are today investing their money in foreign and domestic government and municipal bonds and other securities of this kind.

In the meantime the machine tool builders, in particular, should devote as much time as possible to improvements in their designs and methods of production. If the machine tool manufacturers devoted more time and money at present to these things, rather than putting up a big stock which will eat itself up in interest, they would be far better off when business comes back, as it will then stay good for a long time.

The American machine tool industry has grown up, not on account of price but on account of superiority in design. The best European machine tool builders are the best imitators of the United States products, and it is by being a lap ahead that we have been able to hold the supremacy in foreign markets. I believe this position is as vital today as ever it was.

To sum up, I believe there will be a gradual revival in business in the fall, and that a year from now the purchasing power of Europe may be enough improved to make machine tool business in the United States about normal.

BEING READY FOR THE RETURN OF BUSINESS

By E. A. MULLER, Vice-president and Manager, The King Machine Tool Co., Cincinnati, Ohio

The principal requisite to a resumption of business in our industry today is confidence, and therefore we are rearranging our factory, repairing such tools as require attention, making new jigs and fixtures, and with the business that is coming to us at the present time we are able to employ about two-thirds of our regular force full time. A recent visit to quite a number of factories situated in various parts of the country has disclosed that needed repairs to buildings and equipment are being withheld until there is a demand upon these plants. We think this is a great mistake.

The history of business has taught that there are periods of depression in almost every decade; therefore, the present situation is not an unusual one, although the necessity for deflation in prices injects a more uncertain factor than has obtained in any period of depression since manufacture has become as important as agriculture in this country. There is no doubt in our minds that it will be a long time before all the plants equipped to build machine tools are filled to capacity with orders; but as all industry has to some extent over-expanded as a result of the war, it will obviously be unwise to expect 100 per cent activity for several years.

COOPERATION IN INDUSTRY

By OGDEN R. ADAMS, Rochester, N. Y.

In my article on "Better Relations between Machine Tool Manufacturer and Dealer," published in the April number of MACHINERY, I mentioned three distinct periods in this relationship, namely, prosperity, restlessness, and readjustment. Prosperity has taken flight; restlessness is still with us, because it is closely identified with, and part of, the readjustment period.

This latter period is now fully upon us; there is no question about it, and it is not at all to our liking. We much prefer the period of prosperity, when orders come easier, and there is not so much worry or work. But the readjustment makes us work, and think, and concentrate hour after hour. We knew it was coming, having been duly warned of its approach by precedence, but we did not want it.

Prices have dropped very greatly on machine tools, which has meant a loss to both manufacturer and dealer—to the manufacturer because he paid the highest prices for material and labor, and to the dealer because he purchased at high prices, and must sell at a distinct loss. Both alike have suffered—manufacturer and dealer—which forges another link between them, and forms a potent mutual reason for cooperation. The word "cooperation" has grown in importance during the past three months, and is demonstrating its value in industry as never before. In fact, only by cooperation during the present period can either manufacturer or dealer hope to withstand the storm of the readjustment.

The manufacturer may cooperate with the dealer in various ways, namely, by standing back of him in his endeavors to stimulate and encourage sales; by giving sufficiently liberal discounts to insure a living wage; and by giving moral and mechanical support. Let us not at this time forget that we are in a basic, and therefore, a most dignified business—one which the world absolutely requires; and let us remember that both manufacturer and dealer in our industry are in a position to help to restore a prosperous era.

THE FUTURE OF THE MACHINE TOOL INDUSTRY

By C. L. Libby, Vice-president and Superintendent, International Machine Tool Co., Indianapolis, Ind.

In relation to the future of the machine tool industry in general, it seems that unless we can find some foreign market as an outlet we can expect no industrial boom in the near future, as the capacity of our machine tool plants is far in excess of our requirements.

After the war was ended, the large manufacturers of war material had a great supply of worn out and abused machines which they unloaded on the market. These were largely purchased by people who were starting into business or by smaller concerns who thought they were getting a bargain. For this reason, it would seem that when business picks up, it will be necessary for the large concerns to buy considerable new equipment.

In going through the country and visiting the different shops, we find that a large number of the concerns which manufacture in large quantities are waking up to the fact that special machines and special tools will give them a much larger output per man-hour—sufficient to warrant the purchase of new and improved equipment. We have in the last six months made more estimates and time studies than at any period of our existence, which indicates that manufacturers have plans for the future and are waiting for a favorable outlook to place orders for equipment.

If the railroad trouble can be settled, it will mean an outlet for a large amount of equipment which is badly needed. Conditions are such that if one large industry like the railroads starts buying, it will start up a number of other industries. So far as the machine tool business is concerned, it is the writer's opinion that the improvement will be gradual and that it will take some time before we get back to normal.

SIGNS OF THE RETURN OF ACTIVITY

By W. C. Acklin, Secretary and Treasurer, Acklin Stamping Co., Toledo, Ohio

It looks as though the worse part of the depression has passed. We are not expecting a rush of business, but for the last six weeks our shop has been operating six days a week. When we first started working full time we doubted our ability to continue, but since that time we have put on more men and each succeeding week has seen work for a few more employes than the preceding week.

Like everyone else we have had time in the last few months to rearrange machinery, go over our methods of production, etc., so that we will not use any of the wasteful methods that were forced upon us during peak production, and because of our reduced costs we have gotten in touch with new lines that would not have been possible twelve months ago.

VALUE OF COOPERATION

By N. P. LLOYD, Sales Manager, Newton Machine Tool Works, Inc., Philadelphia, Pa.

When it seemed that the thirteen American Colonies would be unable to cooperate in forming the United States, Franklin is credited as saying, "Gentlemen, we must all hang together, or else, most assuredly, we shall all hang separately." Machine tool manufacturers can best "hang together," I believe, by one of the following methods:

1. Voluntary syndicates of non-competing lines, permitting individual ownership or decentralized control.
2. Consolidation of companies of non-competing lines of which there might be two or three such consolidations, providing centralized control through a holding company similar to the "steel corporation," such consolidation to be effected by (a) uniform method of appraisal establishing sound values; and (b) present owners accepting securities of the consolidated companies.

Either method would accomplish the following: (1) Control of sales at less expense, giving better service and closer contact with user. (2) Standardization, overcoming multiplicity of designs and overlapping of sizes, including interchange of facilities for special parts, and perhaps, centralized manufacture of small parts now purchased. (3) New developments at a minimum of expense through wider application. (4) Uniform accounting methods preventing sales at less than cost. (5) Financing by group method, which would be easier than by the several units; this includes individual plant financing, as well as the financing of orders, particularly for complete installations.

The British Machine Tool Makers, Ltd., is one recent effort to create a voluntary syndicate. Under the German laws, I understand trade syndicates are compulsory. These two countries are our principal competitors in foreign trade, and it would appear that if they recognize the value of cooperation, we should at least investigate its possibilities.

If there is the will to cooperate and improve the business of the machine tool industry, I believe either plan suggested would prove highly successful and beneficial.

IMPORTANCE OF TRADE ANALYSIS

By CHARLES D. OESTERLEIN, President, Oesterlein Machine Co., Cincinnati, Ohio

Ignorance of important facts as they exist and lack of appreciation of their proper co-relation costs more money, more misery, and more lives than civilization should be willing to pay, and our greatest problem at all times is to gather, co-relate, and disseminate such facts among the masses as will reduce friction, discomfort, and losses.

Employes should understand many of the problems of employers, who, in turn, should understand all of them themselves. Graphical statistics compiled by the Government, showing relative costs of commodities delivered to foreign markets from the United States, as compared with those from competing nations; living conditions here and in competing countries; something of the distribution of gross profits by industries from experience records, etc., would prove of inestimable assistance. Further, without driving home reliable knowledge of relative economical conditions in competing foreign countries, as compared with our own there will not be the kind of effort made by labor nor by management to make for a continuation of our prosperity.

HOW TO AID THE RETURN OF BUSINESS

By C. E. BILTON, President and General Manager, The Bilton Machine Tool Co., Bridgeport, Conn.

The inquiry as to how to expedite the return of business activity is a hard question to answer. One viewpoint is this: If Bridgeport and the other greater and lesser manufacturing centers would get down to bed-rock prices and then convince the retailers that the bottom had been reached, the wheels of industry would again begin to turn. The retail stock in our mercantile establishments is extremely low, and our merchants naturally will not buy in more than hand-to-mouth quantities until satisfied that price-cutting is at an end. Depleted shelves will not bring back normal orders until accompanied by the conviction that price deflation is a thing of the past.

Every merchant knows just as well as the manufacturer that further reductions are coming. The fact has been published far and wide that the cost of living has fallen a greater percentage than wages.

Each manufacturer can help expedite the return of business activity by putting his own house in order. The disagreeable obligation of forcing wages and prices to a practically permanent low post-war basis must be fulfilled before quantity buying will be resumed. Scolding the retail merchant (who is a distributor) for not stocking up has not helped and will not help the situation.

I have only touched upon one minor phase of this great problem, but I am convinced that the establishment of rock-bottom prices would expedite the return of prosperity.

TAKING STOCK OF EQUIPMENT AND METHODS

By FRED ROSS EBERHARDT, Manager Gear Department, Newark Gear Cutting Machine Co., Newark, N. J.

Business is not made by a "feeling of optimism," nor is it possible to "restore confidence" by talking about it. There are an infinite number of small things all of us need, and many things are cheaper to buy than to do without. Whenever we buy anything that benefits us, we help to keep business moving.

The present lull gives us all a chance to find out how we stand. Some find that the unusual times swelled their organizations to unwieldy proportions, and a few plants have grown to such size that the normal demand for their products could not begin to keep them busy. Now is the time to compare one's production capacity with one's probable share of the normal demand. This may mean the sale of buildings or equipment for some, while many will find their plants not equipped well enough.

Very often when a new machine is needed, and apparently there is no place to put it, one can make room by scrapping some old type machine that has outlived its profitable years. In gear-cutting machines, for example, an old type gear-cutting machine may be cutting about one gear in the time it takes a new modern machine to cut three. This holds equally true of many other types of machine tools.

Some of the men are working better since there are more men than jobs. This is only human nature, and we cannot blame them any more than we could help their taking it easy during the war and afterward, when there were more jobs than men. With trouble makers kept out of the shop, there is no labor problem. The only problem is to keep enough work so that the men will be kept busy.

Some of our friends will not buy anything now, no matter what it is. But they make a mistake. Of course, prices will come down a little more, but that is nothing to worry about. If you need something, buy it and benefit by it as soon as possible. By improving your own tools and methods you can reduce your own prices a little. This may induce somebody to place an order. You may find, on careful study, that your product bears the burden of a lot of unnecessary expenses which can be done away with. Then you can make your prices commensurate with cost of manufacture, plus a reasonable profit.

Urgent questions confront the manufacturer of machine shop equipment today. Ever on the alert, always leading instead of following, ceaselessly improving their products, and forever inventing machines and accessories, American manufacturers have earned and achieved an enviable position in all countries. In the world-wide mechanical market, greatly changed by the war, wholly new conditions exist at home and abroad. It may be as hard to hold what was won as it was to achieve it. There is no question of the necessity for making greater efforts than ever before, and of the need for all the resource, inventive ability, and enterprise that our manufacturers and selling organizations command.

PREPAREDNESS SHOULD BE THE WATCHWORD

By C. W. BETTCHER, Sales Manager, H & G Die Head Works of Eastern Machine Screw Corporation, New Haven, Conn.

We believe that the words of Charles M. Schwab, "Now is the time for the business man to concentrate attention on the cost sheet and not on the profit statement," should be given serious thought by every executive. We have passed through a period where any old tool or method that would turn out something to meet the unprecedented demand, regardless of its efficiency or the quality of the work it produced, was put to work. We are now entering upon a period of competitive production in which the fittest to survive will be those that produce either a better quality of product for a given price, or by their efficient tooling a product at a lower price, or both. The present depression provides the opportunity much desired to test, without interference of forced production, such tools as may in the future be the deciding factor in reduced expenses of manufacture and improvement in the quality of the work, or both. Such tests should be regarded as a far-sighted policy, without which an enterprise cannot expect to weather the ever-changing business conditions from decade to decade.

The present depression worries should not be allowed to cloud the fact that everyone knows that good business must come back. It always does, and with the added zest of competition. Those who have been far-sighted enough to prepare for most efficient manufacturing in the future will reap their reward. In times of depression prepare for that healthy and fierce competition that must eventually follow.

THE INCREASING SCARCITY OF SKILLED WORKERS

By A. W. FORBES, Manager, Forbes & Myers, Worcester, Mass.

The controling factor in the machinery and machine tool fields will be the available supply of skilled workers. We have seen and must expect to continue to see a great decline in the ability of the men in this field. Our colleges are being thoroughly advertised. They are collecting the best of the young men of the country and making of them professional men, salesmen, engineers, etc. The college and technical school graduates will not consider the operation of a machine as a life work, even if the pay and degree of skill required are both greater than in the clerical jobs they are able to secure. There seems to be no prospect of changing this tendency.

This change in the character of the men must increase the demand for fool proof machinery. To an increasing extent the machines must be such that they can be operated without requiring much of either brains or muscles.

We should abandon hope of improved labor conditions until the job of foreman is made the equal of that of lawyer, both in compensation and in social prestige. With the elimination of the best from the ranks of the workers, it is going to require an increasing degree of skill in the management from the top to the foreman. Even with this added attraction to the job of foreman, it is doubtful if the supply of available material will be sufficient to produce a reasonable number of foremen of suitable caliber.

MAIN CAUSES OF THE PRESENT DEPRESSION

By ARTHUR BROCK, Jr., General Manager, Arthur Brock, Jr., Tool & Mfg. Works, Philadelphia, Pa.

The present business depression is due to a variety of causes for which there is no single cure. There isn't any doubt that the relative basis of values in decreasing the purchasing power of the agricultural population has a material effect on the situation. There is also no doubt that a business revival is retarded more by other considerations, especially by the destruction of capital by Legislative and governmental interference in the questions affecting the values and purchasing power of the railroad and public utilities. This last consideration has gone far to make increased capital for manufacturing extremely difficult to obtain, and the manufacturers of production equipment are all suffering from a lack of orders due to this cause.

There isn't any doubt that the machinery business in its various branches should be very busy to meet the competition of cheap labor in Europe, and even if owing to the business depression it is not possible to place orders immediately, the machinery business will profit greatly by a campaign to increase production by new equipment later.

The Odontometer for Testing Gear Teeth

By EARLE BUCKINGHAM, Engineer
Pratt & Whitney Co., Hartford, Conn.

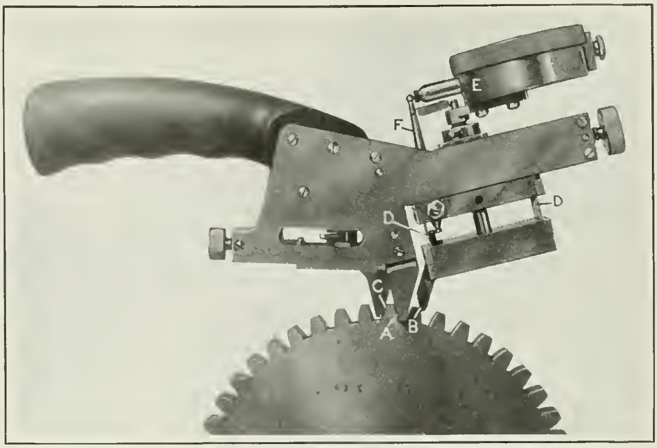


Fig. 1. Odontometer applied to a Spur Gear for testing the Profiles and Spacing of the Teeth

THE satisfactory testing of gear tooth profiles, spacing, etc., is one of the most difficult of inspection operations. Many devices are at times employed. First, there are gear tooth calipers, and gear-testing machines which hold the gears at fixed center distances and merely test, in effect, the thickness of the teeth or the amount of backlash. These machines show only whether or not the gears will run together without interference. When testing gears at fixed center distances, an experienced operator can detect errors in form or spacing which prevent the gears from running smoothly, but he only knows that such errors are present and can tell nothing about their exact nature and amount.

Second there are various forms of involute testing devices. These are invaluable for the diagnosing of the various errors in both the profile and spacing of gear teeth, but they are primarily laboratory instruments. Special disks, representing either the base circle or the pitch circles or ratios, must be used in conjunction with them. Furthermore the actual pressure angle employed may vary appreciably from the theoretical pressure angle specified. In the majority of cases this is of little importance, provided the actual pressure angle is the same on all gears that mesh together. Uniformity rather than absolute accuracy as regards this factor is the essential consideration. Therefore if base circle disks are employed, such gears will show an error in profile when tested, although they may run together properly. In order to determine this point definitely, the size of the base circle disk which would show a true, or a practically true, involute would have to be determined experimentally, and the base circle disks of the two mating gears changed proportionately.

All the foregoing testing instruments have their proper place, and are of importance in the testing of involute gears, yet there has been need for a simple and self contained instrument or gage for testing the accuracy or uniformity of gear tooth profiles and spacings of the teeth in production work. It was to meet this need that the odontometer here described was developed by the Pratt & Whitney Co., Hartford, Conn. It is equally adaptable to spur and helical gears, is fully self-contained, has a range of from 3 to 10 diametral pitch, may be used to check any pressure angle, and can be applied to a gear while it is in place in the machine. An instrument of larger size is now under way for testing the teeth of gears ranging from about 3/4 to 4 diametral pitch.

Construction of the Odontometer

The odontometer is shown in Fig. 1, as used to test a spur gear. In effect it is composed of a section of a straight-sided rack with two parallel effective faces, one being fixed and the other movable. A third face, set at an angle to the two working faces, is used to hold the fixed working face in contact with the flank of the gear tooth. The fixed registering surface is at *A*, and the movable indicating surface at *B*. The third surface *C* holds surface *A* in contact with the involute surface of the gear tooth. The surfaces *B* and *C* are adjustable so that gears ranging from 3 to 10 diametral pitch can be tested with the same instrument.

The indicating surface *B* is mounted on two thin flat springs *D*, which act as pivots, free from backlash. The dial indicator *E* is actuated by the lever *F*, which has a ratio of 5 to 1, so that each division on the dial represents a movement of 0.0002 inch of the indicating surface *B*.

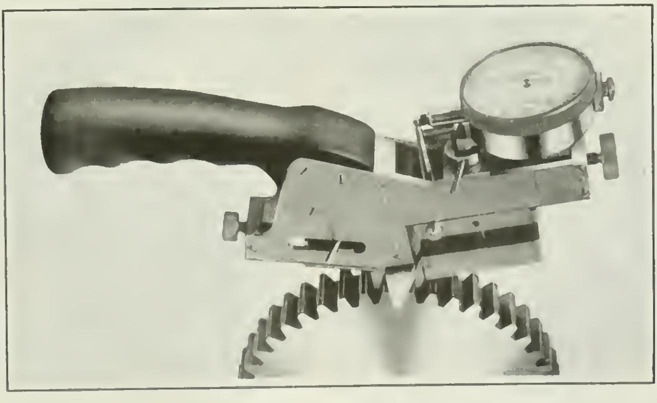


Fig. 2. The Indicator of the Odontometer shows Profile Errors and Any Variation in the Normal Pitch

Operation and Use

In order to explain the operation of this instrument, it is necessary to consider some of the characteristics of the involute profile. In Fig. 3 is shown a series of involutes, equally spaced on a given base circle. The distance *a* between these involutes along a line tangent to the base circle is always the same, no matter where the tangent is drawn.

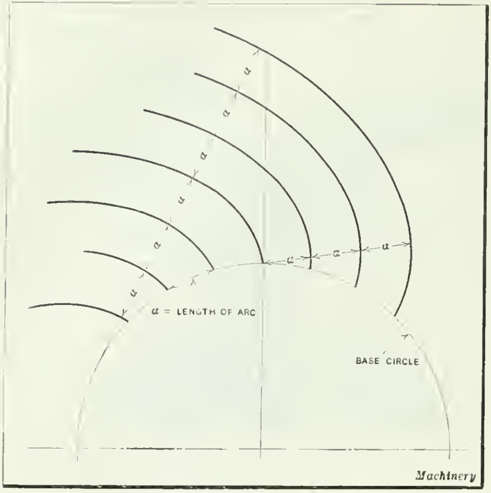


Fig. 3. The Odontometer checks the Uniformity of Dimension a between Successive Involutes at Different Tangential Positions

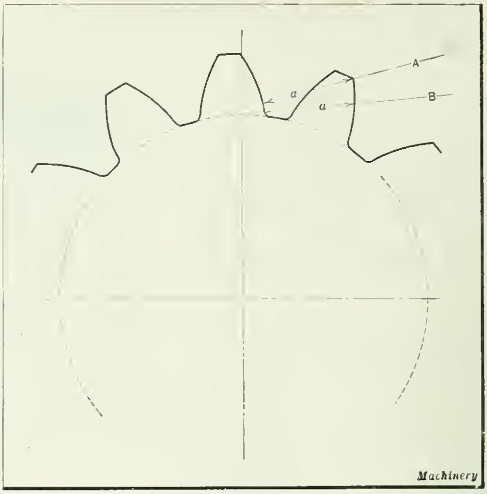


Fig. 4. That Part of the Gear Tooth Profile between the Lines A and B is tested by the Odontometer

This distance *a* is equal to the length of the arc of the base circle intercepted by two successive involutes. The odontometer measures this distance *a*. In testing any pair of profiles, if this distance does not remain constant, it indicates an error in the involute profile. In testing successive pairs of profiles, if the distance *a* does not remain uniform, it indicates an error in the spacing.

Fig. 4 shows a few gear teeth, and indicates the portion of the involute which the odontometer actually tests. It will be noted that this does not cover the entire involute flank of the tooth. The instrument is located over one tooth and rocked into contact with the adjacent tooth. When the movable face of the instrument reaches position *A*, the distance *a* should be registered. This distance should be constant until the instrument reaches the line *B*. Although the instrument only tests the accuracy of the involute profiles on the "overlapping" portions, these portions are the most essential for quiet and smooth running. Experience will soon show how much variation can safely be allowed on either the profile or spacing before noticeably noisy gears result. Thus a definite inspection tolerance can be established for any class of gears.

In general, the instrument is used as a comparator, to test the uniformity of interchangeable and mating gears. If actual measurements are required, the distance between the two parallel working faces of the instrument can be measured. Then, if a record is kept of the variation on each tooth, the value of this measurement between the parallel faces, multiplied by the number of teeth in the gear, corrected in accordance with the variations on the successive teeth, will give the circumference of the actual base circle of the involutes.

The instrument is made so that the dial indicator is in full view of the operator as he rocks it into the teeth, as shown in Fig. 2. The weight of the instrument is so disposed that it rocks of its own weight into the second tooth. The handle is used only to steady the instrument and not to exert any pressure on it. The face of the fixed parallel rack tooth is made of liberal width to square up the instrument. The instrument can be adjusted quickly from one

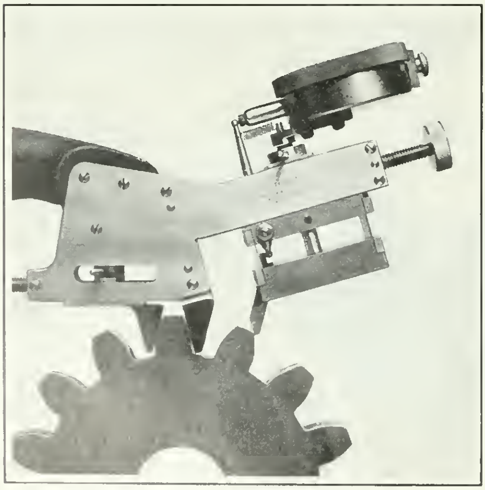


Fig. 5. Odontometer adjusted for testing Gear of Larger Pitch than that shown in Fig. 1

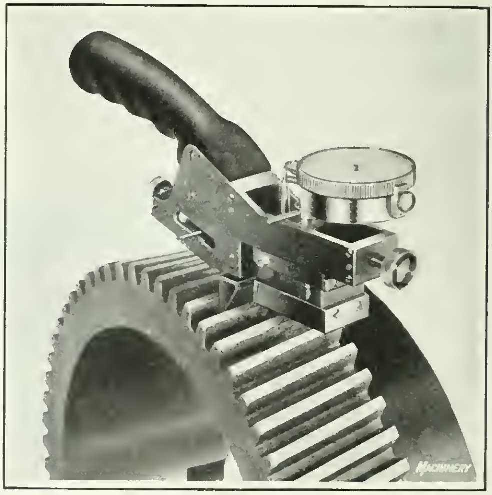


Fig. 6. The Odontometer may be applied to Helical Gears as well as to Spur Gears

pitch to another. Fig. 5 shows it set for a gear of larger pitch than that in Fig. 1. Fig. 6 shows the odontometer employed to test a helical gear. Its operation here is identical to its operation on a spur gear. Such an instrument will prove invaluable in testing the uniformity of the teeth of herringbone reduction gears which are to operate at high pitch-line velocities.

* * *

SPEEDS OF GRINDING WHEELS

In general, a soft grinding wheel revolving rapidly permits a higher production than a hard wheel revolving more slowly, according to an article by W. T. Montague, published in *Grits and Grinds*. This is true because the more open structure of the soft wheel provides greater clearance for the grinding chips, which results in a freer and cooler cutting action. Theoretically, therefore, the correct speed for grinding wheels is the safe maximum speed at which the wheel may be operated. In actual practice, however, certain ranges of peripheral speed have been found to give good results on certain classes of ground work. For example, a satisfactory wheel speed for sharpening wood-planer knives is around 3500 surface feet per minute; for off-hand snagging of castings, 5500 surface feet per minute; for cylindrical grinding of crankshaft pins and bearings, around 6000 surface feet per minute; and for cutting off hardened and high-speed steel, tubing, and the like, the proper speed approximates 9000 or 10,000 surface feet per minute.

In surface grinding, lower wheel speeds are used than for cylindrical grinding, because mechanical limitations usually prevent the work-table being traversed fast enough to keep the wheel face opened up and free-cutting; but, generally speaking, certain grits and grades of grinding wheels operating under these speed conditions have given satisfactory results.

It is generally thought that the faster a grinding wheel revolves, the greater its productivity in a given time. This is not altogether true in precision operations, as in cylindrical grinding for instance. It is only true to a limited extent in off-hand grinding, such as the snagging of castings. In cylindrical grinding, the production of a given wheel is determined by the depth of cut, the table traverse, and the diameter of the work. Hence, the controlling and limiting factors are the rigidity and general sturdiness of the grinding machine to permit deep cuts, and the traverse speeds of the table or wheel, if the wheel-head travels instead of the work-table. Increase of wheel speed in cylindrical grinding changes the size and shape of the chips. The rate of production is not greatly affected, unless the higher speed permits the use of a softer wheel, which might cut more freely. But for a given wheel there is no difference in production, whether 4500 or 6500 surface feet per minute is used, provided the grade or the work speed is adjusted to these different wheel speeds.

In off-hand grinding operations, a somewhat different condition is obtained. Here the grinding may be said to be done under constant pressure in contrast to the constant feed in cylindrical grinding just described. For example, if a bar of metal is pressed against a revolving wheel face under a given pressure, it is obvious that the faster the cutting grains come around, the quicker succeeding sections of the bar will be cut away; but, in practice, this is only true up to a certain speed, for if the grade of a wheel is correct for a speed of 5000 surface feet per minute, there will come a point, if its speed is increased, when the wheel face will begin to glaze over, thus reducing its cutting capacity. Nothing is really gained from increasing the wheel speed in off-hand grinding over the generally accepted range, unless wheels softer than those usually recommended are employed; and the extremely severe service to which many wheels are put in off-hand grinding discourages the use of soft grades.

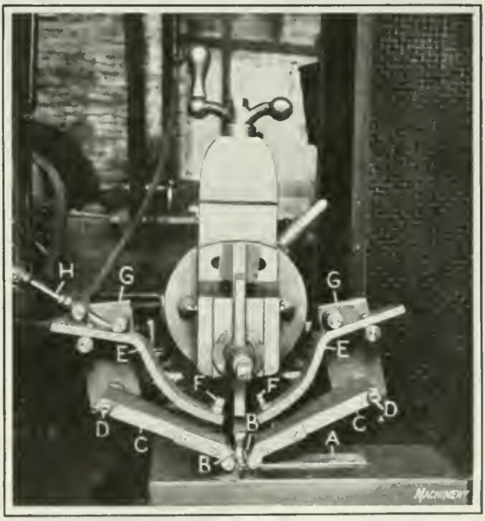
From the foregoing, the following conclusions are reached:

1. The grade of hardness to be recommended for a grinding operation depends on the surface speed of the wheel.
2. The grinding wheel should be as soft as is feasible for the operation, and whenever possible operated at the high end of the recommended range of speeds.
3. For a given wheel used for precision grinding operations, not much increase in production is to be expected from increasing the speed of the wheel alone.
4. The logical way to increase production in precision grinding operations is to increase the traverse of the work past the wheel or the depth of cut of the wheel.

* * *

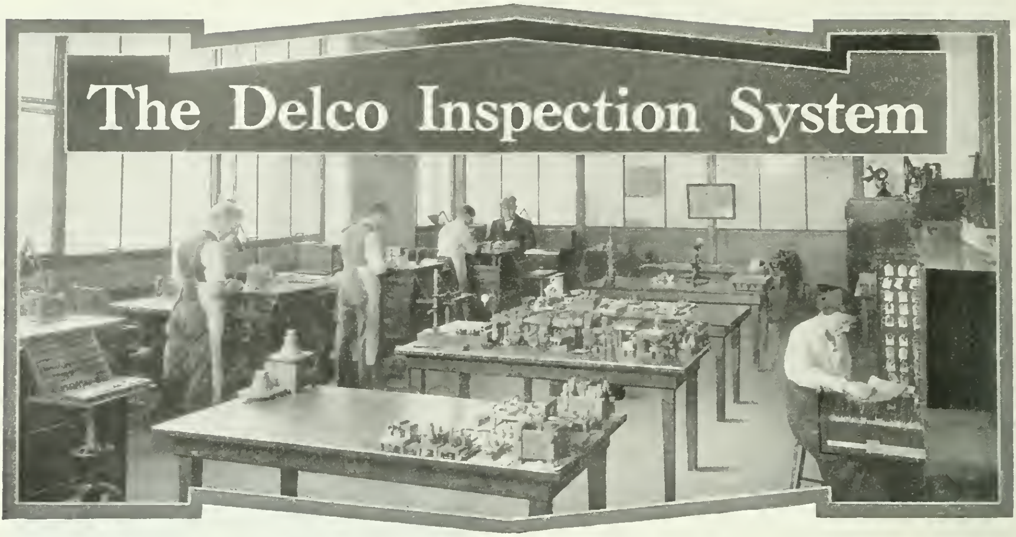
INTERESTING SHAPER OPERATION

In the plant of the Todd Protectograph Co., Rochester, N. Y., rather an unusual equipment has been provided on a shaper built by Gould & Eberhardt of Newark, N. J., to adapt a machine of this type for finishing the backs of bronze type plates for protectographs. One of these pieces has its back side finished during one pass of the shaper table. About 0.020 inch of metal is removed, and the entire back of the work is required to be parallel with the face of the type within 0.001 inch. These pieces of work measure 6 inches long by 1½ inches wide, and with a feed of 1/16 inch per stroke of the shaper ram, the actual machining time is thirty-five seconds. The hourly rate is eighty type plates, making the routine production time forty-five seconds each.



Interesting Method of holding Work on a Shaper while performing a Finish-planing Operation

After one plate has been machined, the shaper table is not traversed back to its original position; but with a view to saving time, the direction of feed is reversed so that the next piece can be finished with the table traveling in the opposite direction. Referring to the illustration, it will be seen that the type plate *A* is held down by means of two rollers *B*. Each roller is carried by an arm *C*, these arms being supported on pivots *D* so that pressure applied by spring bars *E* is depended upon to hold the rollers *B* firmly down on the work. Regulation of the pressure is accomplished by means of set-screws *F*, carried at the ends of the spring arms *E*. It will be apparent that the entire work-clamping mechanism is carried by brackets *G*, secured to the shaper column; and the chips are blown away by means of compressed air delivered through a nozzle *H*.



The Delco Inspection System

A Description of the Methods Used in the Tool and Gage Designing Department of the Dayton Engineering Laboratories Co. and the Standards of Gaging Adopted

By ERIK OBERG

IN the June number of MACHINERY the general principles of the Delco inspection system were described. It is evident that with an inspection system which is as carefully planned and worked out as that of the Dayton Engineering Laboratories Co., the system for the designing of jigs, fixtures, tools, and gages must also have been given careful consideration, and everything in connection with this work that permits of standardization has been properly studied and worked out with a view to providing uniformity in the methods used.

Organization of the Tool Designing and Tool Making Departments

The tool designing and tool making departments are under one head, the two departments being classified together under the name "Tool Division" and placed in charge of a supervisor. It is clear that many advantages are gained by having what are ordinarily considered two separate departments under a single head, directly responsible both for the design and the making of the tools. The divided responsibility that results when the tool designing and the tool making are conducted independently is avoided, and the friction often met with when the work is so organized is eliminated.

The Handling of the Tools for New Jobs

When a new mechanism is to be built by the Delco organization, the tool equipment and the gaging system are first definitely determined upon. The drawings for the mechanisms to be built are turned over by the engineering department to the tool designing department. Before any tools are designed, a conference is called at which are present the head of the tool designing department, the machine division supervisor, the head of the routing department, and the foremen of the departments in which the machining of the parts for the new mechanism will be done. At this conference a decision is reached as to the methods by which the various parts are to be machined, the machines that are to be used for the work—depending upon what machines are available and suitable—the order of operations, and the specific tool equipment that will be required, including jigs and fixtures and other special tools, as well as the gaging equipment. When standard gages can be used, this part of the work is taken care of directly by the tool ordering department, while special gages are designed by the tool designing department. In case the gaging equipment is very special and of an unusual nature, the inspection department is also consulted before the actual designs are made. The ordering of standard gages and tools is taken care of by using Van Dyke prints for all standard plug gages, snap gages, etc., on which the tool designing department fills in the required dimensions.

Tool Lists

Before the tools to be used for the parts for certain mechanisms are ordered and before any designing of special tools is done, the proposed tool list is taken by the head of the tool designing department to all the foremen and the inspectors who will have anything to do with the machining

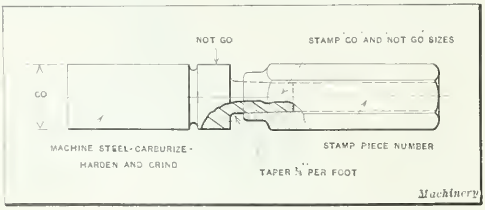

NOT GO
STAMP GO AND NOT GO SIZES
GO
MACHINE STEEL-CARBURIZE-HARDEN AND GRIND
STAMP PIECE NUMBER
TAPER ¼" PER FOOT
Machinery

Fig. 1. Design of Single-ended Limit Plug Gages for Sizes up to 1½ Inches in Diameter

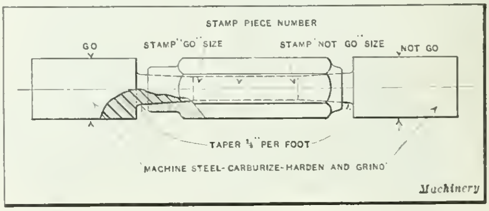


Fig. 2. Design of Double-ended Limit Plug Gages for Sizes up to 1½ Inches in Diameter

or inspection of the parts to be made, in order to determine that all details have been worked out in accordance with the ideas of everyone concerned. The tool list contains at its top the names of all the supervisors or foremen who should be consulted, a typical tool list containing as many as thirty-five names. The general appearance of a typical tool list (without this list of names) is shown in Table 1.

In the first column of the tool list is given the routing number that corresponds to the number on the routing list provided for the manufacturing divisions. The column farthest to the right gives the symbol or designation employed to indicate the different departments in the plant, there being in all twenty-five separate departments thus designated.

TABLE 1. TYPICAL TOOL LIST

Routing No.		Parts to be made and tools used	Department
		Pc. 220 Generator	
100		Use same test fixture as used on 165	Final Insp.
2	TN-94002	Pc. 15309 Armature	E-XE
		Dup. Overall Length Gages	
		Pc. 33322 Rivet No.00 Brown & Sharpe	
155	TN-25856	One circular form tool	S
	TN-94083	Duplicate Gages	S-XS
		Pc. 33323 Screw No.52 Acme	
155		No tools needed as per Mr. Ely	S
		Pc. 33324 Bearing Retainer	
16-132	TN-93973	One progressive die	Q
132-B	TN-93971	One piercing die	Q
75	TN-93972	One forming die	Q
		Pc. 33325 Armature Shaft	
		* 7/16 - 20 U.S.F. Button Dies	
		* No. 29 H. S. drills	
		* No. 5 Woodruff Keyway Cutters	
37	TN-93977	Dup. Gages	L-XL
115-A	TN-93978	Dup. Gages	L-XL
115-B	TN-93979	Dup. Gages	L-XL
51	TN-93981	One Drill Jig	L
120	TN-93980	One Mill Fixture	L
64	TN-93975	Two Set Plugs size .86425	L-XL
	TN-93976	Two Set Plugs size .98385	L-XL
		Other Set Plugs in No.17 Tool Supply	
		Pc. 33326 End Frame	
		* .161 x .250 H.S.S.S. Co-bores	
		* .250 x .406 H.S.S.S. Co-bores	
		* 5/16 x 32 U.S.F. Thread Plugs	
		* No.22 H. S. Drills	
		* 9/32 H. S. Drills	
200-A	TN-94003	One Set of Chuck Jaws	M
	TN-25842	One Set of Tools	M
	TN-94006	One Middle Limit Plug 4.062	M
	TN-94005	Dup. Depth Gages .657 - .662	M-XM
	TN-94004	Dup. Depth Gages .250 - .7485	M
200-B	TN-94007	One Turning Fixture	M
	TN-25843	One Overhanging Tool Holder	M
	TN-94008	Dup. Gages	M-XM
		Plugs will be ordered for bearing hole as soon as new limits are determined by the Engineering Department	
61	TN-94009	One Drill Jig (All Holes)	M
190	TN-94022	One Tapping Fixture	M
		Pc. 33327 Frame	
200 etc.		Use the same tools as Pc. 31731	J
51-B	TN-93974	One Drill Jig (Angular Holes)	J
		Pc. 33330 Washer	
16-132	TN-94084	One Progressive Die	Q
		Pc. 33334 Bearing Retainer	
16		Use same die for Pc.32638 TN-91334	Q
132		Use die for Pc. 32638 TN-91333	Q
		Pc. 33335 End Housing	
200 etc.		Use same tools as Pc. 32639 End Frame	M
51	TN-93983	Add hole in TN-90944 Drill Jig	M
13	TN-93982	One Broaching Fixture	M
		Pc. 33339 Screw (Davenport)	
155		No tools needed as per Mr.J.Ely	S-XS

It will be seen that the tool list contains a statement not only of such jigs, fixtures, and gages as will be required, but also states the sizes of standard drills, dies, cutters, etc., that will be needed. This is done in order that these standard tools may be obtained directly from the stockroom, and an asterisk (*) is used to indicate such standard tools as should be in stock.

TABLE 2. TOLERANCES ON WORKING PLUG GAGES

Tolerance on Product, Equal to Difference between Maximum and Minimum Plug Gage Sizes	Amount that "Go" Plug Gage is over Blueprint Size	Limits to which Toolmakers must work on Gages
0.0005 or under	0.0002	+ 0.00005 — 0.0001
0.0005 to 0.001	0.0003	+ 0.00005 — 0.0001
0.001 to 0.002	0.0004	+ 0.00005 — 0.0001
0.002 to 0.004	0.0005	+ 0.0002 — 0.0002
0.005 or more	0.001	+ 0.0002 — 0.0002

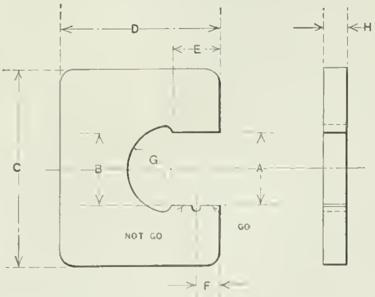
Machinery

By studying the tool list it will be found that in many instances the same fixtures or tools as are used for some other part or mechanism are employed. When no tools are needed for a certain operation, the authority for the statement that no tools are required is generally also included on the tool list, as indicated.

Standards for Gage Design

In the design of gages for the inspection of the product made by the Delco organization, a number of standards have been adopted both for the design of the gages and for the tolerances that should be used in the tool-room in making the gaging equipment. The specific tolerances required on the work or ultimate product are established by consultation between the engineering department, the tool designing department, the machining department, and the inspection department, as these four factors must be brought together in any case when a satisfactory system of tolerances is to be established.

TABLE 3. DIMENSIONS OF SNAP GAGE BLANKS



All dimensions in inches

A	C	D	E	F	G	H
1/4–1/2	1 5/8	1 5/16	1/2	1/4	5/16	1/4
1/2–3/4	2	1 5/8	1/2	1/4	7/16	1/4
3/4–1	2 1/4	1 3/4	1/2	1/4	9/16	1/4
1–1 1/4	2 1/2	2	9/16	9/32	11/16	1/4
1 1/4–1 1/2	2 7/8	2 1/4	5/8	5/16	13/16	1/4
1 1/2–1 3/4	3 1/4	2 11/16	3/4	3/8	15/16	5/16
1 3/4–2	3 9/16	2 13/16	3/4	3/8	1 1/16	5/16
2–2 1/4	4	3 1/4	7/8	7/16	1 3/16	5/16
2 1/4–2 1/2	4 1/4	3 3/8	7/8	7/16	1 5/16	5/16
2 1/2–2 3/4	4 1/2	3 1/2	7/8	7/16	1 7/16	5/16
2 3/4–3	5	3 3/4	7/8	7/16	1 9/16	3/8
3–3 1/4	5 1/4	3 7/8	7/8	7/16	1 11/16	3/8
3 1/4–3 1/2	5 1/2	4	7/8	7/16	1 13/16	3/8
3 1/2–3 3/4	5 3/4	4 1/2	1	1/2	1 15/16	3/8
3 3/4–4	6	4 5/8	1	1/2	2 1/16	3/8
4–4 1/4	6 1/4	4 3/4	1	1/2	2 3/16	3/8

Machinery
]

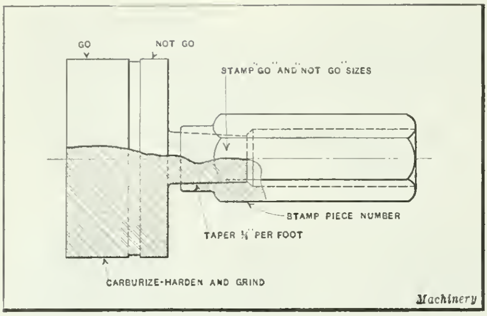


Fig. 3. Single-ended Limit Plug Gages for Sizes between 1½ and 4½ Inches

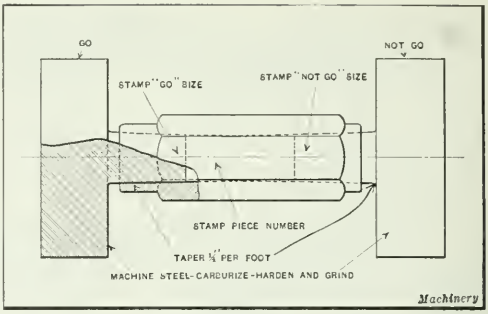


Fig. 4. Double-ended Limit Plug Gages for Sizes between 1½ and 4½ Inches

In addition to the tolerances on the work to be made, which determine the maximum and minimum limits on the gages, there must be tolerances established for the tool-room, as the gages themselves cannot be made absolutely to maximum or minimum limits, but must also have limits established within which they are to be made. This subject has been carefully considered, and certain limits have been established for the location of holes in jigs and fixtures, for inspection plug gages, for plug gages for the manufacturing departments, for reamers and reamer bushings, and for studs; these limits are given in the following:

Tolerances for Tool-room Work

The tolerances established for the location of holes in jig and fixture work are plus or minus 0.0005 inch for dowel holes, plus or minus 0.0015 inch for tapped holes, and plus or minus 0.005 inch for holes in which the mating part is not expected to have a close fit. Different limits are given the tool-room for inspection plug gages and for plug gages used in the manufacturing departments, because by having the limits in the manufacturing departments such that whenever the work has passed the manufacturing gages it is always certain to pass the inspection gages, a great deal of controversy and loss of time is avoided.

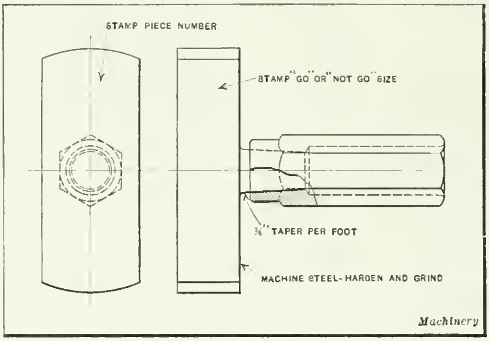


Fig. 5. Design of Plug Gages for Sizes Larger than 4½ Inches

Inspection Plug Gages—When the tolerance on the work—that is, the difference between the maximum and the minimum plug gage sizes—is 0.001 inch or under, the tool-room is required to finish both the maximum and the minimum plug to the size given on the blueprint with a limit of + 0.0001 inch above this size.

When the tolerance on the work is from 0.001 to 0.002 inch, the tool-room is required to finish both the maximum and the minimum plug gages to the size given on the blueprint with a limit of + 0.00015 inch above this size.

When the tolerance on the work is 0.002 inch or more, the tool-room is required to finish both the maximum and the minimum plug gages to the size given on the blueprint with a limit of + 0.0002 inch above this size.

Plug Gages for the Manufacturing Departments—The "Go" plug gages for the manufacturing departments are made to a nominal size which is a certain amount over the size given on the blueprint or over the nominal size of the inspection "Go" plug gage. Table 2 shows both the amount that the "Go" plug gages for the manufacturing departments are made over the size of the inspection gage, and the limits to which the toolmakers must work on the gage.

In making plug gages, a distinction is made in the handles so that an inspection gage may be easily distinguished from one used in the manufacturing departments. The inspection gages are provided with hexagon handles, while the manufacturing gages are provided with knurled handles.

Tolerances for Reamers

When limits for the dimensions of reamers are stated as ± 0.0005 inch, the desired size is 0.00025 inch under the maximum limit.

When limits for the dimensions of reamers are stated as ± 0.001 inch, the desired size is 0.0005 inch under the maximum limit.

When limits for the dimensions of reamers are stated as ± 0.002 inch, the desired size is 0.001 inch under the maximum limit.

All reamer bushings are made as nearly as possible 0.0002 inch over the size of the reamer.

Tolerances on Locating Studs

On all locating studs on jigs and fixtures made for parts in which the hole is to be ground, an allowance must be made for the amount left for grinding. In addition, the studs should be a certain amount smaller than the minimum limit of the hole, the following allowances being made:

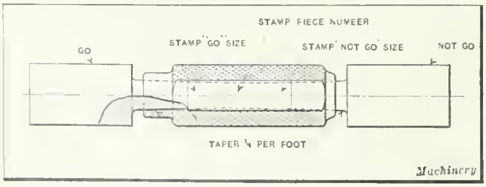


Fig. 6. Design of Manufacturing Gages with Knurled Handles

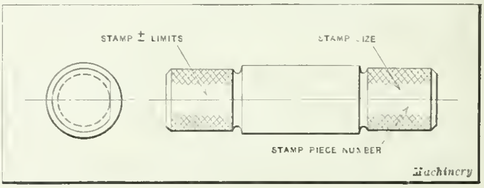


Fig. 7. Special Plug Gage for setting Indicating Gages

0.0005 inch on studs up to ½ inch diameter;
0.001 inch on studs up to 2 inches diameter;
0.002 inch on studs larger than 2 inches in diameter.

Design of Gages

The accompanying illustrations show the design of plug gages of different sizes. Fig. 1 shows the design used for plug gages up to 1½ inches in diameter with the "Go" and "Not Go" gages at the same end of the handle. Fig. 2 shows double-ended limit gages for sizes up to 1½ inches. Fig. 3 shows single-ended limit gages for sizes larger than 1½ inches, but less than 4½ inches; and Fig. 4 shows the design of double-ended limit gages for the same range of sizes. Fig. 5 shows the design used for plug gages larger than 4½ inches in diameter. In this case the gage is always made single-ended, two separate gages being made, one for the "Go," and one for the "Not Go" limits.

The gages shown in Figs. 1 to 5 inclusive have hexagon handles and are inspection gages. The design of the manufacturing gages is the same as for the inspection gages, except that the handle is knurled as indicated in Fig. 6. On the double-ended limit gages the lengths of the "Go" and "Not Go" plugs are made the same, because in this way there is an opportunity to grind down the "Not Go" plug to the "Go" size, if it should be found desirable to do so.

Special plug gages are used for setting indicating gages. These are designed as shown in Fig. 7 with knurled ends and with the gage portion in the center.

Snap gages with the "Go" and "Not Go" steps on the same side of the gage are shown in Table 3, where the general dimensions for gages of this type are also given. Gages of this design are made for gaging dimensions of from ¼ to 4¼ inches.

Snap gages with the "Go" and "Not Go" gaging spaces on opposite sides of the gage are made for dimensions from ⅛ to 6⅛ inches, and are shown in Table 4 together with the general dimensions used.

Snap gages with the regular snap gage frame and with inserted gaging points are made to the design shown in Fig. 8. Gages of this type are made for gaging dimensions from 2 to 8 inches.

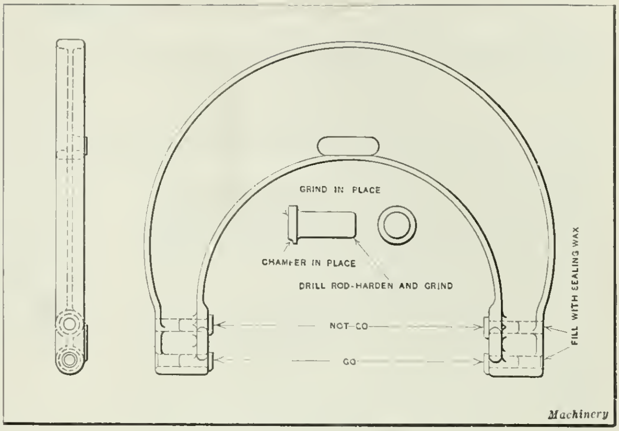
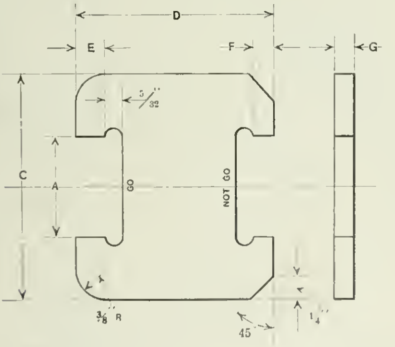


Fig. 8. Design of Limit Snap Gages for Dimensions from 2 to 8 Inches

TABLE 4. DIMENSIONS OF SNAP GAGE BLANKS



All dimensions in inches

A	C	D	E	F	G
1/8– 1/2	1 3/4	2 1/4	9/32	7/32	3/16
1/2– 7/8	2 1/8	2 1/4	9/32	7/32	3/16
7/8–1 1/4	2 1/2	2 1/4	9/32	7/32	1/4
1 1/4–1 5/8	2 7/8	2 1/4	9/32	7/32	1/4
1 5/8–2	3 1/4	2 1/4	9/32	7/32	1/4
2 –2 3/8	3 5/8	2 1/2	11/32	9/32	1/4
2 3/8–2 3/4	4	2 1/2	11/32	9/32	1/4
2 3/4–3 1/8	4 3/8	2 3/4	13/32	11/32	1/4
3 1/8–3 1/2	4 3/4	2 3/4	13/32	11/32	5/16
3 1/2–3 7/8	5 3/8	2 3/4	13/32	11/32	5/16
3 7/8–4 1/4	5 3/4	2 3/4	13/32	11/32	5/16
4 1/4–4 5/8	6 1/8	2 7/8	15/32	13/32	5/16
4 5/8–5	6 1/2	2 7/8	15/32	13/32	5/16
5 –5 3/8	6 7/8	3	1/2	15/32	3/8
5 3/8–5 3/4	7 1/4	3	1/2	15/32	3/8
5 3/4–6 1/8	7 5/8	3	1/2	15/32	3/8

Machinery

* * *

FIRST APPLICATION OF COMPRESSED AIR TO POWER PRESSES

A rather humorous anecdote is related concerning what is claimed to be the first time that compressed air was employed to eject work from a power press. A young fellow applied for a job as a die-setter in a power-press shop of considerable size, and was engaged on the strength of the glowing capabilities he claimed for himself. The first task given him was to set up and try out a die for stamping a simple circular blank of very light metal, and he was given the choice of two presses for the purpose. Both presses were small and of equal capacity, but one was of the straight-sided type, while the other was an inclinable press. He chose the latter for the work. The boss kept his eye on the young die-setter because, from a previous inspection of the construction of the die, he knew that the stamping would not lift out and slide away from the press of its own accord, even though the machine was inclined at a generous angle.

When the die had been set up and was tried out, the result was not as the die-setter expected, but, of course, as the boss had anticipated the work would not slide off the die. The young fellow seemed puzzled for a minute; then his worried look changed to one of hope and understanding. He left the press for a few minutes and returned with a hand bellows. This he gave to his helper and stationed the latter in a sitting position on the floor and under the press. The helper was then instructed to place the nozzle in a vent in the bottom of the die and to squeeze hard immediately after each tripping of the machine. The helper followed the instructions faithfully and the stampings kept flowing out of the die and rolling from the press after each operation. Thus, the young genius not only made good on his new job, but also instituted the first compressed-air device for the removal of small stampings from a press, even though it was operated by a "human knock-out."

N. T. T.

Graphical Determination of Shaft Diameters

By N. BARNES HUNT, Engineer, U. S. Reclamation Service, St. Ignatius, Montana

THE combinations of torsion and compression and torsion and tension in shafts are treated in various ways by designers. One of the most satisfactory methods is to apply the true-stress theory, in which stress is assumed to be a function of deformation.

Torsion produces a shearing stress which may be considered in combination with either the flexural compression or the flexural tension. Since the compressive and tensile strengths of steel are approximately equal, and the flexural compressive and tensile stresses are equal, it is customary to consider only the combination of torsion and tension, knowing that by so doing the requirements for compression will be satisfied.

The accompanying diagrams give the diameters of solid round shafts for various loads, the curves being plotted in accordance with the true-stress theory. The diagrams have been prepared for the low working stresses of 10,000 pounds per square inch in tension and 8000 pounds per square inch in shear, but by means of the accompanying table of coefficients, the diameters may be determined for other working stresses. It is customary to place a greater restriction on stresses in shafts than in members not subject to variable stress.

The diagrams are based on formulas taken from the author's article "Practical Applications of the Combined Stress Theory," which was published in August, 1919, MACHINERY. These formulas are:

$$D^3 = \frac{32R}{\pi S_t} \left(M_b + 2\sqrt{M_t^2 + M_b^2}\right) \qquad (1)$$

$$D^3 = \frac{64R}{\pi S_s} \sqrt{M_t^2 + M_b^2} \qquad (2)$$

in which

D = diameter of shaft in inches;
S_t = true unit tensile stress;
S_s = true unit shearing stress;
R = Poisson's ratio;
M_b = bending moment in inch-pounds;
M_t = torsional moment in inch-pounds.

Formula (1) gives the shaft diameter for tensile stress, and Formula (2) for shearing stress.

A not uncommon conception of combined stress is that the elementary stresses form a single stress for which the member must be designed. The facts are, however, that torsion increases the tensile stress and that tension increases the shearing stress resulting from torsion, so that the stresses must be considered separately. Similarly, in the diagrams the tension curves must be considered separately from the shear curves, and the diameter to be used will be the greater of the diameters found. It will be noted that the solid lines give the diameters for tensile stresses, and the broken lines those for shearing stresses. It is apparent that the controlling stress is determined by the relative magnitude of the bending and torsional moments.

The value of R (Poisson's ratio), that was taken in preparing the charts, was 1/3. By the process of interpolation the diameters of intermediate sizes of shafting can be obtained, if desired, to a sufficient degree of accuracy.

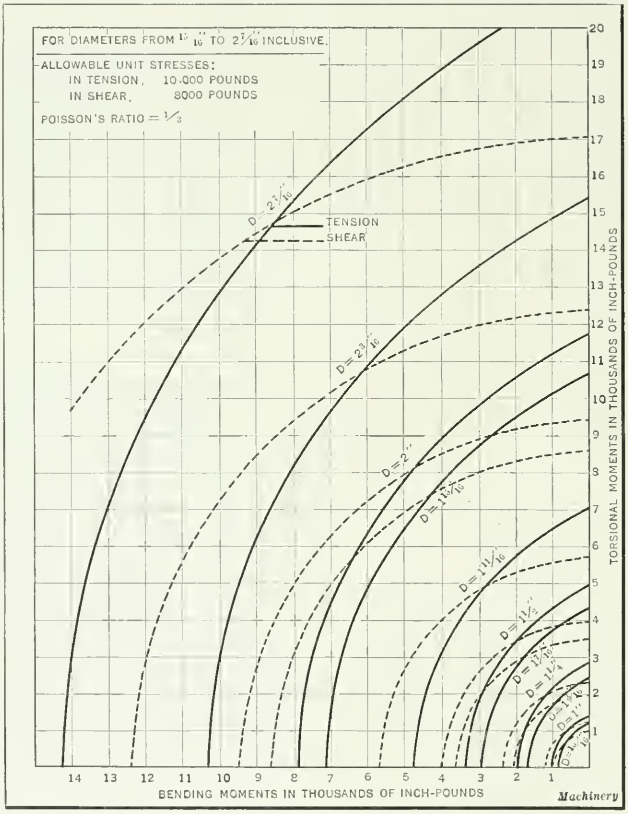


Fig. 1. Chart for graphically finding the Proper Diameters of Shafts subjected to Combined Tension and Torsion—Sizes from 15/16 to 2 7/16 Inches, Inclusive

Examples of the Use of the Charts

Example 1—The bending and torsional moments in a shaft are, respectively, 20,000 inch-pounds and 60,000 inch-pounds. Allowing stresses of 10,000 pounds per square inch in tension and 8000 pounds in shear, what should be the diameter?

Referring to Fig. 2, it is seen that for tension (solid lines), the coordinates intersect at a point which practically lies on the curve for a 3 11/16-inch diameter shaft. Considering shear (broken lines), the diameter is found to lie between 3 11/16 and 3 15/16 inches. The 3 15/16-inch diameter shaft should be used.

Example 2—Find the proper diameter of shaft, using allowable stresses of 12,000 pounds per square inch in tension and 9500 pounds in shear, for the moments given in Example 1.

TABLE OF COEFFICIENTS FOR VARIOUS WORKING STRESSES

Kind of Stress	Allowable Unit Stress in Pounds						
	6000	8000	10,000	12,000	14,000	16,000	18,000
Tension	——	1.08	1.00	0.94	0.89	0.85	0.82
Shear	1.10	1.00	0.93	0.87	0.83	0.79	——

Machinery

Referring to the table of coefficients, $D = 0.94 \times 3.6875 = 3.47$ inches, which is suitable for a shaft when under a tension of 12,000 pounds per square inch. Interpolating between the coefficients for 8000 and 10,000 in the table to obtain the proper value for an allowable shearing stress of 9500 pounds per square inch, and also between the shaft diameters 3 11/16 and 3 15/16 in Example 1, $D = 0.95 \times 3.77 = 3.58$ inches, for shear. In this case a 3 11/16-inch diameter shaft should be used.

* * *

INVESTIGATION OF ELECTRIC ARC WELDING OF STEEL

The United States Bureau of Standards has made an investigation of the properties of arc-fused metal. The complete report on the investigation, prepared by Henry S. Rawdon, Edward C. Groesbeck, and Louis Jordon, is given in Technologic Paper No. 179 of the Bureau of Standards. Briefly stated, the report reaches the following conclusions:

A fusion weld is fundamentally different from all other types in that the metal of the weld is essentially a casting. The arc-fusion weld has characteristics which are peculiar to it alone. A knowledge of the mechanical properties of the arc-fused metal which is added during the process of welding is fundamental in the study of arc-welding. The mechanical properties, as revealed by stressing in tension, were determined by testing specimens (0.505 inch diameter and 2 inches length) cut from blocks of arc-fused metal prepared under conditions similar to those met with in welding. Additional specimens were also prepared by expert welders outside of the bureau and submitted for comparison with those prepared by the bureau.

Two types of electrodes—a "pure" iron, and a low-carbon steel—were used. During fusion the composition changes considerably as the carbon and other elements are eliminated. The two types of electrodes become very much alike in composition. In each case a considerable percentage of nitrogen is taken up. The mechanical properties of the arc-fused metal as measured by the tension test are essentially those of an inferior casting. The most striking feature is the low ductility of the metal. All of the specimens examined (about seventy) showed evidence of unsoundness in their structure, tiny enclosed cavities, oxide inclusions, and lack of intimate union. These appear to be a necessary consequence of the method of fusion as now practised. They determine almost entirely the mechanical properties of the metal. The observed elongation of specimens under tension is due to the combined effect of the numerous unsound spots rather than to the ductility of the metal. The material is, however, inherently rather ductile, as may be shown by the changes produced in its microstructure by cold-bending.

A characteristic feature of the microstructure of the arc-fused metal is the presence of numerous microscopic plates within the ferrite grains. These persist in the metal upon prolonged heating; for example, six hours at 1000 degrees C. in vacuum was not sufficient to remove them. The various lines of evidence available indicate that they are related to the nitrogen content of the metal. The microscopic examination indicates that there is but little, if any, relation between these so-called "nitride plates" and the path of rupture produced by tensional stresses. The effect of the grosser imperfections of the metal is so much greater than any possible effect of these plates in determining the mechanical properties, that the conclusion appears to be warranted that this feature of the structure is a matter of relatively minor importance in ordinary arc welds.

Judged from the properties of the metal after fusion, neither type of electrode used appears to have a marked advantage over the other. The use of slight protective coatings on the electrodes does not appear to affect the mechanical properties of the arc-fused metal materially in any way. The specimens were prepared in a manner quite different from that used ordinarily in electric arc welding, and so do not justify specific recommendations concerning general methods to be employed in welding practice.

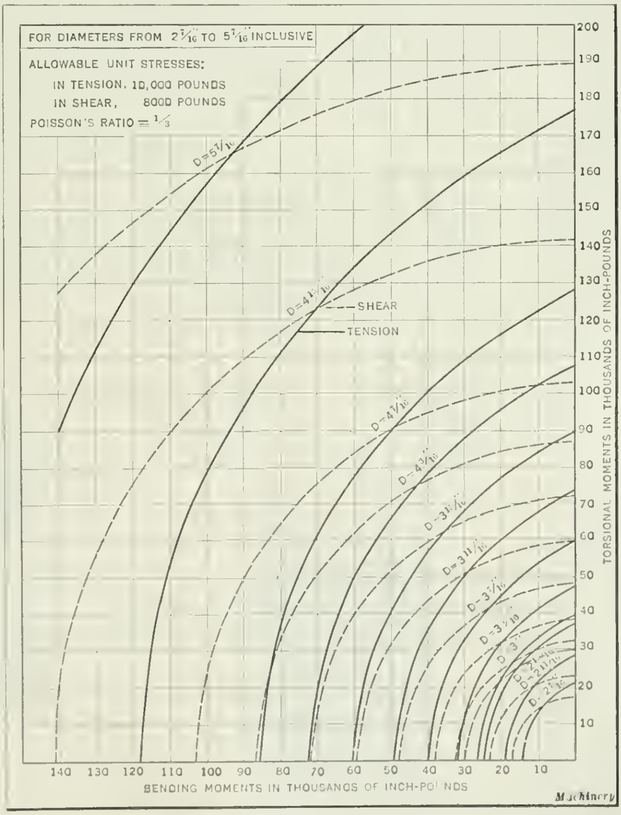


Fig. 2. Chart for graphically finding the Proper Diameters of Shafts subjected to Combined Tension and Torsion—Sizes from 2 7/16 to 5 7/16 Inches, Inclusive

PORTABLE ELECTRIC RIVET-HEATER

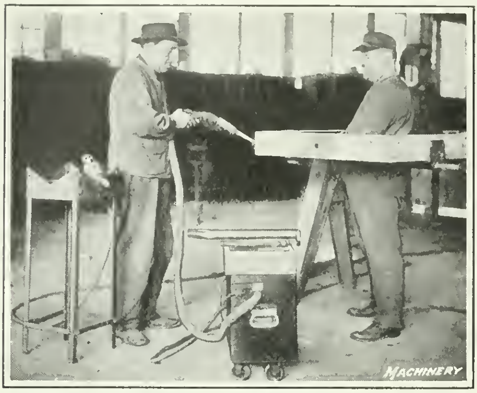


Fig. 1. Heating Rivets by inserting them in Members to be assembled and placing Electrodes in Contact

An electric rivet-heating apparatus, self-contained in a small wooden box, which is mounted on rollers so that it can be readily moved about the shop as required on various jobs, is illustrated in Fig. 1. This equipment was developed several years ago in the shops of the Commercial Truck Co., Philadelphia, Pa., for use in constructing the electric motor trucks manufactured by this concern, and has rendered such satisfactory service that several more have been built since then. In heating a rivet with this equipment, the rivet is first inserted in the holes of the parts to be assembled, and then, after the electric current has been turned on, a copper electrode or terminal is applied to each end of the rivet, as shown, until it is hot enough for the heading operation, which is performed next. In Fig. 1 a pneumatic riveting hammer may be seen on the stand at the left, ready for use as soon as the rivet has reached the desired condition. A 3/8-inch diameter rivet, 1½ inches long, is heated to the riveting temperature in approximately sixteen seconds.

Alternating current of 220 volts and 60 cycles is supplied to the rivet-heating unit, which contains a transformer that reduces the voltage to 6. From the assembly view of the transformer in Fig. 2, the construction may be readily observed. The primary coil *A* has 156 windings about core *B*, which is made up of a large number of laminated wrought-iron plates, 9¼ inches long and 8⅜ inches wide. No. 9 double cotton-covered wire was used in making the primary coil, a thin sheet of fiber being placed between each layer of windings and the outside of the coil wrapped with fiber and insulating tape. Two copper castings *C* serve the purpose of a secondary coil. Thick sheets of fiber *D* are placed between the adjacent surfaces of these castings and those of the iron core *B* as shown, while other insulation is supplied at *E* and *F*. Thick sheets of fiber are also placed between the primary coil and the iron core.

Two ingoing wires are connected to the primary coil, one through tap *G* and the other through tap *L*, which is connected at the end of the 156 windings of the coil. Tap *H* is connected to the primary coil at the end of 108 windings; tap *I*, at 120 windings; tap *J*, at 132 windings; and tap *K*, at 144 windings. These four taps were only furnished on the original rivet-heater for experimental purposes, because of the lack of knowledge regarding how much the original voltage should be reduced. However, 156 windings proved satisfactory, so that on subsequent equipments, taps *H*, *I*, *J*, and *K* were omitted. Thick sheets of fiber are also placed between castings *C* and the copper details by means of which the wires are connected to the primary coil.

Two flexible cables conveying the current of reduced voltage to the terminals are clamped and soldered in the openings of holders *M* and *N*. These cables are about 6 feet long and are composed of three stranded cables, twisted together and wrapped with insulating tape. The terminals originally used with the equipment were made as shown at *O*, consisting of a copper end held to the end of the flexible cable by means of a set-screw, and a handle made of 3/16-inch diameter wire. Reference to Fig. 1 will show that the terminals now employed are of somewhat different design. The wooden box in which the transformer is contained is completely insulated inside.

* * *

As a result of the experience during the war, investigations were made in Switzerland to determine whether any iron ore is available in that country; the outcome of these investigations was the discovery of an iron ore district containing fifteen million tons of ore, and it is estimated that an additional amount of twenty-two million tons is available. Based upon the pre-war consumption rate, this iron ore should cover all the industrial requirements of Switzerland for forty-five years.

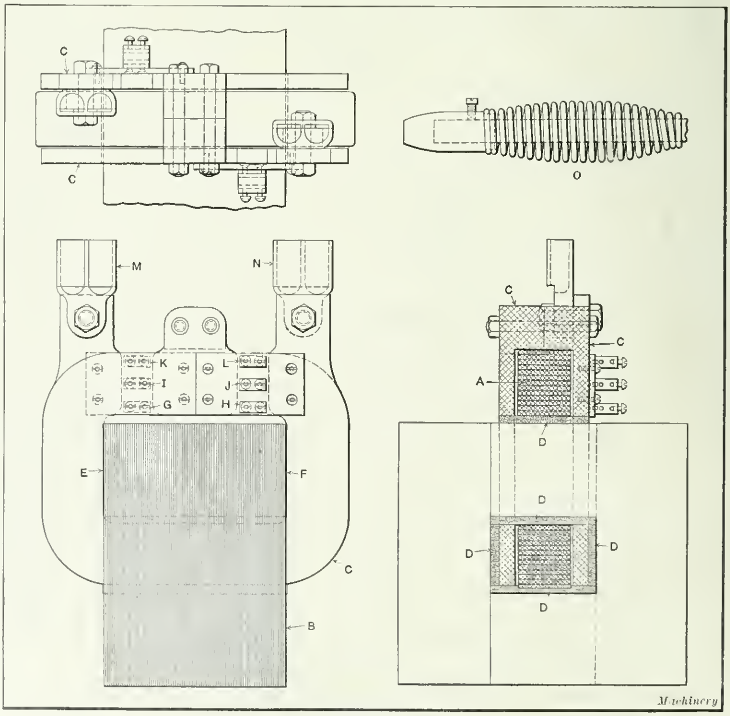
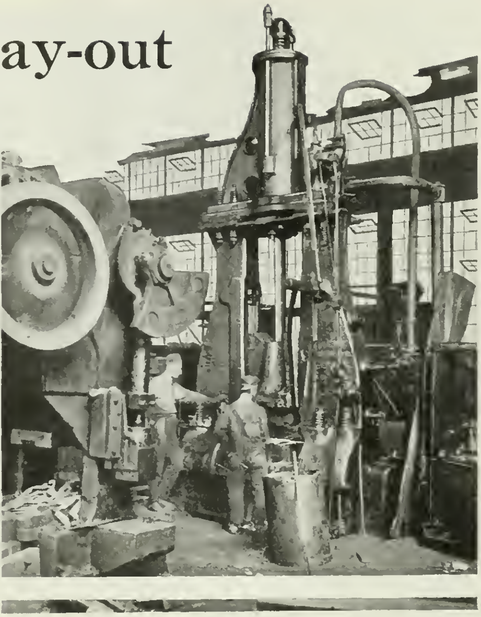


Fig. 2. Transformer used in Rivet-heating Unit to reduce the Voltage of the Current supplied

Drop-forge Plant Lay-out and Equipment



A Model Drop-forging Plant Arranged for Handling Large Quantities of Work

THERE are many angles from which the selection of a proper site for a drop-forge plant may be regarded, and each of these has an important bearing on the efficiency of the plant. Railroad facilities for handling the product; the kind of fuel that can be most readily and economically obtained; the possibilities for extensions to the plant; and the types of hammers to be used—each of these factors should receive due consideration. No rules can be given which will satisfy all the conditions that may be encountered in various localities. For example, there are certain sections of the country where it may be necessary to provide for using both oil and gas as a fuel, while in others an adequate supply of gas is always assured, and the likelihood of requiring the installation of an oil storage plant is very remote.

There are at present in the United States about 135 commercial drop-forging plants, but only a few of these were built complete at one time, so that there is no recognized standard for hammer-shop arrangement. In fact, where a plant has grown to large proportions by additions from time to time, made as the available space would permit, systematic routing of the work is very difficult. A new plant should be laid out to permit extensions as the requirements of the industry demand, without disturbing the remainder of the plant. It is apparent in locating hammers as well as other drop-forge shop machinery, that it should be predetermined whether the material is to travel crosswise of the shop while in process, or in some other way.

While the plan suggested herein provides for installing all types of drop-hammers in one building, some modern plants have other arrangements to best suit local conditions. In one shop, the board hammers and the heat-treating department are in one building, leaving the steam drop-hammers, upsetters, etc., in another, these two buildings running parallel and being separated by an areaway. Another arrangement is the combining of all hammers and forging machines in one shop with a section reserved for blacksmithing, the heat-treating department being housed in a separate building. The drop-forge plant lay-out suggested in this article is based on observations of some of the most modern drop-forging plants in the country, and it is believed that the lay-out shown includes all the best details of construction which have heretofore been incorporated in the more modern drop-forge plants. The lay-out described is intended to refer to a plant with a certain drop-hammer capacity and rated monthly output as specified in the following, and it is assumed that this plant is in an industrial section of the country where it is possible to obtain both oil and gas fuel, and where good railroad facilities are available.

Size and Number of Drop-hammers

An arrangement which has been laid out to take care of a monthly output of 3000 tons of drop-forgings is shown in Fig. 1. A conservative estimate of the number of drop-hammers required in a plant of this size is fifty, and the estimated total falling weight, 150,000 pounds. The expert drop-forger will appreciate the flexibility that any figures relative to capacity must have, because these are contingent upon the size and nature of the product. For example, there are many shops where a 10,000-pound drop-hammer would not be required, while in others the size of the drop-forgings produced may necessitate the use of hammers of this or even heavier weight of ram. A drop-hammer shop which would conveniently house fifty drop-hammers and the various accessory units, such as furnaces, upsetters, etc., would contain about 40,000 square feet of floor space. In an average fifty-hammer shop engaged in the production of forgings ranging in size from small levers to motor truck

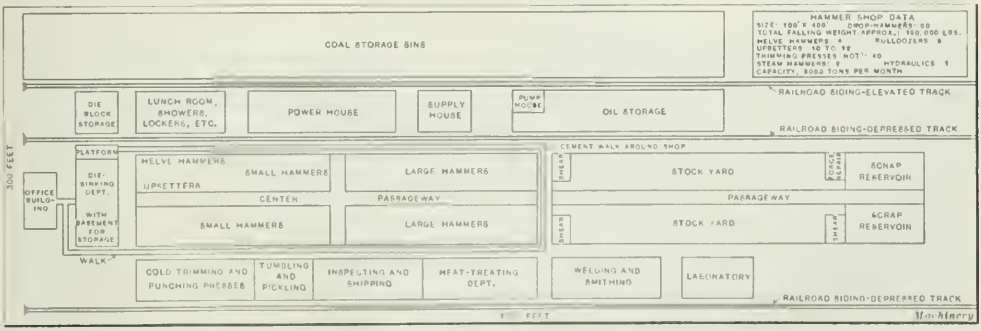


Fig. 1. Plan of Model Drop-forge Plant, showing Lay-out of the Different Departments

engine supports and axles weighing 300 pounds or more, there would be required, perhaps, thirty-five steam drop-hammers and about fifteen board drop-hammers.

The size of drop-hammers and the number of each estimated for a shop of this size is as follows: Four 1500-pound hammers; eight 2000-pound; ten 3000-pound; six 5000-pound; six 6000-pound; and one 10,000-pound hammer, giving a total falling weight of 128,000 pounds. Of the fifteen board drop-hammers the apportionment would be: Five 1000-pound, four 1500-pound, four 2000-pound, and two 3000-pound hammers with a total falling weight of 25,000 pounds. If very small forgings, eight or ten to the ounce, are to be manufactured, hammers as small as 300 pounds weight of ram will be required. Other drop-forge plant equipment would include four helve hammers; two bulldozers; from ten to twelve upsetters or forging machines, ranging in size from 2½ to 5 inches; about forty hot trimming presses; two open-frame steam hammers; and one hydraulic press.

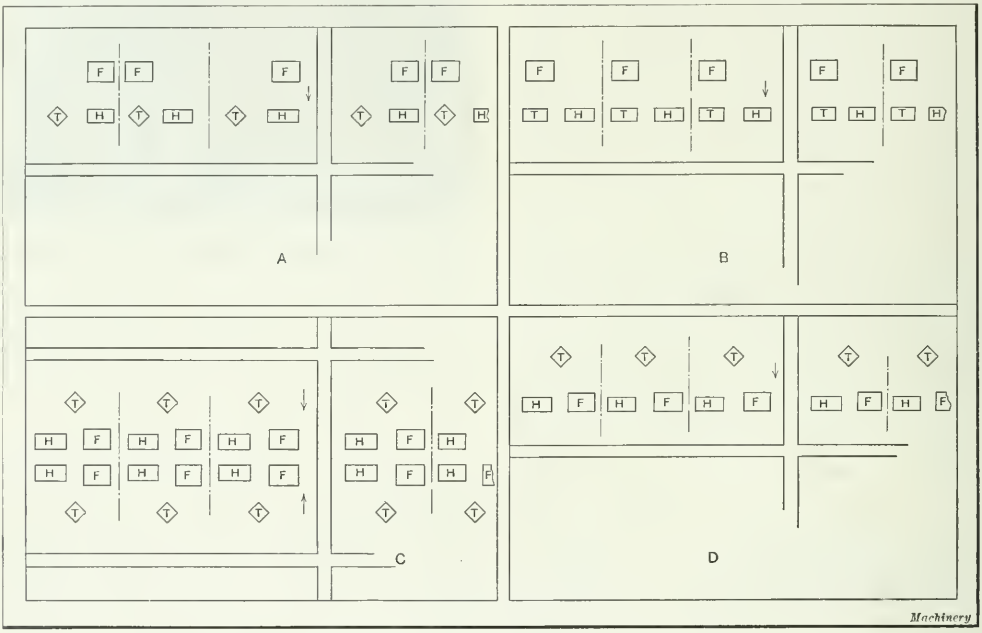


Fig. 2. Various Groupings of Drop-hammers, Furnaces, and Trimming Presses

Transportation Facilities

As shown in Fig. 1, the plant is served by three railroad sidings, one on each side of the hammer shop, having depressed tracks, and a third to accommodate the handling of coal, oil, and other stored supplies, which is elevated. A straight-away passage runs through the center of the shop, and extends through the stock-yard, which is a continuation of the forge shop. Both the forge shop and the stock-yard should be served by a full-width span traveling crane. For the accommodation of such a crane it is necessary to construct the building with rather high walls at the side, so that the crane may be run over the line of drop-hammers, when it becomes necessary to dismantle them in making repairs. This is an important detail, because the replacing of such parts as broken pistons on steam hammers is accomplished only with great difficulty, if a crane is not available.

The principal use of a crane is in the transporting of the finished product through the shop and the handling of the stock as it is taken from the cars and deposited in bins or other suitable storage space in the stock-yard. In the installation of a traveling crane, provision should be made for running the electric magnet over the concrete bins in the stock-yard where the scrap from the shears, the flash from the trimming presses, and the slag from the furnaces are deposited. The central passageway should always be kept clear, for by so doing the work can be more easily handled and the shop has a better appearance.

Hammer Arrangement

The usual arrangement of a drop-hammer shop provides for grouping a drop-hammer, a hot trimming press, and a furnace in such a manner that the hammer-man and his helper can work with the least difficulty. There are many ways in which these three units can be grouped, and in Fig. 2 are shown a number of different arrangements employed in several drop-forge plants. In the arrangement shown at *A*, the furnaces extend in a row next to the wall so that the hammer-man must stand between the furnace and the hammer. In the winter, when the sliding doors are all closed, this arrangement may be as desirable as any. In the warm weather, however, when the doors are open, the heat waves from the furnace reduce the workman's efficiency. The idea of placing the trimming presses at an angle is a good one, and should be followed wherever it is possible.

In the diagram shown at *B*, the same general criticism applies, only that the furnaces are not directly in back of the hammers, but it is necessary on account of the trimming presses not being set at an angle, for the hammer-man to walk over between the hammer and the press, and thus there is the same objection to this arrangement. In both these instances the groups are strung along opposite walls of the hammer shop. In the arrangement shown in the diagram at *C*, the idea is to conserve space and facilitate the installation of fuel, air, and steam lines, by placing the furnaces and hammers back to back through the center of the shop with the trimming presses placed at an angle and not directly in line with either the hammers or the furnaces. This is a good arrangement, and in a monitor-roofed building affords excellent working conditions on account of the facilities for ventilation and light. This arrangement also enables a narrow-span crane to be installed, which will not be required to make such a wide crosswise travel in handling the work as is required when the equipment is located along the walls of the building.

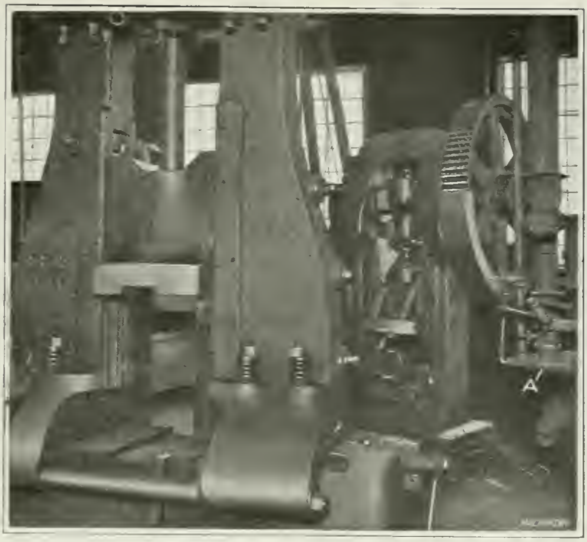


Fig. 3. Steam Drop-hammer, Trimming Press, and End of Furnace, showing Relative Positions

In all of these arrangements it should be understood that sufficient floor space is available to locate the upsetters, and other auxiliary equipment in some convenient locality. One disadvantage of the plan shown at *C* is that twice the amount of heat is concentrated through the center of the shop owing to the double rows of furnaces, so that forced ventilation might be required. Another point which should be considered, if this arrangement is contemplated, is the fact that another hammer is situated adjacent to the one on which each man is working, which may distract the attention of the men and have an unfavorable effect on the quality of workmanship.

While the double-row arrangement shown at *C* has certain noteworthy features, it is probable that this arrangement, with the groups located along the side walls, is the best when all things are considered. Such an arrangement, which is shown at *D*, is used in a certain large drop-hammer shop in the Pittsburg district, and it is probable that this cannot be improved on. Fig. 3 shows a steam drop-hammer at the left, a trimming press in the background, and a furnace (only the burner side of which is visible) grouped in this manner. It will be understood that the hammer-man stands between the row of trimming presses and the row of hammers and furnaces, which are all in one line. Nothing is lost by this arrangement when the walls of the shop are closed in winter, and also certain considerably better working conditions are afforded in the summer. The incoming breezes blow the heat from the furnace away from the operator and toward the center of the shop, where if the roof is of monitor construction with suitable ventilation facilities, the heat will be carried away. The trimming presses are placed at an angle which is convenient for the forger.

A slight modification of this arrangement may be necessary on the smaller size hammers up to 2000 pounds capacity. This consists of using the same general arrangement, but including two drop-hammers to one furnace and trimming press. Work ordinarily handled on hammers of small capacity is of rather light construction and can be handled more quickly and in greater quantity than the heavier forgings; also, small work is often not trimmed hot, so in that case there would be but one hot-trimming press idle to two hammers, rather than one for each hammer, as would be the case if the suggested grouping were strictly adhered to, without suitable modifications where small work is involved.

The hammer shop consists of little more than a shelter for the drop-hammers and the workmen. The walls may be composed almost entirely of sliding doors made of corrugated sheet iron; this is an inexpensive construction and is just as good as a more elaborate arrangement.

Oil Storage and Piping

Modern oil-tank cars are provided with heating coils for preventing the oil from congealing during the cold weather, so that the cars may be run beside the oil storage plant and the oil siphoned or deposited by gravity into similarly heated boiler-plate tanks. This arrangement is convenient, but may be improved on by providing underground storage tanks, from which the oil is pumped direct to the furnaces in the hammer shop. Safety valves are required in the oil line at intervals to safeguard against fire and leakage losses.

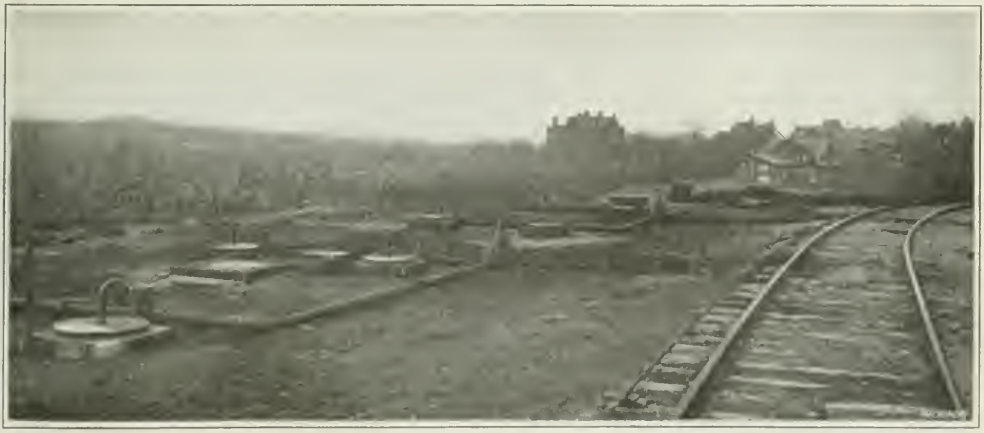


Fig. 4. Railroad Siding and Manholes leading to the Fuel-oil Concrete Storage Tanks

In one modern drop-forge concern the oil storage plant consists of a number of sunken concrete tanks, and a pump house equipped with 3½- by 4-inch Goulds triplex pumps, which deliver the oil at 60 pounds pressure to the burners, through 2-inch iron pipe. The return pipe, through which the unused oil from the furnaces is brought back into the tanks, passes the oil through a pressure valve, so that both the supply and return may be provided with meters. The difference in the meter readings gives the oil consumption. Fig. 4 shows a view of the manholes and the piping by means of which the oil is carried into the tanks from the cars. The illustration also shows the railroad tracks and their proximity to the tanks as a convenience for supplying them with oil. The capacity of the entire storage plant is 350,000 gallons and each tank is provided with heating coils.

The construction of the tanks and their design may be of interest. There are fourteen of these, designed with a central passageway 5 feet wide, in which the feed and steam piping is arranged. The tanks, of which there are eight of the design shown in Fig. 5, are made of reinforced concrete, and are 18 feet long, 15 feet wide and 9½ feet deep. In constructing these tanks, the concrete is mixed in the proportion of one part cement, two parts sand, and four parts pea gravel. An equal number of tanks is arranged on each side of the passage, and the valves from the feeding pipes may be conveniently reached from the passageway. The tanks on each side are connected by outlets at the base so that they can be drained to the same level. Each tank and the passageway is provided with a manhole and a ladder for convenience when it is desired to inspect the tanks. The connecting ports may be closed if desired by a valve operated from the passage.

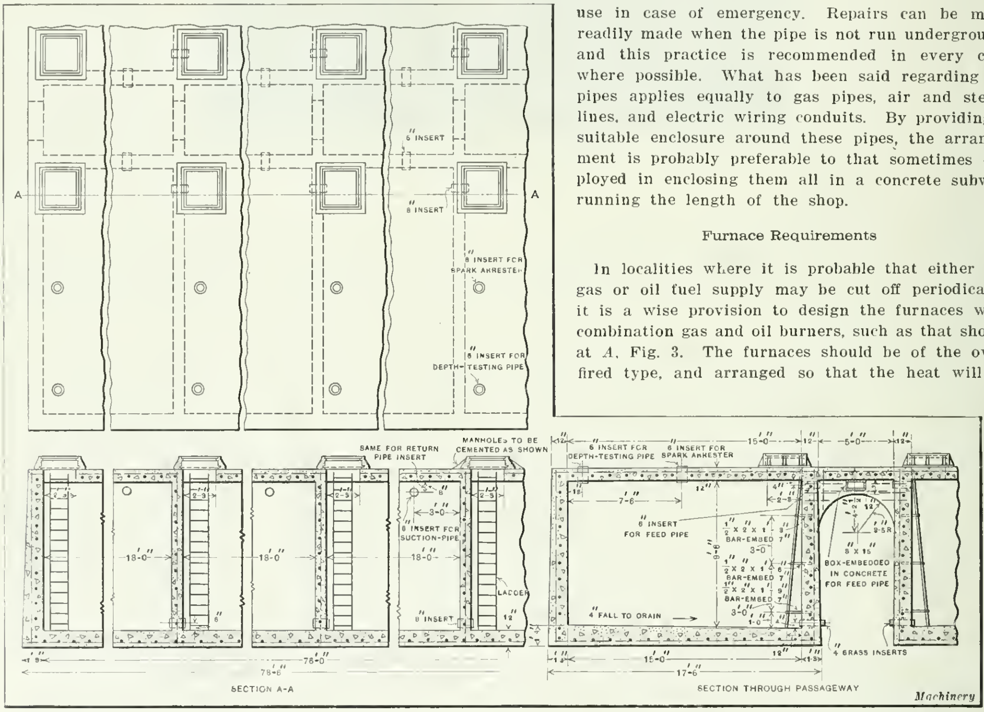

A
A
6" INSERT
8" INSERT
8" INSERT FOR SPARK ARRESTER
8" INSERT FOR DEPTH-TESTING PIPE
SAME FOR RETURN PIPE INSERT
MANHOLES TO BE CEMENTED AS SHOWN
2'-3"
18'-0"
3'-0"
8"
8" INSERT FOR SUCTION-PIPE
8" INSERT
6"
12"
LADDER
1'-9"
78'-0"
78'-6"
SECTION A-A
12"
6" INSERT FOR DEPTH-TESTING PIPE
6" INSERT FOR SPARK ARRESTER
15'-0"
12"
5'-0"
12"
7'-6"
6" INSERT FOR FEED PIPE
4"
2'-8"
½" X 2" X 1'-8" BAR-EMBED 7"
3'-0"
½" X 2" X 1'-6" BAR-EMBED 7"
½" X 2" X 1'-9" BAR-EMBED 7"
3'-0"
1'-0"
9'-8"
4" FALL TO DRAIN
12"
2'-5R
8" X 15" BOX-EMBEDDED IN CONCRETE FOR FEED PIPE
4" BRASS INSERTS
1'-3"
15'-0"
12"
1'-3"
17'-6"
SECTION THROUGH PASSAGEWAY
Machinery

Fig. 5. Construction Details of the Concrete Oil-storage Tanks

The walls of the tanks are waterproofed with a coating of pitch, great care being taken to seal all joints. Some of these tanks are fed from a common feeder (shown in the foreground, in Fig. 4), while in a later construction separate feeders are furnished each tank and each is drained separately from the others. On account of the slight weakening of the walls due to the action of the oil, the tanks are constructed heavily enough to allow a safety factor of from 10 to 15 per cent. It is probably unnecessary to use waterproofing material in the construction of concrete tanks intended for heavy fuel oil, because the oil after slight penetration, fills the pores of the concrete and makes them absolutely reliable. A wall 8 inches thick is sufficient to obviate the possibility of seepage. The tanks are located 18 inches below the yard level, which is covered with cinder so as to prevent excessive change in temperature of the oil.

The fuel oil pipes should be laid underground from the storage tanks to the hammer shop, and thence run along the wall, from which spur lines should be run down and laid underground to the furnaces. This arrangement permits any leaks in the pipe to be readily detected, and a number of valves can be provided at intervals for use in case of emergency. Repairs can be more readily made when the pipe is not run underground, and this practice is recommended in every case where possible. What has been said regarding oil pipes applies equally to gas pipes, air and steam lines, and electric wiring conduits. By providing a suitable enclosure around these pipes, the arrangement is probably preferable to that sometimes employed in enclosing them all in a concrete subway running the length of the shop.

Furnace Requirements

In localities where it is probable that either the gas or oil fuel supply may be cut off periodically, it is a wise provision to design the furnaces with combination gas and oil burners, such as that shown at *A*, Fig. 3. The furnaces should be of the overfired type, and arranged so that the heat will be conducted to the work by radiation rather than by direct contact. If a standard commercialized furnace is used, all details of construction will be taken care of in the design. The question of refractories for furnaces is of interest, particularly in connection with the making of repairs. Any good quality hand-made clay firebrick is suitable for the walls and roof of the oven, but for the hearth a chrome brick is more serviceable, because it is a resister to slag and consequently its use will prolong the life of the hearth. The furnaces used in connection with drop-hammers, forging machines, bulldozers, etc., are all of the same general type and have been described in detail in the technical press.

Blast for Furnaces and for Blowing Scale from Dies

The pressure of the air blast at the furnace burner should be governed by the style of burner selected for the furnace, and will probably be about six or eight ounces per square inch. Two blast lines of equal size should be provided, one running the entire length of the shop on each side. The blowers for the air blast should be mounted on a platform at one end of the hammer shop, according to the general arrangement shown in Fig. 6, together with the motor for driving the blower. This illustration shows a 100-horsepower motor driving a Sturtevant low-pressure blower, and an arrangement such as this should be installed for each of the two blast lines. The blast line should be about 40 inches in diameter at the blower and should taper down to approximately 10 inches at the opposite end of the shop, to compensate for the loss of pressure as the air is delivered to the furnaces along the line.

The size of furnace burners will necessarily vary according to their location along the blast line; if a 4-inch mechanical sprayer burner, such as shown in Fig. 3, is employed, the outlet to the furnace should be 2¼ inches in diameter. Where the inlets to the burners are less than 4 inches, the outlet to the furnace should be decreased in the same proportion. As previously stated, these burners are of the combination type and are connected to the gas supply pipe so that the gas may be delivered to the combustion chamber of the furnace under the air pressure of the blast line.

Although in many shops air compressors are used for furnishing air to the hammers for blowing scale from the dies, steam has been used with equal success, thus eliminating the need for an auxiliary compressor. Steam may be taken from the line which feeds the steam hammers and which furnishes steam for the heating system of the plant. Referring to the general lay-out, Fig. 1, it will be seen that the power house is a separate building. The pipes for delivering the steam from the power house to the hammer shop should be covered with asbestos and buried in sawdust in a suitable concrete conduit, which should be located well below the frost line. In one plant where this arrangement has been in successful operation for a number of years, no difficulty has ever been experienced in the cold weather by excessive condensation of steam or by freezing.

Cold Trimming, Cleaning, Inspecting, and Shipping Departments

It is usually the small work that is trimmed cold, and in the suggested plant lay-out the cold trimming and punching presses have been located in a building adjacent to that end of the hammer shop in which the small drop-hammers are situated. The estimated number of presses required for handling the contemplated capacity is fifteen, but this like other similar data here given relative to equipment, may serve only as an indication of the amount of floor space that this department should occupy. In this department there should also be installed perhaps four disk grinders for snagging rough-trimmed forgings.

Next in order of location comes the tumbling and pickling room in which the acid tanks, tumbling barrels, sandblasting machines, and other ordinary cleaning equipment are installed. If the product is of small size rather than varied as would be the case in the average commercial shop, the quantity of tumbling barrels should be considerably greater in proportion to other cleaning appurtenances, to handle the work suitably. Usually the reverse will be the case, that is, a larger percentage of work will be cleaned by either sandblasting or pickling than by tumbling.

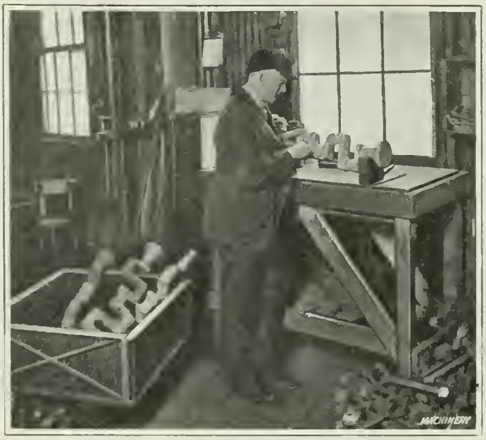


Fig. 7. Checking a Crankshaft at the Inspector's Bench

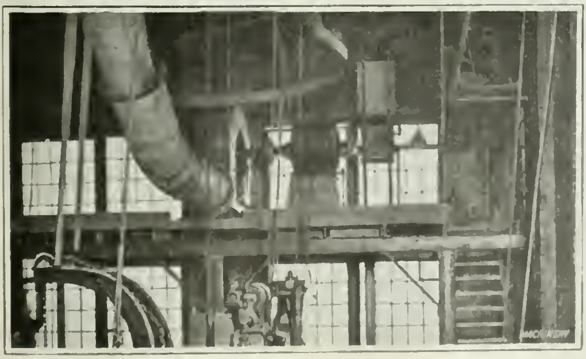


Fig. 6. Installation of Blower for the Air Blast Line.

A convenient location for the inspecting bench is in the shipping room, which is located between the cleaning room and heat-treating department. A sample of all work in process should pass through this department and be checked by the blueprints before production is really started. Usually this process inspection occurs at least once a day for each job in the hammers. A liberal amount of floor space should be available for the tote boxes and trucks which will necessarily gather in the vicinity of the inspector's bench, and there should be ample space provided for the installation of suitable metal cabinets for filing blueprints. Fig. 7 is a view of an inspector's bench, showing a crankshaft resting on V-blocks while being checked; the blueprint cabinet is located at the further end of the bench. The suggested location of the shipping room is ideal for the most efficient routing of the work, either from the heat-treating department on one side, or if the product is not to be heat-treated, from the cleaning department. By depressing the railroad track, by means of which the outgoing material is shipped, the work of transporting the forgings to the cars is readily facilitated.

Repair Equipment for a Drop-forge Plant

It will be noted that in one corner of the stock-yard there is a space provided for repairing the furnaces. This department should be under the supervision of the man who looks after the furnace linings, and here should be stored the refractory materials and all necessary equipment for handling this line of work.

The welding and blacksmithing department is a necessary adjunct to the well-equipped drop-forge plant. The use of welding, in connection with drop-forging repair work, is quite necessary on the intricate designs of parts. The principal uses for welding in drop-forging plants are for building up parts of this type which have not entirely filled up the dies in the forging operation (due to wide variety in the shape and size of certain sections of one particular forging) and for repairing checks and cold shuts which, even under the most favorable manufacturing conditions, will sometimes be encountered. The equipment should consist of about

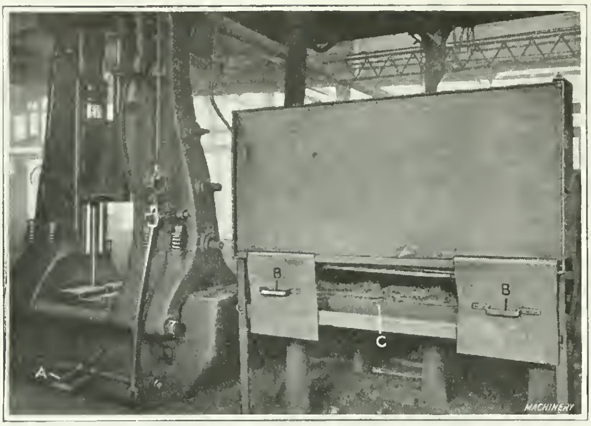


Fig. 8. Steam Drop-hammer and Furnace, showing Shortened Treadle, "Comfort" Blast, and Furnace Shields

six acetylene gas torches for use on this kind of work and a portable electric arc welding outfit for making repairs on tools and hammers. It has been found that the acetylene gas flame is more suitable for salvaging defective forgings than any other type of welding equipment.

It is sometimes advisable on long or tapered forgings where only a few are ordered and where the expense of making special dies would be prohibitive, to draw out the blank from which the forging is to be made. The blacksmith department should be suitably equipped for handling this kind of work. Adequate machines for the smithy department would include one helve hammer, perhaps three 1000-pound capacity and two 2000- or 3000-pound capacity open-frame steam hammers, a punch press, and eight or ten forge furnaces. A blower of suitable capacity should be provided for carrying away the fumes and gases from the forge furnaces, and the blower should be connected with a delivery pipe from a hood which should form a roof over the welders' benches. In this way all disagreeable gases will be removed.

Upkeep work of a general character, such as welding broken tongs, and repairing certain hammer parts, is assigned to this department. The nature of the work performed by the smithy and the welder is of such similar character that the logical arrangement is to place these departments together, and this has been done in the lay-out shown in Fig. 1.

Die-room and Storage House

One of the most important phases of the drop-forging industry is the manufacture and the hardening of the dies, and for this reason this subject will be considered in detail in a subsequent article. In the lay-out of a modern drop-forge plant a special storage house should be provided for the unmachined die-blocks as they are received from the steel mill. These blocks are often massive and awkward to handle, and the storage house should be located either in the same building with the die-sinking department or in close proximity to it. In the lay-out shown in Fig. 1 the storage house is situated directly opposite the building in which the dies are machined.

Facilities such as portable hoists should be provided for transporting the die-blocks from the storage space to the platform at the end of the die-sinking department. Storage space is also provided in the basement of the die shop, where the finished dies should be stored after they have been used and stripped from the hammers. This basement should be heated in cold weather, so that the dies will not become permeated with frost. Often such a condition has led to the fracture of dies when they are subjected to a severe blow in the hammer.

Improving Working Conditions

Accidents that occur around a drop-hammer are usually severe. One of the most common sources from which injury results is the accidental tripping of the hammer, due either to something heavy falling on the treadle, which extends the full width of the hammer, or by someone other than the operator accidentally stepping on the treadle. In one shop, measures have been taken to decrease the frequency of accidents resulting from this cause by shortening the treadle to about the width of an ordinary power press foot-treadle. Conditions under which the forger and his helper work, even with the best arrangement of equipment, are not especially favorable. The furnaces should all be provided with curtain shields to keep the excessive heat from the men's faces, and in almost every shop this is done. In Fig. 8 the treadle design *A*, previously mentioned, and a simple form of shield *B* for the furnace are shown, as well as a "comfort" blast for the furnace, which is indicated at *C*. This blast consists simply of a pipe from the air-line, perforated with holes so that the heat from the furnace is driven upward and away from the vicinity of the furnace-tender.

A suitable retiring room in which the showers and lockers are located is a necessary provision. Showers are a necessity, and the room should be especially well heated, because the men usually make use of this room when they are in an overheated condition. A complete change of clothing is necessary before the men can leave the shop, and this clothing must be thoroughly dried before it can again be worn. For this purpose, a clothing room in which the various pieces of wearing apparel are hung over steam pipes is an ideal arrangement. A view of the interior of one of these retiring rooms is shown in Fig. 9.

The equipment and lay-out of the heat-treating department and physical laboratory will be dealt with in a subsequent article in MACHINERY.

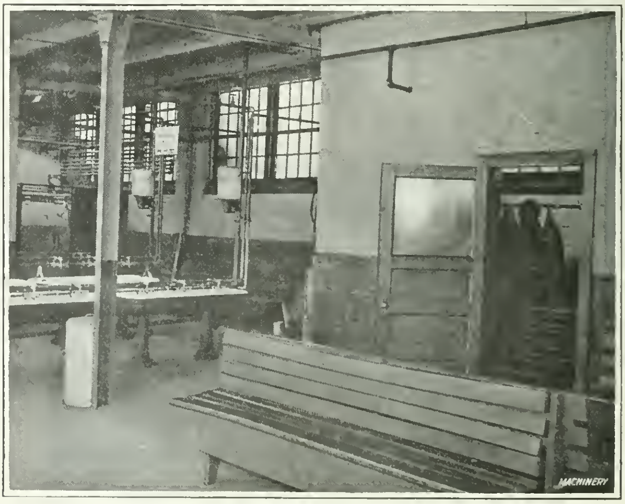


Fig. 9. Retiring Room, showing Showers, Wash Basins and Clothes-drying Room

Common Causes of Errors in Machine Design

The Dimensioning and Checking of Drawings—Seventh of a Series of Articles

By R. H. McMINN

IN the sixth installment of this article, published in the June number of MACHINERY, the matter of accuracy and clear representation in drawings was discussed. The present installment continues the discussion of points to be observed in making drawings in order to prevent errors in the finished part, taking up in detail the subjects of dimensioning and checking.

Dimensioning Drawings

In order for a drawing to be sufficiently dimensioned, it must require no extra figuring of dimensions by the shop departments in order to make all parts. As a general rule the shop should be required to make no assumptions regarding the shape or size of parts. There are a few exceptions to this, however. When the view of any part is rectangular, it is customary to give the dimension of only one end and one side, requiring the assumption that the opposite sides are parallel and the corners right angles. Likewise, when a view is circular it is not always necessary to add the word diameter, or an abbreviation, after the figure denoting the dimension, but the assumption is made that if it appears circular it is so unless other dimensions are given showing it to be elliptical.

If a detail has a number of identical parts, like the spokes of a wheel, it is not customary to give the dimensions of all, but only of one, and the rest are assumed to be the same unless otherwise indicated. If a flat bar has a line drawn down the center of its widest view, with holes located along this line, it is not always the practice to indicate by dimensions that the line is in the center of the piece, but it is assumed to be if not otherwise dimensioned. From the standpoint of accuracy it is better to definitely show that the line is in the center, as this is more likely to promote consideration as to whether the line should be in the center or off center to properly fit in with other details.

If the end view of a piece shows a number of concentric circles, like the end view of the trunnion in Fig. 10, it is best not to give the diameters of the various portions on that view, but on the side view or a longitudinal section. If one of these circles is distinguished in some way with bosses or holes having a circle as their center line, the diameter of this circle may be given on the end view. If a piece consists of a series of rounds and squares joined together along a common center line, they all appear rectangular in a side view or longitudinal section, as in Fig. 11. The dimensions of the round portions on the side view or section should therefore be followed by the abbreviation "diam.", and those of the square portions by "sq." The underlying principle is to so associate dimensions with parts that there will be no cause for misconception, and to describe the shape of the part dimensioned if necessary to more readily distinguish it from other shapes in the same detail.

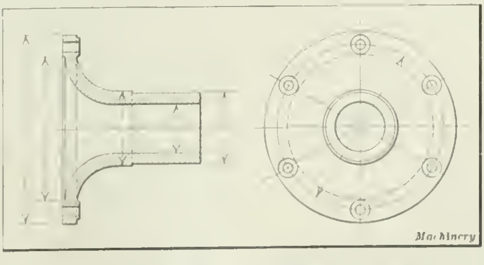


Fig. 10. Preferable Method of placing Dimension Lines on the Views shown

Dimensioning for Convenience of Shop

The fundamental principle to keep in mind in order to dimension any detail completely is that every detail consists of a combination of geometrical parts, each of which must be completely dimensioned in shape and size and be properly located by dimensions from other parts of the same detail. The ease with which the method of dimensioning can be used by the shop should always be considered. Following through in the mind the necessary operations which a patternmaker, machinist, or other workman must go through in laying out a part helps in this respect. Before denoting an angle on any part in degrees, consideration should be given to the shop's facilities for laying out or machining the part in degrees. In structural work, an angle is usually shown by giving the total length of two sides of a triangle or the slope of diagonals in inches per foot. Holes, surfaces, and parts should be dimensioned from other parts with which they have the closest relation in reference to accuracy of measurement demanded and, when allowable, ease of measurement. One should not give dimensions that are unnecessary and thus deceiving as to their importance, even though correct.

Time for Inserting Dimensions

There is no uniform practice as to what time during drawing, dimensions should be put on. Some draftsmen follow up their drawings closely with dimensions, while others wait until a detail is finished and then dimension. In following the latter method, only those dimensions that have been duplicated from another sheet, and those that may not be easily determined at a later time, or that cannot be scaled with sufficient accuracy, are put down immediately following the location of the lines or points they dimension. When the detail is finished, the rest of the dimensions are put in. This method has the advantage that after a detail is completed the exact space and location allowed for dimensions is evident. All dimension lines can first be added to the detail, and when this is done each dimension and pair of arrow heads can be inserted. This separates the work into two divisions, allowing first full attention to where it is best to locate dimensions and then full attention to what the dimensions should be.

Each dimension should be scaled prior to inserting the figures, as this gives a graphical check on it. If close attention is given to this scaling, it will prevent putting down dimensions that are very far wrong. Absolute accuracy of dimensions should always be aimed at, but, as a general rule, difficulties in the shop arising from a slight error in dimensions are more easily remedied than those caused by a large error. Dimensions should be kept separated as much as possible. Where they are crowded or the scale is small, use the letters C. L. for center line, C to C for center to center, and similar well-known abbreviations in conjunction with a dimension, in order to make its meaning doubly clear. The location of a dimension should always be changed if, after it is inserted, it is left in an obscure place by later drawing or if a full line runs through it. An attempt should be made to avoid the use of small fractions like sixty-fourths, thirty-seconds, or even sixteenths in over-all sizes of large rough castings. These can hardly be maintained and are therefore deceiving as to their importance.

Center-line Extensions

A center line or any line extended for dimensioning purposes should not be allowed to accidentally coincide with any part to which it is not related if it gives a wrong impression regarding the location of the part. In Fig. 12 there are eight holes equally spaced around a circle which has a radius *R*. There are two other holes *C* and *D* shown in the diagram. These are so placed that when giving their distance from line *MN* at *J* a line through their center also passes through the center of hole *A*. If this is a mere coincidence encountered in drawing, it is probable that accurate figuring of the distance of *A* from *MN*, by using radius *R*, would show that *A* is not exactly in line with *C* and *D*. In such a case, a dimension should never be located at *J*, but at *K*, and the vertical center line between *A* and *C* should be stopped off, as between *B* and *D*. Even if the dimension from *A* to *MN* should by coincidence be exactly equal to *K*, the holes *A*, *B*, *C*, and *D* should preferably not be located on the same center line, unless they have a very close relation to each other, as in the attachment of some other part which has four holes in line.

Repeating Dimensions

It has often been stated that a dimension of a part given in one view should not be repeated in another view of the same part. The main reason for this is that if the dimension be changed in one view it may be overlooked in the other view. This principle of non-repetition is a good one for the engineering department to follow for its own benefit, but it may frequently be better to ignore it for the benefit of the shop or an erector. If it helps to identify holes, surfaces, or parts by repeating dimensions in different views, they should be repeated. It is especially convenient to have some dimensions repeated if different views of the same part appear on separate drawings. Preferably, dimension lines should not cross each other. It is better, however, to have them cross than to have them too far removed from the parts they dimension. An arrow-head is an important part of a dimension line. This is best seen when one is wrongly placed and is acted upon as shown.

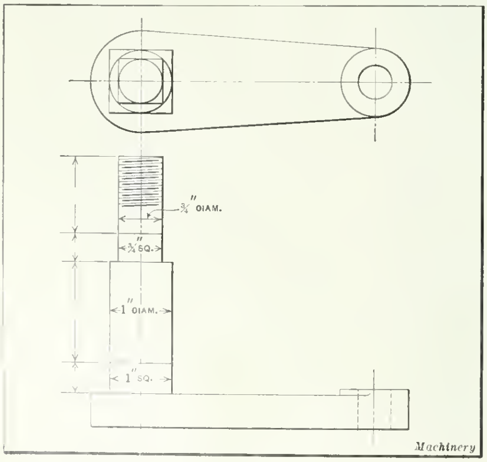


Fig. 11. Dimensioning a Part having Round and Square Sections

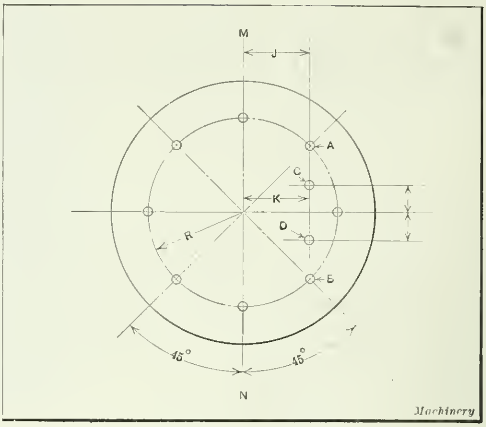


Fig. 12. Diagram illustrating Approved Practice in Regard to Use of Center Lines

Checking Drawings

The system followed in all well organized engineering departments whereby the drawings of designers and draftsmen are corrected by checkers unquestionably reduces the number of errors attributable to that department to a very small per cent of the number that would occur without checking. The first important requirement to insure that a set of drawings of a machine be properly checked lies in the checker acquiring a complete and accurate perception of the things to be accomplished by the machine. He should therefore first thoroughly examine all data and instructions submitted by authorities above the designer, so he may determine what result is required and what restrictions in form or size are placed upon the design by special conditions stated or clearances demanded. After this information is acquired, the drawings to be checked should be subjected initially to a comprehensive view and then to a minute inspection.

Preliminary Examination

The object of the first examination is to survey the machine as a whole and to determine, as far as can be done before completely checking, whether its elements appear to perform all of the main duties demanded. An endeavor should be made to exclude from the mind at this time the question of sizes, materials used, speed ratios, and considerations as to how the drawing is executed, unless some inconsistency is too glaring to be ignored. Such an observance by a checker may show that some important element has been omitted. For instance, it may be noted that a reciprocating member, like a cross-head on a punch press, requires some means of stopping it at the top of its stroke when a driving clutch is released. In this case the drawings may need such changes to provide the addition that it will pay to revise them before further checking.

Checking with Reference to Specifications

If it appears that the machine will function properly, the drawings should then be examined to see if they conform to all restrictions in design and size imposed by any specifications, drawings, or instructions of the purchaser or manufacturer. An error in over-all size or design imposed by the conditions surrounding the machine at its destination will not be discovered during the course of manufacture. Unless the inspection department is supposed to detect such errors —which should not be required of them—the error will not be discovered until the erection or trial of the machine. The correction of an error after the machine has been shipped is often difficult and costly, as well as damaging to the prestige of the manufacturer. Such errors are probably the worst type, except those that cause loss of life, and therefore special care must be observed to avoid them.

While giving the drawings a comprehensive survey, the checker may be impressed that some special point needs checking. It may not be desirable to pause to check it when he is trying to concentrate on the broad features of design. It is well, however, to make a note of each such impression, for the strength of one impression is partially lost when others are received. The checker may observe that the machine has a swinging door, and wonder if, when it swings, it will clear a building column which is near; or a lever may appear somewhat inaccessible for the operator to reach. It may be more convenient to check these features later, but the importance of these points may be submerged by a clamor for him to get the checking done, and he may forget to consider them. It is therefore best to profit as much as possible by a fresh mind and more freedom from pressure which usually exists when one starts to check a set of drawings and to make a written note of anything which looks doubtful. In so far as possible, routine checking should be left until last, in order to preserve mental alertness for the checking which most demands it.

Checking the Details

When it comes to the more minute inspection, the function, form, size, quantity, material, finish, and part or pattern number of each detail must be checked. The drawing must show that nothing is omitted from the detail that should be attached; that each geometrical part is complete and correct in each view, and that the drawing is clear enough to be correctly understood. The necessary manufacturing operations must be followed through in the mind to see that the detail conforms with those requirements. It must be so dimensioned as to be made without further figuring or questions. Its clearance from other parts of the machine must be assured, as well as the ability to assemble, transport, erect, and easily remove it if necessary. The work must finally be resolved into checking the complete area of each drawing. Every point, line, figure, and word on the drawing needs sufficient evidence or reason for its approval. All notes on drawings should be read carefully to see that they are not capable of more than one interpretation. A set of drawings must be further checked to see if any element which is necessary for the proper functioning of the machine has been omitted.

The temptation to skip steps in the gathering of evidence needed in checking a detail must be resisted. More errors arise from failure to investigate questionable points than from arriving at wrong conclusions after investigation. It is not necessary, nor desirable, to investigate every doubtful point as soon as a question arises. An attempt should be made to preserve the continuity of thought as much as possible, so such points should be questioned in some manner on the drawing and looked up afterward.

Checking Dimensions

When checking dimensions, they should be added when possible, instead of subtracting, following somewhat the same method that is used in making change. Let us say that there are three intermediate dimensions on a detail, as 5½, 7 1/16, and 6 3/16 inches, their overall dimension given as 18¾ inches, and that 5½, 6 3/16, and 18¾ inches have been checked as correct. Instead of adding 5½ and 6 3/16 together, and subtracting from 18¾ to see if 7 1/16 is correct, the three smaller dimensions should be added to see if their sum is 18¾ inches. All dimensions arrived at by subtracting should be checked by adding. It promotes accuracy, except in very simple cases, to first tabulate in a vertical column any series of dimensions to be added. This allows the feet, inches, and fractions to come in rows under each other. The transferred figures should be checked to see that each figure has been correctly transferred and that only those required have been included. This separates the work of deciding what dimensions must be included in a series, in order to obtain a desired dimension, from the actual work of adding.

Checking Bills of Material

Errors often occur in lists or bills of material which give the quantity, kind of material, names, part numbers, and sizes of the parts required for making a complete machine. As these lists may form the basis for determining a large portion of the material that is especially purchased or made up for a machine, they must be thoroughly checked. It is a good plan to go over the bills of material, after they have once been checked, and select single items that are costly, either because they consist of one expensive part or a large quantity of less expensive parts, and again check the description of these items in order to reduce the chance of costly errors to a minimum. If the bills should be written to include material for a large number of duplicate machines, each item should have this second checking, preferably by another person.

It is important to clearly indicate, as one proceeds, what has been checked on a drawing. In this way repetition of work is avoided. When a discrepancy is discovered, a prominent enough notation should be made so that there is no chance for it to be overlooked.

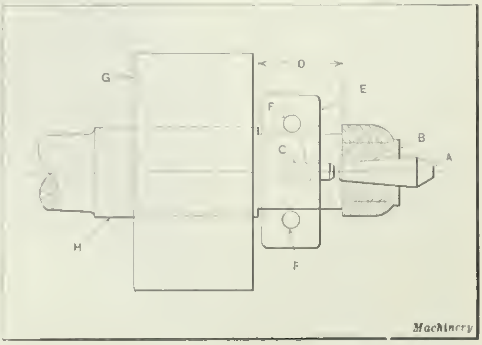
* * *

CHUCK FOR HOLDING SMALL TAPER PINS

By P. BERTLES

The device shown might be termed a "non-stop" chuck, as it is so designed that small taper pins can readily be inserted or removed without stopping the machine spindle. It can be used in performing light turning operations on the ends of taper pins, and is especially well adapted for holding pins of the type shown at *A*, which require the end to be ground smooth and at right angles with the axis of the tapered body.

Part *H* is an extended live spindle provided with a loose fitting collar *G*. When slid or forced quickly forward by the hand, this collar will hit part *E* with sufficient force to cause the hardened pin *C* to knock out part *A*. Spindle *H* is flattened for a distance indicated by dimension *D*, so that pins *F* will glide on these flattened surfaces. Part *E* is made a sliding fit in a slot through the spindle. A hardened bushing *B* provided with a tapered hole to fit the work is placed in the end of the spindle to prevent undue wear. In using this chuck, the spindle is set in motion, and the work *A* inserted in bushing *B*, after which it is given a light tap with a hammer. After performing the machining operation, collar *C* is quickly brought forward, thus causing the work to be ejected from the bushing so that a new piece can be inserted.



Chuck for holding Small Taper Pins

Some Products of a Modern Tool-room

Description of a Jig for Drilling One Hundred Holes, and a Small Assembling Fixture Produced in the Toolmaking Department of the Leeds & Northrup Company of Philadelphia, Pa.

By CHARLES O. HERB

A WELL equipped and wide awake toolmaking department is essential to the development of time- and labor-saving methods of manufacture in a modern machine building establishment. Such a department usually produces, not only tools for performing the cutting operations on a piece of work, but also ingeniously constructed jigs, fixtures, and other devices whereby the existing method of performing an operation is replaced by a method permitting a higher rate of production and, perhaps, a higher quality product. In order to have the department truly efficient, it should contain several skilled toolmakers or designers having the ability to judge whether the manufacturing methods in use can be improved upon and in what way. Although the initial cost of a device built in the tool-room is generally comparatively high, owing to the necessity of employing highly skilled mechanics, the time usually saved in the performance of an operation by the use of the device is such as to more than warrant the expense.

The Leeds & Northrup Co., Philadelphia, Pa., has a large modern tool-room equipped with machines of the precision class and several electric heat-treating furnaces provided with recording pyrometers of the potentiometer type which are manufactured by this concern. Hardening is performed by using the "hump" method for indicating when the part being heated reaches the decalescence or critical point. Recorders control the temperature of the tempering furnace by automatically operating switches when the temperature becomes greater or less than that desired. In the following will be described two tools built in this department by means of which the operations on two respective parts are performed in a more economical and satisfactory manner than previously.

Jig for Drilling One Hundred Holes in Recorder Frame

The main frame of a potentiometer recording pyrometer is shown in Fig. 2, from which the distribution of the numerous holes may be observed. This frame is a bronze casting weighing about 7½ pounds. All the holes drilled in the part are not shown in the illustration, but there are approximately one hundred. ranging from those produced by a drill of gage No. 52 to one that is ½ inch in diameter. Originally all these holes were laid out prior to the drilling operation, a step which obviously required a vast amount of unnecessary labor, the time consumed being approximately four days of eight hours each. In an endeavor to perform this operation on a production basis, the jig illustrated in Figs. 1 and 3 to 6, inclusive, was developed, and consequently all the holes are now being drilled in about thirty minutes.

The operation is performed on a drilling machine having four spindles, but only one hole is drilled at a time. There are ten different sizes of holes in the frame, and the procedure followed in producing them is to drill all those on one side of the jig which can be produced by the four drills mounted in the spindle sockets, and then drill those on the other sides. The drills are then replaced by others and the same method followed as before, in this way reducing to a minimum the changing of drills. By observing leaf A of the jig in the various illustrations, it will be seen that some of the holes to be drilled are spaced so close together that it is necessary to provide two guiding holes in one bushing.

There are approximately two hundred parts entering the construction of the jig, including the various bushings, and all these parts are hardened in the electric furnaces previously referred to. A point of unusual interest in connection with the hardening of these parts is that each one is ground accurately prior to the operation and their size and shape are not affected by the hardening process, so that it is unnecessary to regrind them afterward. In fact, the only surfaces requiring lapping are the holes of bushings larger than ¼ inch in diameter and, in these instances, only about one-quarter of a thousandth inch of metal is removed. The success of the hardening processes is attributed to the use of the "hump" method previously referred to. The bushings and the various surfaces of the jig which make contact with the work are hardened to a scleroscope reading of 95 to 100.

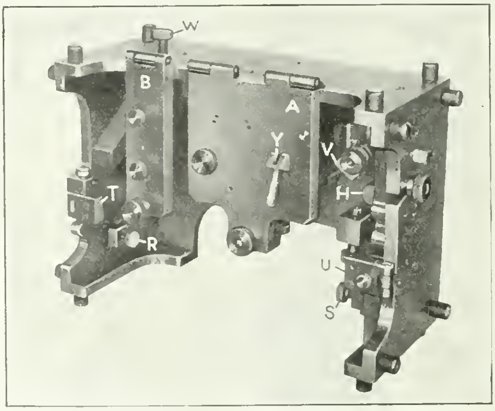


Fig. 1. Jig designed for drilling One Hundred Holes in the Main Casting of a Recording Pyrometer

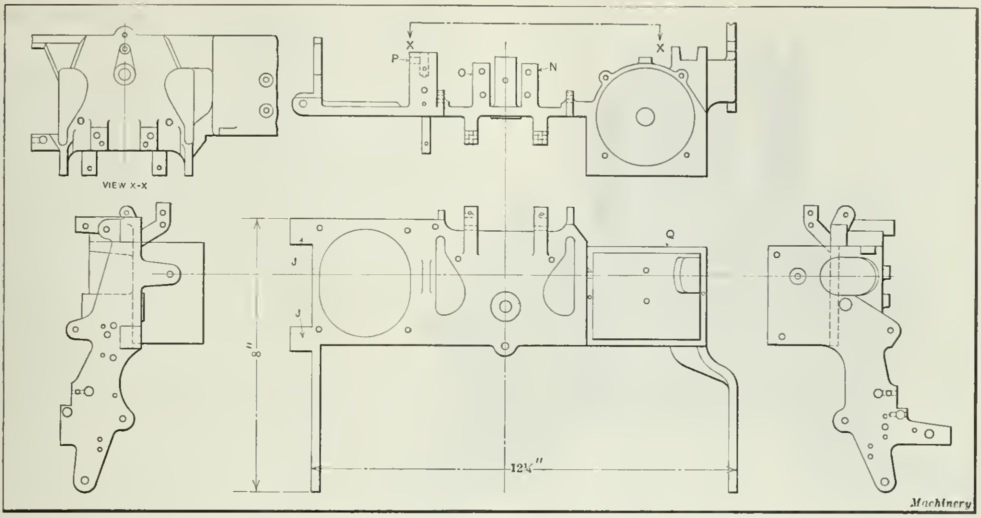


Fig. 2. Frame of Potentiometer Type of Recording Pyrometer for which the Drill Jig shown in Figs. 1 and 3 to 6, Inclusive, was designed

General Description of Drill Jig

The reference letters used in the following description of the jig refer to the same part in the different illustrations. In Fig. 1, the jig is shown with the various leaves and clamping members, except clamp *V*, in the positions occupied when the work is in place and the jig has been made ready for the drilling operation; however, the work is not shown in place in the jig. Fig. 3 shows the jig with the movable members arranged for the insertion of work, while Fig. 4 shows the jig after the work has been inserted but before the leaves have been lowered. Assembly views of the jig are shown in Figs. 5 and 6, but as they are the original designs which were not strictly adhered to in the making of the jig, they do not entirely agree with the jig as shown in the other illustrations. Nevertheless, the general design is sufficiently similar to be of value in connection with the description.

When placed in the jig, the work rests upon surfaces *C*, *D*, *E*, *F*, *G*, and *H*. Link *I* is then lowered and clamped in place by means of the knurled nut on a screw projecting from the side of link *I*, which operates in the slot on the right-hand end of the jig. Movement of link *I* is also prevented by means of a locking pin having a push fit. The purpose of the link is to hold down ends *J*, Fig. 2, of the casting. Clamping screws *K*, *L*, and *M* on the front of the jig are then tightened, forcing the work against the bearing surfaces at the rear provided for lugs *N*, *O*, and *P*, and surface *Q* of the work, and thus properly locating the work in that direction. Clamping screws *R* and *S* are then tightened against the legs of the work, and clamp *V* swiveled and tightened against a raised surface. Leaves *T* and *U* are next lowered and locked in place by means of pins having push fits, the pin for leaf *T* being located in a horizontal position, and that for leaf *U* in a vertical position. Leaves *A* and *B* are finally lowered and secured by means of the eye-bolt clamps at the front of the jig, and the two clamping screws on leaf *B* and that on leaf *A* are tightened against the work. A clamping screw *W*, Fig. 1, is also furnished at the back of the fixture.

The cam-operated clamp *Y* on leaf *A* is operated after all the clamping screws have been tightened. The clamping screws in each case are only tightened to bear slightly against the work, and the function of the cam-operated clamp is to hold the casting securely in place. This clamp is provided with a coil spring that regulates the pressure applied to the work, so that the pressure will not be sufficient to cause distortion of the casting, and, at the same time, the spring insures that there is enough pressure on the casting when the thickness of the latter happens to be a trifle under size. The time required for the building of this jig was 650 hours.

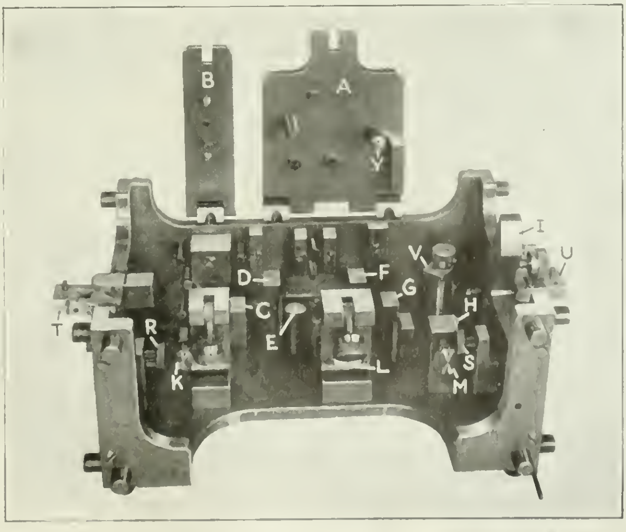


Fig. 3. Jig with Movable Members in Position to permit the Insertion of Work

Fixture for Assembling Tungsten Tip on Brass Screw

The device illustrated in Fig. 7 was designed to facilitate the assembling of the part shown at the right in the same illustration, which is a governor contact screw also employed in the construction of some of the temperature-recording instruments manufactured by the

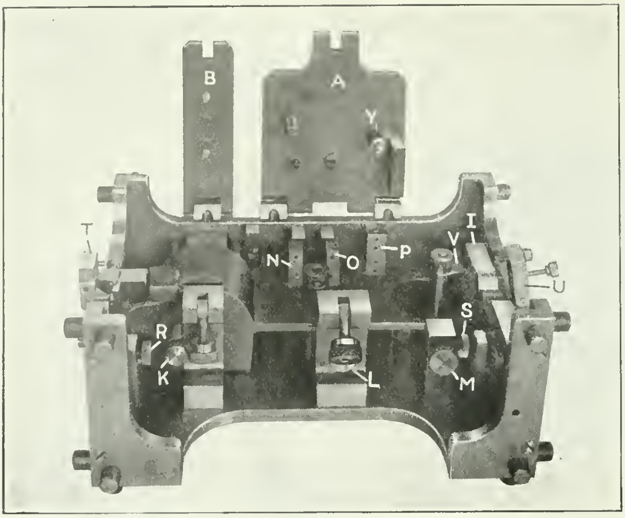


Fig. 4. Manner in which the Work is placed in the Jig

Leeds & Northrup Co. The assembling operation consists of gripping the shank of a machine steel part so tight in a hole in the lower end of the screw that the two parts will be held securely together. A small disk of tungsten is welded to the face of the machine steel part. The screw is made of brass, is a No. 8 size, and has 32 threads per inch. The head is made of hard rubber and the threads at the opposite end are turned off for a distance of about 1/16 inch from the end for the purpose of furnishing a smooth surface for the assembling operation. The shank of the machine steel part is 0.045 inch in diameter, and the diameter of the tungsten tip is 7/64 inch.

In the operation of this device, the tungsten tip is placed in the counterbored hole in the upper end of screw *A*, with the machine steel shank projecting upward. A screw with the rubber head attached is then held in an upright position in the opening of the device, with the lower end placed over the shank. Lever *B*, which is provided with three cam grooves that engage a pin contained in each of jaws *C*, is then operated in a clockwise direction, the result being that, owing to the action of the cam grooves, the three jaws are brought into contact with the screw, with such force that the shank is clamped securely in it. The device is bolted to a bench, and the assembly of screws is performed by a girl, the rate of production averaging 125 screws per hour.

It is evident that the position of the upper end of screw *A* can be adjusted so that the jaws *C* will always grip the smooth cylindrical surface on the screws. The function of plate *D* is to tie the movable parts of the device to the base. The base is made of cast iron, while the remaining parts are made of steel, jaws *C*, the circular portion of lever *B*, and screw *A*, being hardened. The outer end of lever *B* is provided with a wooden grip. After the device had been used for some time, a stop-pin was located in the base to stop the movement of lever *B* at a certain point so that jaws *C* would not be forced against the screws sufficiently to punch holes entirely through the brass wall surrounding the machine steel shanks.

Prior to the development of the assembling method described, the tungsten tips were brazed to the screw, but this method was decidedly unsatisfactory because in the operation the brass screws became burned, and the threads at the brazed ends covered with a hard coating of borax. The latter material was used in the brazing operation to protect the metal from oxidation and to dissolve the oxides formed. In order to remove the borax coating, it was necessary to dip the screws in acid, and run a die over the end threads. When this assembling method was employed, the production was only fifteen per hour and the number of screws rejected amounted to approximately 15 per cent, whereas by using the device described in the foregoing, the screws are assembled uniformly and the rejection is less than 1 per cent.

* * *

CUTTING A STEEL RISER WITH AN OXY-ACETYLENE FLAME

An unusually severe task recently performed by the use of the oxy-acetylene flame was the removal of a 44-inch square riser from a steel casting in the Attica, Ind., shops of the National Car Coupler Co. The operation was rendered especially difficult on account of the riser being in an upright position, which necessitated the taking of a horizontal cut. The procedure followed by the operator was to first cut the corners of the riser at a point close to where it was attached to the casting, so as to reduce the cross-section at this point. This operation was repeated until the cross-section was reduced to such a small area that it could be easily cut through.

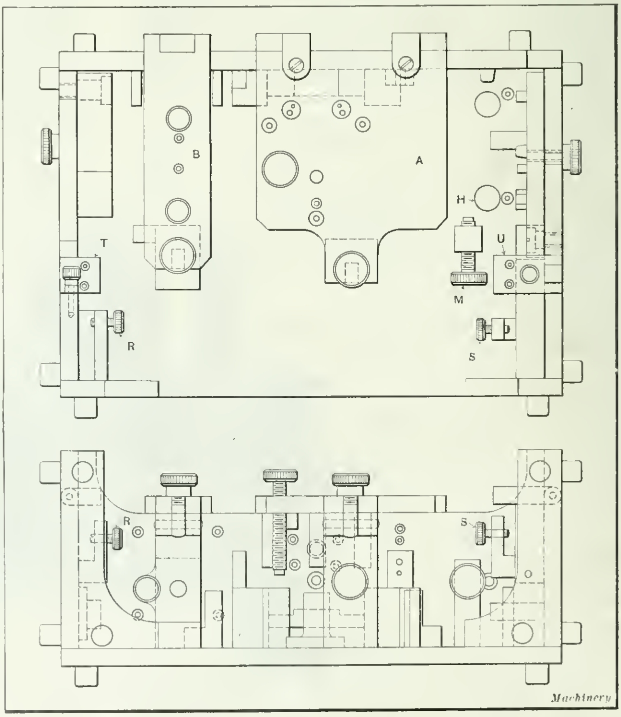


Fig. 5. Original Design of Jig for drilling Pyrometer Frame

THE KJELLBERG PROCESS OF ELECTRIC ARC WELDING

In electric arc welding processes, before the introduction of the wire electrode method, it was usual to fuse together the metal of the object being welded and the metal added by means of an electric arc formed between a carbon electrode and the object. For this purpose, a carbon rod or electrode, held in a suitable holder, is applied to the object in such a way that an arc is struck and the metal to be added, which may be in the form of a rod or otherwise, is fused by the arc simultaneously with the object, thereby producing a more or less perfect weld. In this method no provision is made for preventing the contamination of the weld by carbon from the electrode, nor oxidation by the oxygen of the air, so that the weld obtained is so hard that it cannot be machined.

In the Kjellberg process the disadvantage referred to has been overcome. With this process a steel rod is used as an electrode, instead of the usual carbon rod. In itself, the use of a steel rod as an electrode is not new, and the result obtained with such a rod, by the ordinary method, is not much better than that obtained with carbon electrodes. In the Kjellberg process, however, the steel rod is covered with a coating or sleeve of normally non-conducting materials, that is to say, conductors of the second class, the function of the cover being to direct the metal where it is required, to protect the fused metal from oxidation, and to make up the loss in the arc of certain constituents of the iron or steel forming the object.

In carrying out the process, the covered rod is held in a clip or holder connected to a continuous current supply, and forms the positive pole, the object forming the negative, though in some cases the polarity is reversed; also every phase and frequency of alternating current can be used. The covering is removed from the end of the rod to enable the current to pass, and an arc is struck between the rod and the object. As soon as the arc is struck, a portion of the metal of the object, having an area approximately equal to the section of the rod, fuses, together with metal from the end of the rods, and at the same time the covering, which is of a friable nature, partly fuses and breaks away at the same rate as the metal of the rod is deposited. In this way metal can be gradually deposited on an object until a sufficient quantity has been obtained for the purpose required. From time to time the deposited metal can be mechanically forged, so as to consolidate it in exactly the same way as a weld made in the fire.

A further advantage of the covering on the rod is that the tensile strength of the weld can be varied within certain limits to suit the purpose required. For example, by this process the weld may have a tensile strength of from 20 to 35 tons per square inch. It is possible also to obtain various degrees of hardness merely by altering the composition of the covering. The use of welding rods, covered in accordance with Kjellberg's patent, has rendered it possible to do a large amount of work that could not be successfully undertaken before. As the metal is deposited in small quantities and the heat is localized within a very small area, the danger of setting up internal stresses is reduced to a minimum. There is no limit to the size of the work that can be welded, which constitutes a very important difference as compared with oxy-acetylene gas welding.

The Kjellberg system of electric arc welding is the latest system to receive the approval of Lloyd's Register for use in the construction of ships' hulls. This system is practised in England by the Anglo-Swedish Electric Welding Co., Ltd., London. Some particulars of the early work carried out by this system have been published in the *Engineer*. In these articles Mr. Kjellberg's views on the application of electric arc welding to shipbuilding were given.

So far this system has been chiefly used for repair work in connection with boilers, but it is equally applicable to new construction, and having now obtained the approval of Lloyd's Register, no doubt constructional work will be undertaken where and when opportunity arises. The Anglo-Swedish Electric Welding Co. has recently completed what is said to be the first marine boiler constructed in England in which most of the joints have been welded instead of riveted. This boiler is of the usual marine type, having three furnaces, and it was especially designed for welded joints. It is 15 feet 6 inches in diameter and carries a working pressure of 180 pounds per square inch. The joints between the shell and the end plates are welded, as are also the joints of the combustion chambers, there being a total length of welding of about 500 feet. The boiler was found to be absolutely tight in a hydraulic test at 360 pounds per square inch, without any touching up being required. The steam trials were equally satisfactory, and the boiler has now been under steam for some time.

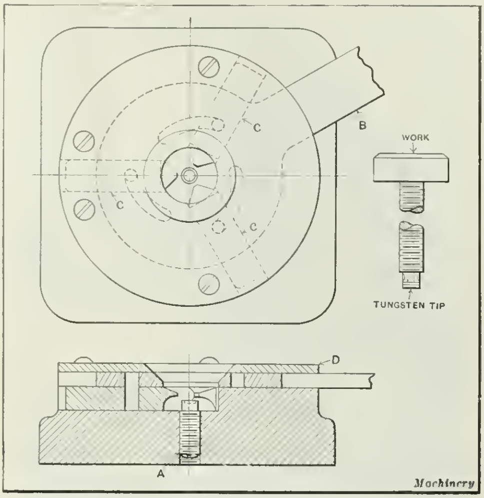


Fig. 7. Device employed to clamp Tungsten Tips to Brass Screws

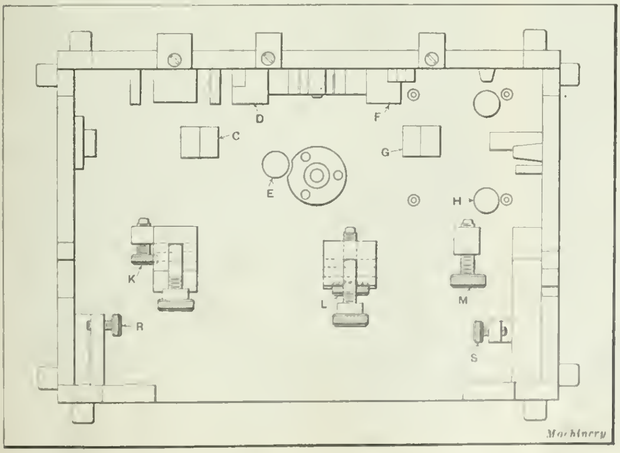


Fig. 6. Plan View of Original Design shown in Fig. 5 but with All Leaves removed

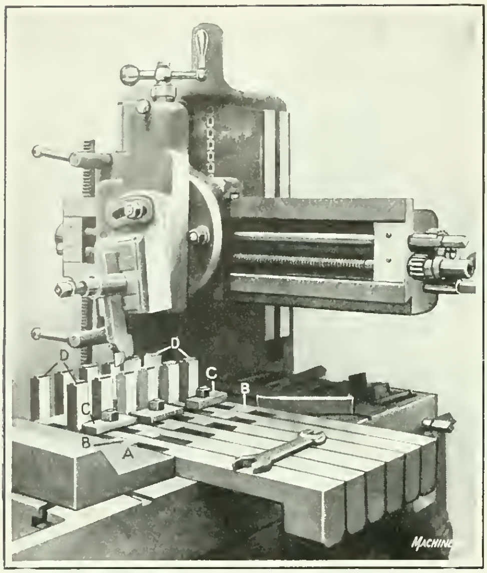


Fig. 1. Rough-planing Operation on Vertical Faces of Front-slide Carriage Links for Lathes

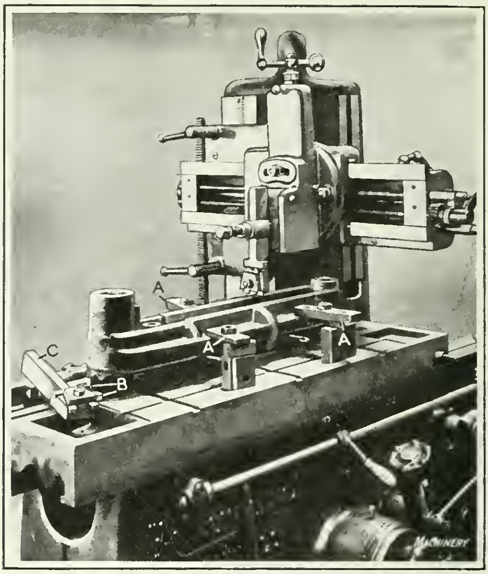


Fig. 2. Finish-planing the Slot of a Crank-arm for a Coulter Open-side Shaping Planer

Results Obtained with Crank-driven Planers

Methods of Operating Machines Possessing Features of Both the Planer and Shaper

By EDWARD K. HAMMOND

FOR use in machining small and medium size pieces, the Cincinnati Shaper Co., Cincinnati, Ohio, builds what is known as a "crank planer"; and a machine known as the Coulter open-side shaping planer, which is equipped with the crank driving mechanism used on shapers, is built by the Automatic Machine Co., Bridgeport, Conn. There also are several other machine tool builders engaged in the manufacture of similar machines which are adapted for about the range of work that is handled on the equipments which have been specifically mentioned. In this article, an outline will be given of the methods used in a number of well-known manufacturing plants in tooling up machines of this type and in operating them on repetition work.

It is claimed for the shaper of standard design that it is adapted for handling many of the same classes of work that might be done on a planer. Advocates of the shaper also call attention to the fact that for those jobs which come within its range, reductions of production costs are effected through the possibility of doing the work on a machine that represents a lower initial investment and against which a proportionately smaller overhead must be charged; also, that such a machine occupies less floor space in the shop, and that it can often be satisfactorily operated by a less experienced and lower priced workman than is required to take charge of a planer.

For work that comes within its capacity, the crank-driven planer gives satisfactory results, both as regards the quality of workmanship and the rate of production. The crank drive affords positive control of the stroke, and it is a simple matter to adjust the length of stroke as required. In the present article, descriptions are given of the methods of equipping and operating machines of this type for the performance of typical operations on production work.

For the so-called crank planers, it is claimed that they possess the strength, rigidity, power, ample capacity, and ability to perform accurate work which are well-known characteristics of the planer, and added to these features there are speed of operation, positive control of the length of stroke, and various other labor-saving characteristics of the shaper. An important advantage of this type of machine arises from the possibility of positioning the platen under the tool, without in any way altering the length of stroke. This makes it possible to cover a surface more than twice the length of stroke, and is frequently taken advantage of in planing two surfaces located some distance from each other on a piece of work, without requiring a second setting. Where such a procedure is followed, the work is first planed at one end, and then the other end is brought under the tool, ready for completing the operation. Still another distinctive feature of a crank planer is that the method of driving affords an accelerated cutting speed, the rate of travel of the work under the tool attaining a maximum near the center of the work and being reduced to zero at the point of reversal. This accounts for higher cutting speeds being employed than on an ordinary planer, because the work is permitted to gradually attain its maximum speed in passing under the cutting tool and then to have its rate of travel decelerated prior to reaching the point of reversal.

In the performance of planing operations, these crank planers are in the same class as the short-bed lathes which have fully demonstrated their practicability as manufacturing machines for the handling of small and medium sized pieces, which would otherwise have to be set up on lathes having far more capacity than is required by the work. With this introductory statement concerning the advantages which may result from the use of medium sized planers of this kind, a description will be given of a number of specific operations handled on such machines, in order that the reader may visualize the methods that are used and the rates of output that are attained.

Planing Links for Front-slide Automatic Lathe Carriages

Front-slide carriage links for use on automatic threading lathes built by the Automatic Machine Co., have a forked end which has to be planed on the inside and bottom; and it is also required to machine the top of each arm of the fork to the form shown in Fig. 1. The links are finished all over on this machine, and previous to the set-up shown in the illustration, they have been planed on their sides and base, and these surfaces are utilized as locating points. Referring to the illustration, it will be noticed that an end-stop *A* is secured to the Coulter open-side shaping planer table, and owing to the form of the work, it is necessary to use parallel spacing blocks *B* between adjacent pieces, in order to provide for squaring them up with the line of travel of the planer table.

With a preliminary location obtained in this way, the pieces of work are held back against stop *A* by means of bolts (not shown) which apply pressure behind the last piece of work. Then, the work is held down by means of straps *C*. It will be noticed that as they are set up on this machine, the ends of these pieces of work overhang for a considerable distance beyond the table, and for this reason the open-side feature of the Coulter planer is the means of enabling a job of this kind to be easily handled, when it would otherwise exceed the planer's capacity.

The inner sides of forks *D* on the work are rough- and finish-planed with side tools, one of which is shown in operation; and it will be seen that the tool-box has been set over at an angle, in order to afford clearance for the tool as it is fed down the vertical face of the work. The three top faces of each arm of the fork, and the bottom of the space between the two arms are rough-planed with a diamond-point tool, after which the top faces of each arm, including the tongue and the space between the arm, are finish-planed with a square-nosed tool 7/16 inch in width. As shown in the illustration, there are six pieces of work set up on the machine for planing, and two hours are required to set up and perform the necessary sequence of operations on this number of links. The dimensions of the work are held within limits of + 0.001 inch and — 0.

Planing the Slot in Coulter Shaping Planer Crank-arms

Mention has previously been made of the fact that the reciprocating movement of the Coulter open-side shaping planer table is accomplished by a shaper crank mechanism. Fig. 2 illustrates one of the crank-arms for this purpose, which is set up on the table of an open-side planer used in the Automatic Machine Co.'s plant for machining the top surface of this piece, and the side walls and bottom of the crank slot. From the illustration it will be apparent that there is a bearing boss at each end of the crank-arm, both sides of which have been previously faced on a milling machine, and these finished faces of the bosses are utilized as locating points for setting up the work. It will be apparent that the method of clamping is quite simple, consisting of two straps *A* on each side and an end-stop *B* to support the tool thrust. It is necessary to have the slot centrally located with the sides of the casting, and square with the faces of the bosses. The bearing holes at each end of the arm are bored after the slot has been finished, the slot being used for locating the work on a horizontal boring mill, so as to get the holes central with it.

With the work set up as described, the first step is to rough-plane the top surface of the crank-arm, a diamond-point tool being used for this purpose, after which a square-nosed finishing tool 7/16 inch in width is employed for taking a second cut over the same surface. Next, the sides and bottom of the crank slot are roughed with a double-pointed tool of the form that is best shown lying on the bed of the planer at *C*. In this connection, attention is called to the fact that the faces to be planed at the bottom of the slot are only ½ inch in width, and each of the tool bits carried by this duplex tool-holder is ⅝ inch wide, so that the tools may be fed straight down the sides of the slot to finish both these side faces and the bottoms, no horizontal feed movement of the tool-holder being necessary. A similar tool is used for taking the finishing cut. This piece of work is 31 inches long and weighs 150 pounds.

Particular attention is called to the fact that the clearance space at each end of the slot is quite short, and that there is a solid metal obstruction against which the tool would strike, if the control of the stroke could not be depended upon to prevent the occurrence of such an accident. Hence, the accurate stroke control which is available on a machine of this kind is one of its useful features in performing this operation. On this job, it is required to plane the slot within limits of ± 0.0005 inch, and to complete this operation with such a degree of accuracy, the production time is one hour per crank.

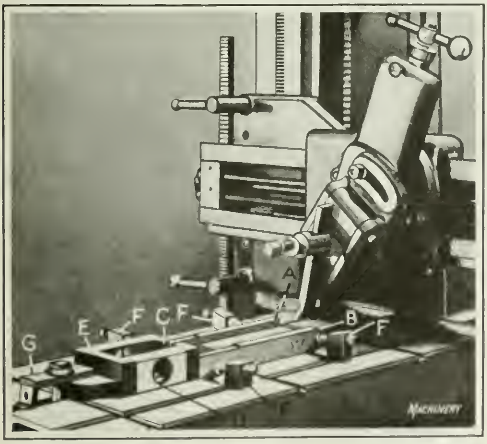


Fig. 3. Finish-planing the Inclined Side of a Dovetailed Bearing for the Slide of a Lathe built by the Automatic Machine Co.

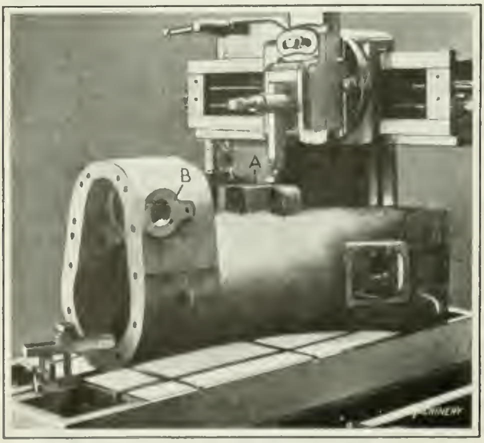


Fig. 4. Finish-planing the Valve Stem Guide in a Gas Engine Cylinder Casting. Four Other Faces are rough- and finish-planed

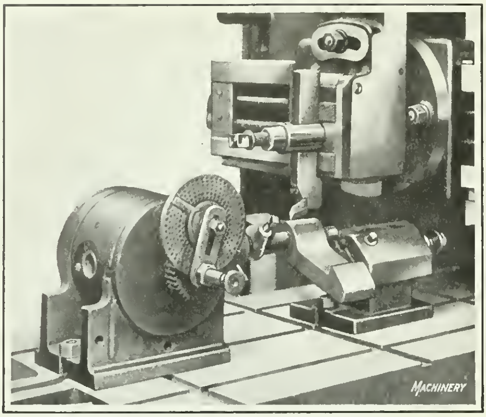


Fig. 5. Finish-planing a Cylindrical Surface with a Diamond-point Tool, to which the Work is fed by a Rotary Movement

Planing Slide for Taper Threading Lathe

In the performance of planing operations, it quite frequently happens that there are several surfaces to be machined on the same piece of work. When such work is of considerable length and the surfaces to be planed are relatively short, it would not be economical to operate the planer on a length of stroke that would provide for reaching all of the different surfaces. Too much time would be lost through having the tool "cut air," which is the term frequently applied by planer operators to the non-productive period of the stroke. Fig. 3 illustrates the use of a Coulter open-side shaping planer in the Automatic Machine Co.'s plant, for handling a job on which there are several short surfaces to finish on a single piece, and for the performance of the required operations, use is made of the stroke adjustment that is provided on this planer, and of the provision made for regulating the position at which the table reciprocates back and forth under the cutting tool.

On this job, the work is a slide casting for an automatic taper threading lathe, and the operations to be performed consist of planing the two inclined sides and the bottom of dovetailed bearing *A* and the top *B* of the work at this point, planing the sides and bottom of slot *C* and planing the face of a boss *D* at each side of the work; also, the top face *E* of the enlarged section of the work has to be planed. In order to save time that would be lost through employing an excessive length of stroke, the stroke adjustment is employed to first provide for taking cuts over the dovetailed bearing *A* and the top face *B*; then, both the length of stroke and the position of the table are changed, so that the work will reciprocate back and forth under the tool to provide for planing opening *C*, bosses *D*, and top face *E*. This possibility of adjusting both the length and position of the stroke without disturbing the work saves time and danger of inaccuracy due to incorrect resetting of the job.

Method of Clamping the Work

In so far as the actual planing operations are concerned, there is nothing particularly unusual, and the same is true of the method of setting up the work. It will be noticed that four stops *F* are set in T-slots on the planer table, and screws carried by these stops apply pressure to fingers or so-called "butters," which are inclined downward, so that they not only apply side pressure but are also effective in preventing the work from rising from the table. A strap *G* at the end of the work serves the double purpose of holding down the casting and preventing the pressure of the tool from causing it to shift laterally on the table.

In conformity with usual practice, care is taken to have the dovetailed bearing *A* and the slot *C* planed so that they are centrally located in relation to the outside of the work. For this purpose, the casting must be set up exactly parallel with the line of table travel, which is accomplished by gaging from the edge of the table; and then, the positions of the tools are regulated for taking successive cuts, so that the various surfaces will be properly located after performing the finish-planing operation. All horizontal surfaces are rough-planed with diamond-point tools, and finished with square-nosed tools 7/16 inch in width. Side tools are employed for rough- and finish-planing the vertical faces, and suitable dovetailing tools perform the rough- and finish-planing operations in the bearing, as shown in the illustration. On this job the work is required to be accurate to gages, and the total time for setting up and planing all of the surfaces which have been mentioned is 1½ hours.

Planing Pads on a Gas Engine Cylinder

A statement was made in the introduction to this article that crank planers are especially adapted for the performance of small and medium sized work, but in certain cases it will be found advantageous to plane quite large castings or forgings on a machine of this kind. A case in point is illustrated in Fig. 4, where the cylinder for a 7½- by 9-inch gas engine is set up to provide for planing the faces of five small pads, two of which are shown at *A* and *B*. The close proximity of some faces to be planed to shoulders on the work makes this an undesirable job for the planer, especially in view of the fact that it is impossible to string up a number of castings with a view to expediting production. As only one casting can be planed at a time, the small crank planer has an advantage over a larger type of machine for reasons previously mentioned.

As compared with a shaper of standard design, the advantage of the crank planer is that the work can be placed directly upon the table, instead of requiring a special cradle fixture. Handled on the Coulter open-side shaping planer, the set-up is quite simple, consisting merely of strapping the casting down on the table. The location of this work for planing is very simple, and will be readily understood from the illustration, in conjunction with the foregoing descriptions of other jobs. Diamond-point tools are used for roughing the planed surfaces, and a 7/16-inch broad-nosed

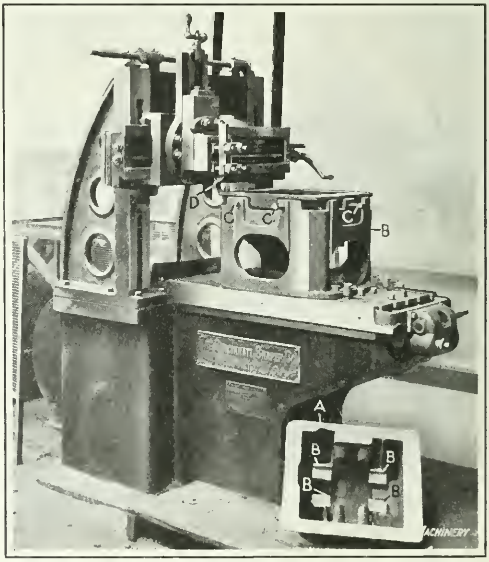


Fig. 6. Fixture for holding Avery Tractor Engine Frame for Planing Operations on Top Flange and on Bosses inside Frame

tool for taking the finishing cuts. A square-nosed slotting tool 1 inch wide is used for taking the roughing cut, and a similar tool for finishing the slot *A* for the valve stem guide, as shown in Fig. 4, these tools being of the proper width for finishing this slot at a single downward feed movement. The total time for performing the planing operations on one of these cylinder castings is one hour.

Planing a Carrier Latch-cam

Fig. 5 illustrates the way in which a pair of index-centers may be used on the Coulter open-side shaping planer to provide for the performance of a planing operation, where it is required to form a cylindrical surface. The work shown on this machine has previously been roughed out from solid stock, and is here illustrated during the process of finishing the cylindrical surface with a diamond-point tool, using the index-centers for continuously rotating the work as it reciprocates back and forth under the tool. This finishing operation requires fifteen minutes, and the present example will give the reader an idea of the utility of this machine for handling unusual operations, when suitable fixtures are employed to supplement the standard movements provided on the machine.

Planing Frames for Avery Tractor Engines

At the Avery Co.'s tractor engine plant in Milwaukee, Wis., there are frame castings to be machined which are of the form shown in the foreground of Fig. 6. These castings have a flange *A* that has to be planed, and there are also four brackets *B* which have to be faced on their vertical and horizontal surfaces, these brackets being located inside the casting at a distance of several inches below the face of flange *A*. If it were simply necessary to face off the flange, any experienced mechanic would regard this as a typical job for a planer or a planer type of milling machine; but owing to the necessity of also finishing brackets *B*, the planning department decided to handle the entire job on a crank planer built by the Cincinnati Shaper Co., of Cincinnati, Ohio.

A machine of this type is peculiarly adapted for working on the four brackets inside the casting, owing to the accurate stroke control that can be obtained. Also, as only one casting can be set up at a time, a crank planer has ample capacity for the job, and does not occupy a large amount of floor space without giving any additional return in the way of a higher rate of output. Hence, it is better adapted than a planer for performing an operation of this kind. As it was considered desirable to machine the surfaces of brackets *B* on the crank planer, the face of flange *A* is also planed while the work is set up, thus saving the time of making a second setting, which more than offsets the greater productive capacity that would be secured through finishing the flange *A* on a planer, where a string of pieces could be set up to pass successively under the planer tool. It will be seen that a fixture is provided on the crank planer for holding the work, this fixture being of the so-called box form, so that the casting may be dropped into place and supported by the under side of flange *A*. Clamping is accomplished by means of screws *C* which extend through the wall of the fixture near the top and engage the sides of the casting.

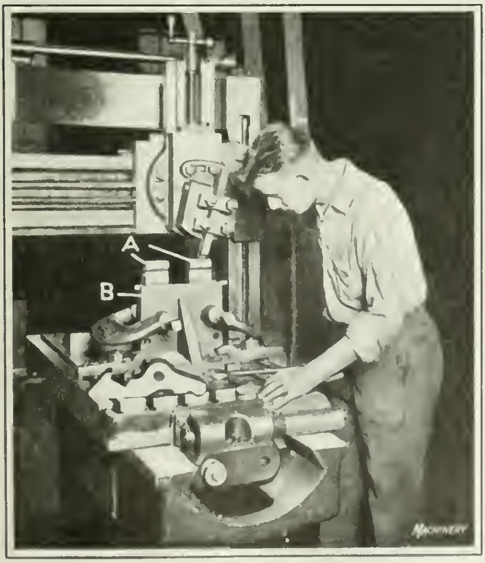


Fig. 7. Performing a Final Finish-planing Operation on Forged Nickel Steel Latches, after completing Preliminary Work

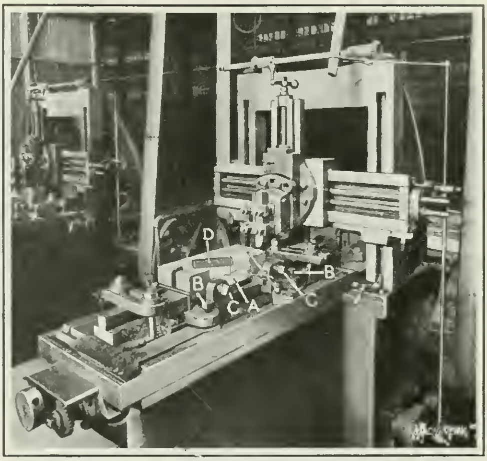


Fig. 8. Use of the Crank Planer in Chicago, Rock Island & Pacific Railway Shops for planing Locomotive Shoes and Wedges

There is nothing unusual about the actual operations performed on these castings. On flange *A* a round-nosed tool is used for taking a roughing cut, and the finishing cut is taken with a square-nosed tool *D* of the gooseneck form, which enables a very smooth finish to be obtained. A roughing cut is taken at a speed of 45 feet per minute with a feed of 3/16 inch; and for the finishing cut, the same speed is employed with a feed of ¾ inch, the amount of metal removed by the finishing cut being 0.015 inch. The same sequence of operations is performed under similar conditions on the horizontal and vertical faces of brackets *B*, except that an unusually large and stiff tool is employed, which extends down sufficiently from the tool-block on the rail head of the crank planer, so that it can reach the surfaces that are to be planed. Large heavy tools of this kind are stiff enough to operate without leaving chatter marks on the work. On this job the rate of production is approximately twelve pieces in an eight-hour day.

Machining Forged Nickel Steel Latches on the Crank Planer

At the Johnston & Jennings Co.'s plant in Cleveland, Ohio, Cincinnati crank planers are used for the performance of various machining operations involved in the execution of contracts for the quantity production of finished forgings. In Fig. 7 is shown an operation incident to the manufacture of a certain type of latch made of forged nickel steel. In making these pieces, the method of procedure is to first forge and then plane on the crank planer a strip of the required form, which is next cut up transversely to make the latch blanks. These blanks then have their hubs turned

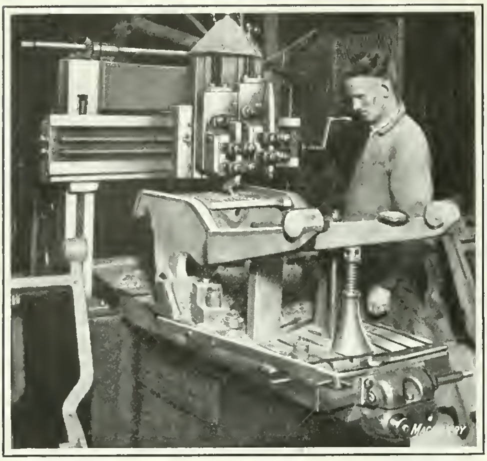


Fig. 9. Use of the Crank Planer by the Chandler & Price Co. for handling a Production Job

and bored, after which they are returned to the Cincinnati crank planers for the finishing operations. In the illustration, it will be seen that two latches *A* are held on an angle fixture *B* by means of C-clamps, to provide for beveling the two corners at one end of each latch. Evidently, the efficient performance of such an operation requires the crank planer to be worked on a short stroke, in order to reduce to a minimum the idle period which occurs between the performance of each cutting stroke and the return of the table to its starting position.

Planing Shoes and Wedges on the Crank Planer

In railway machine shops where locomotive engines are being overhauled, one operation of frequent occurrence is the machining of the shoes and wedges that hold the driving-boxes in place between the jaws of the engine frame. Men who are familiar with this work know that the shoes and wedges are employed to provide an adjustment that takes up side play between each driving-box and the frame. In the performance of such maintenance work on engines, the fitting of these members involves laying out the shoes and wedges to fit properly between the refinished driving-box and the jaws of the engine frame, so that the correct adjustment will be obtained.

In Fig. 8 is shown a Cincinnati crank planer at the Chicago, Rock Island & Pacific Railway's shops at Silvis, Ill., where it is used for planing shoes and wedges. Before being sent to this machine, each piece of work has been carefully laid out in the manner described, and during this process, three locating points are center-punched in chalk marks *A*, two at one side and one at the opposite side of the work. Then, when the piece comes to the crank planer, it is set in position and leveled up with a surface gage, using these center-punch marks as reference points, so that the work can be leveled by means of screws *B* provided for that purpose at each corner of the fixture. The work is held in the fixture by screws *C* that engage it at the sides, and it will be noticed that the fixture is secured to the planer table by straps, an end-stop being furnished to support the thrust of the tool. In the performance of this operation, the steel castings are planed with a cut ¼ inch deep, at a speed of 28 strokes per minute, the rate of feed being 1/16 inch per stroke. Gage *D* is set the proper distance from the center-punched mark to the planed top surface of the work, and shows when the piece has been finished to the correct size.

Planing Printing Press Platens on the Crank Planer

In Fig. 9 is shown a 28-inch widened pattern crank planer built by the Cincinnati Shaper Co., that is equipped with two tool-heads, one of which carries the roughing and the other the finishing tool. This machine is employed upon the planing of platens for printing presses. These pieces of work vary in size, but the largest requires the full 28 inches capacity between the housings of the crank planer on which the job is handled. It is a piece of this size which is shown in the accompanying illustration, and the production figures that will subsequently be quoted refer to the machining of such work.

In the performance of the rough-planing operation on the work, the tool is first fed down to depth and then across the piece. It is followed by a finishing tool which is fed down to depth, thus finishing the edge at one side, then across the work, and finally the tool is once more fed down on the opposite side to finish the left-hand edge of the work. In performing the finish-planing operation, the cross-feed is approximately 0.125 inch per stroke.

For rough-planing, approximately ¼ inch of metal is removed at the same rate of feed. For the performance of both roughing and finishing operations, the machine is operated on an average of twenty-eight strokes per minute. As the finished surfaces of the edges are only about 2 inches deep, downward feed in most cases is operated by hand, although power feed can be used for this purpose. The minimum amount of metal is removed by the finishing cut, as it is required to get as perfect a surface as possible. Even minute inequalities are reflected in the printing; consequently, the work is carefully tested in the inspection department to assure having a good bearing, as proved with a surface plate and red lead. The average size of the surface to be planed on these pieces is 12 by 22 inches, and the average production of castings of this size is 13 in an eight-hour working day.

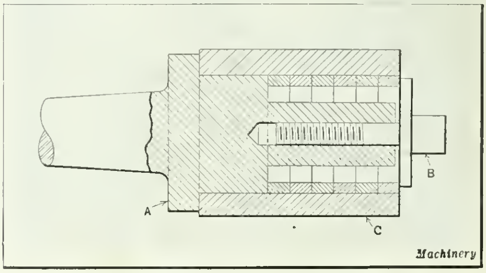
* * *

PISTON-RING CHUCK

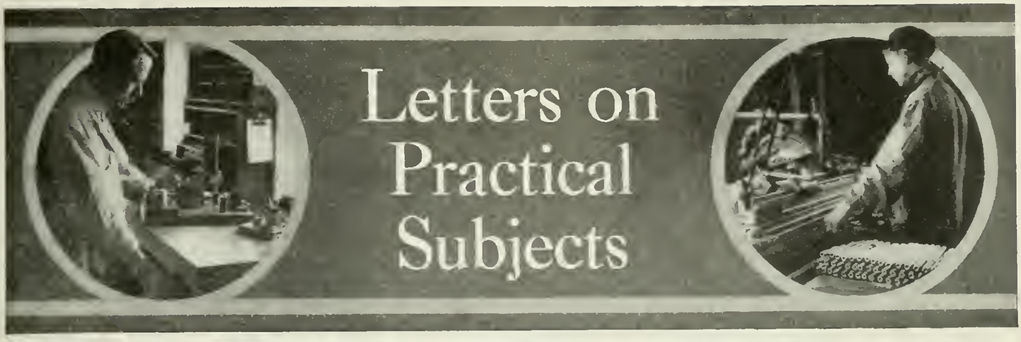
By HARRY MOORE

The piston-ring chuck here shown was provided with a taper shank so that it could be held in the spindle of a cylindrical grinding machine. This chuck was used with excellent results in performing grinding operations on the peripheries or surfaces of the rings which bear against the cylinder walls. The end of the arbor or chuck *A* was turned as shown, and tapped to receive the tightening screw *B*. The sleeve *C* for locating the rings concentric with the machine spindle was made of sufficient length to cover six rings when seated on the shoulder of the chuck as shown in the illustration.

The rings are pressed into locating collar *C*, one by one, until they are all in place, then the screw *B* is inserted and tightened, after which sleeve *C* is removed, leaving the rings clamped in place, concentric with the spindle, ready for grinding. A slight taper or chamfer was given the end of the bore in sleeve *C* to facilitate the insertion of the rings, and the outside of this member was knurled in order to afford a better grip for twisting or wringing it off the piston-rings.



Piston-ring Chuck with Centering Collar



Letters on Practical Subjects

MAKING A RELIEVED GEAR-CUTTER ON A MILLING MACHINE

Twenty racks of 10 pitch, each having 16 teeth, were required to be cut in 2-inch round bars. The pitch line was 0.6625 inch below the outside surface of the bar thus necessitating the use of a special cutter of large diameter, to permit cutting to the required depth without the arbor interfering with the work. Only one cutter large enough for the work was available, and this was required on regular work. As the racks were urgently needed, the delivery of a gear-cutter from the cutter manufacturer was out of the question, so far as the job in hand was concerned. However in less than a day and a half, not a mere cutter, but a five-toothed hob, of ample diameter, was made from a fine quality of high-speed steel and placed at work on the rush job. This hob was properly relieved for grinding on the face in the regular way. The manner in which the hob or cutter was made is described in the following:

Two blanks were turned up, and the first one was gashed or fluted and then cut with the cutter in stock, on the milling machine, employing the set-up shown in Fig. 1. The hob *E*, Fig. 2, produced in this way of course had teeth of an internal or inverted form. After hardening and grinding, this hob was placed on the milling machine spindle. The second blank (which was fluted at the same time as the first) was put on the arbor of the dividing head, as shown in Fig. 1. The hob milled in this operation is shown at *F*, Fig. 2. This hob has teeth of the same form as those of the standard cutter, and was therefore the one employed in cutting the racks. The hobs and arbors employed are shown in Fig. 2. Arbor *A* is the cutter-arbor used in the milling machine spindle. The blanks, while being cut and relieved, were held on arbor *B*, which was inserted in the dividing-head spindle. It will be noticed that this arbor has an eccentric part *C*, on which the blank is placed; also that there is a small locating pin *D* near the outer edge of the large flange, at the lower side. This pin is used for locating the successive teeth of the hob during the relieving operation.

In performing the relieving operation, the blank is placed on the eccentric arbor, where it is located by the pin previously referred to and held in place by a nut on the end of the arbor. The cutting and relieving of the tooth form are performed simultaneously, by turning the dividing-head crank until one tooth is cut through to the next flute. The relieving is accomplished by the throw, or upward travel, of the blank resulting from the eccentric mounting of the blank on the arbor. The amount of relief may be governed by positioning the arbor in the dividing head. When one tooth is cut, the blank is loosened and set around by hand for the next tooth, this operation being repeated until the teeth are all cut.

Springfield, Vt. O. S. Marshall

ROLLING RACK TEETH

A number of white metal racks of 12 diametral pitch were required for some small special machines. These racks were 12 inches long by $\frac{1}{2}$ by $\frac{3}{4}$ inch below the pitch line with a shroud 1/16 inch on each side of the teeth. It was originally planned to cut the rack teeth in the usual way and then form the shroud by screwing plates to the sides of the rack. A horizontal milling machine was available for this work, but as it was not equipped for cutting racks and as a rack-cutting attachment could not be obtained at once, it became necessary to devise some other method of producing the racks in order to deliver them within the specified length of time. The method employed was that of rolling the teeth instead of milling them, and this was found to give satisfactory results.

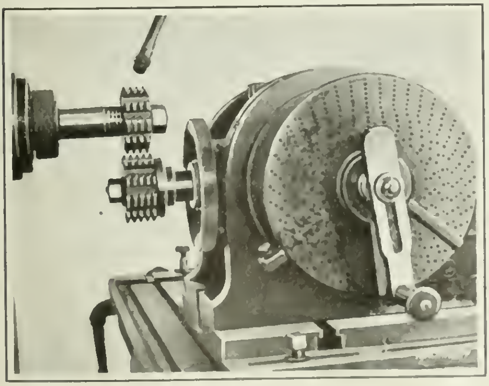


Fig. 1 Milling Machine Set-up for milling Relieved Gear-cutters

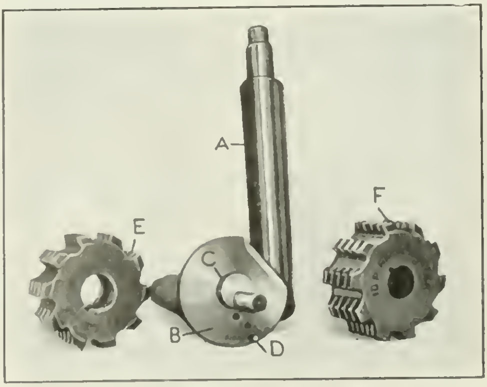
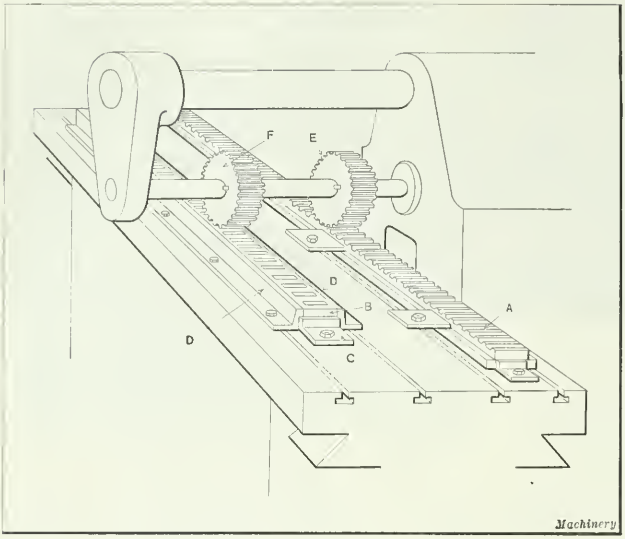


Fig 2 Arbors and Cutters used in Set-up shown in Fig 1



Milling Machine equipped for rolling Teeth in Soft Metal Bar

This was accomplished by the use of the fixtures shown in the accompanying illustration, which were mounted on a universal milling machine. By this method it was possible to complete the racks within five days instead of twenty days—the time required by the method first considered. The actual time taken in rolling the rack teeth was one day, the other four days being spent in making and setting up the tools. The set-up on the milling machine was made as follows: The rack *A* taken from an ordinary 8-inch lathe was set parallel with the milling machine table and securely bolted to it, wedges being used at both ends to prevent it from slipping on the table. The white metal bar *B*, to be rolled, was held securely to the table by angle-plates *D*, which were also set parallel with the table. These plates prevented the metal from spreading during the rolling operation, and the pieces *C* were provided to prevent the bar from becoming elongated when the die member was in operation.

To an ordinary milling machine arbor were keyed the timing gear *E*, which was of the same pitch as rack *A*, and the die member or gear *F*. This made a positive drive between the timing gear *E* and rack *A*, thus enabling motion to be transmitted to gear *F* by a feeding movement of the table. The die member *F*, being of the same pitch diameter as the timing gear, allowed blank *B* to be rolled beneath it at the correct speed. It was necessary to have a deep tooth for the timing gear and rack, so that they would be well meshed before the teeth of gear *F* came in contact with, or exerted pressure on, the white metal bar *B*. The timing gear *E* and rack *A*, which was of 6 diametral pitch, were found satisfactory in this respect, as the rack to be rolled was of 12 diametral pitch.

The back-gear of the milling machine was disconnected, leaving the arbor free to revolve. The power feed was then connected with the table, so that when the table moved forward it caused gear *E*, in mesh with rack *A*, to be revolved which, in turn, caused die member *F* to roll over the surface of bar *B*. Pressure was then applied by slightly raising the table at each forward and backward movement until the required depth of tooth was obtained. In rolling the rack teeth, some of the metal below the pitch line was naturally pressed up or made to flow above the pitch line to form the top of the tooth. Although it was not tried, there would seem to be no reason why rack teeth could not be rolled in soft metals such as brass. It would also be possible to roll herringbone, single helical, and other forms of teeth in the same manner.

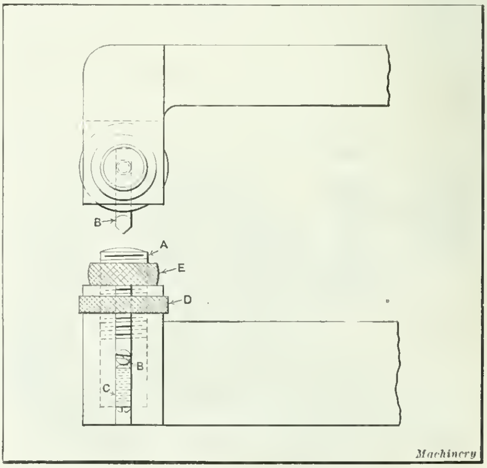
Cleveland, Ohio C. F. George

CENTERING TOOL FOR LATHE

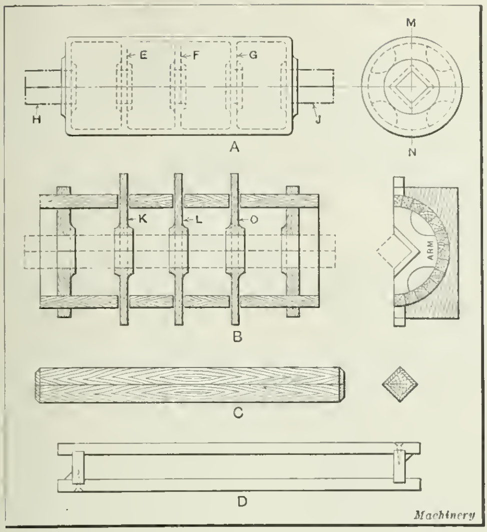
The tool shown in the accompanying illustration was designed for centering work held in the chuck jaws or on the faceplate of a lathe preparatory to drilling. With the ordinary centering tool or centering bit such as is usually held in a V-block in the toolpost, the operator is obliged to loosen or tighten the toolpost screw in order to obtain the fine adjustment necessary to center the tool properly. This method requires considerable time, and it frequently happens that the final adjustment is so imperfect that a small tip is left by the tool where a sharp conical shaped center is desired. If the centering operation is to be followed by the use of a large drill, the tip left in the center will be worn down or broken so that little harm is done, but if a small drill is to be used, a true and clean center must be produced to start with; otherwise, the drill will break or be thrown off center by the side pressure caused by the tip.

The adjustable tool-holder shown is made of 1⅛- by ¾-inch stock. The end of the holder is bent at right angles, and a hole drilled through this end to take the sliding member *A* in which the centering tool is held. This piece is threaded for about half its length as indicated, and is drilled for the 3/16-inch drill-rod centering tool or bit *B*, and tapped for the clamping screw *C*. A slot cut across the face of the holder accommodates the knurled nut *D*, which is threaded to fit part *A*. Another knurled nut *E* is also threaded to fit this piece. A vertical slot in the face of the holder permits the tool bit to be moved up and down by adjusting knurled nut *D*. When centering work, the tool-holder is clamped in the toolpost in the approximate centering position. Nut *E* is then backed away from the holder so that the tool can be raised or lowered by means of nut *D*. When located in the required centering position, nut *E* is tightened, thus locking the tool in place.

Rosemount, Montreal, Canada Harry Moore



Adjustable Centering Tool



Casting for Coiler-spool, and Core-boxes used in making the Casting

CASTINGS FOR SHEET-METAL COILER-SPOOLS

Spools for coiling sheet metal as it comes from the rolls may be made from maple-wood or from either steel, iron, or aluminum castings. Many spools designed for this work have proved unsatisfactory, due either to their failure to withstand the pressure exerted on them, their excessive weight, or the great expense entailed in their production. To overcome these objections, the writer designed the coiler-spool shown at *A* in the accompanying illustration. This spool is intended for use in coiling sheet brass as it comes from the rolls. It consists of a single hard iron casting that requires no machining. The casting must, therefore, be straight and uniform in diameter throughout its length. There must be no seams or pores on the face of the casting, and it must be light in weight to facilitate handling. It must also have sufficient strength to withstand the binding pressure of the sheet metal during the process of coiling and the tension of the sheet as it leaves the rolls. Some idea of the pressure which a coil-spool of this kind is required to withstand may be gained from the fact that a cast-steel spool, 7½ inches in diameter and 14 inches long, with a wall thickness of ¼ inch, collapsed ¼ inch in diameter when in use, an amount which made it unsuitable for sheet-metal winding.

Referring to the illustration at *A*, the square holes through the ends of the casting and through arms *E*, *F*, and *G* are required to be in line, and a loose fit over a 2-inch square shaft. To meet these requirements, it is evident that considerable care must be taken in the designing of the patterns and core-boxes, as well as in the making and drying of the cores, the making of the mold, and the setting of the cores in the mold. The pattern as designed has the same exterior form as the casting shown at *A*, with the exception that core-prints *H* and *J* were added at the ends, as indicated by the heavy dot-and-dash lines. The pattern is, of course, split lengthwise on line *MN*. The core is made in two parts, and the core-box for making the two halves that form the core is shown at *B*. The pieces *K*, *L*, and *O* are evenly spaced and set into slots cut into the sides of the box. These pieces and the ends of the box are cut away, as indicated, to receive the square piece shown at *C*. This piece is made of wood and is the same size as the auxiliary core formed by the core-box *D*.

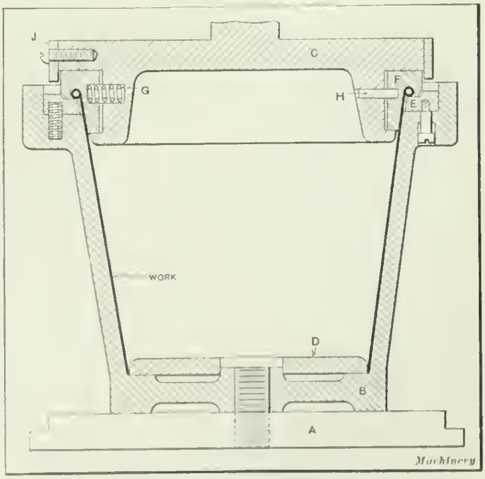
When making the core, the arms *K*, *L*, and *O*, and the piece *C*, are put in place in the box, and sand is filled in up to the top of the box, and struck off. The piece *C* and the pieces *K*, *L*, and *O* are then removed, thus completing the half-core. The openings left by the piece *C* and the arms *K*, *L* and *O* are filled with "black sand" to prevent a "drop" in the core-sand when it rests on the drier plate. When the two half-cores are baked and ready for assembling, the square core produced from core-box *D* is given a coating of paste and placed between the V-grooves in the half-cores, after which the three parts are bound together with wire, wound in the grooves which form the arms. One point which should not be overlooked in making the cores is the fact that the square holes through the center of the casting, must be in line. Therefore, the drier plates on which the half-cores are placed for drying, should be perfectly flat.

Kenosha, Wis. M. E. DUGGAN

WIRING DIE FOR WATER PAILS

Wiring operations on comparatively high pieces, such as water pails, are generally accomplished on long-stroke power presses on which the maximum distance between the lowest point of the punch and the top of the die is sufficient to permit the work to be inserted in the die, or else the operation is performed on a press having a much shorter stroke but which is provided with a die that can be slid from under the punch to enable the insertion of work. A die for wiring water pails by the latter method is shown in the accompanying illustration, the sliding of the die back and forth under the punch being accomplished by pulling or pushing slide *A* by hand. Die *B* is correctly located relative to the center of punch *C* for an operation by slide *A* coming in contact with a stop.

It will be noted that the pail is of the type in which the bottom is a separate piece from the tapered shell and that the wiring operation is performed prior to the assembly of the bottom sheet. On account of this procedure plate *D* is provided to prevent the bottom edge of the pail from curling during the wiring of the top edge. Prior to inserting a shell in the die, a previously bent wire is placed on ring *E*, the latter being in a raised position due to the action of the coil springs beneath it. The height to which this ring is raised is governed by the heads of special screws operating in counterbored holes in die *B*. After the shell has been placed in the die and the latter slid under the punch, the wiring operation is performed on the downward stroke of the press ram as sections *F* mounted on punch *C*



Die with Sectional Punch for wiring Water Pails come in contact with the top edge of the pail and force the latter and ring *E* down until the bottom of the ring rests on the die.

There are twelve sections *F*, each of which has sufficient clearance on the punch to permit a slight radial movement. Each section is provided with a coil spring *G* and a guiding pin *H*. The springs force the sections outward, so that the desired pressure will be exerted on the work when the sections come in contact with the latter, while pins *H* prevent the sections from moving circumferentially around the punch. Ring *J* serves to hold the sections on the punch and fixes the maximum expansion. In dies of this kind, it is well to make the wiring groove in each of the sections about 1/64 inch larger in diameter than the diameter of the wire plus twice the metal thickness of the pail. This permits a free and easy curling operation.

Toledo, Ohio J. Bingham

SHAPER FIXTURE FOR MACHINING A CONCAVE SURFACE

The foreman of a small experimental shop recently received rush orders for a number of parts similar to that shown in Fig. 1. These parts were to be made of cast iron and were for use in molding glass plates—a class of work that requires a highly finished mold, free from scratches, tool marks, or other irregularities that might be reproduced upon the glass. Upon investigation, it was found that the lathes and milling machine on which the parts would ordinarily be machined were in operation on work that could not be removed. A shaper, being the only available machine, was finally equipped as shown in Fig. 2, for performing the work.

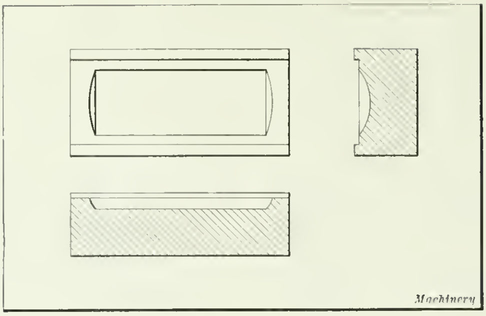


Fig. 1. Mold with Concave Surface for molding Glass Plates

A steel bar *A*, 2 inches square, with a drilled and reamed hole for stud *B* was bolted to the side of the machine over the slide ways by means of two cap-screws, one of which is shown at *C*. The holes for these cap-screws were so spaced that the screws could be inserted in the threaded holes provided for the gib-screws. A ½- by 1-inch machine-steel piece *D*, with a hole drilled and bell-mouthed as shown in Fig. 3, to allow free movement of part *E*, was made and inserted in the slot of the toolpost.

Stud *B* was turned on a bench lathe, being made a snug fit in the hole in bar *A*, so that it would oscillate freely with no play, when in operation. An oil-hole *H* was drilled in bar *A* to provide means for lubricating the bearing surface of the stud. The small end of this stud was threaded and a standard nut and washer employed to hold it in place as shown. A tapped hole was also provided for a standard set-screw *F*, which holds part *E* in place. Part *E* was made from a bar of drill rod, and was hardened and ground on the cutting end. When assembling the attachment, care is taken to adjust *E* so that the distance from the cutting point to the center of stud *B* as indicated by dimension *R* will equal the radius of the curved surface of the work. The stroke of the shaper head is first roughly adjusted in the usual way, a finer adjustment afterward being obtained by raising or lowering the head of the machine.

Fig. 3 shows how the point of the tool forms the curved surface in the work by the oscillating motion imparted to it by the forward and return stroke of the shaper ram. The dotted lines in this illustration show the positions of parts *E* and *D* at the end of the forward and return stroke, respectively. A hole was drilled and tapped in the side of the clapper-block and a small cap-screw inserted to hold the clapper-block down tight. As this arrangement causes the tool to drag on the back stroke, it is necessary to adjust the feeding pawl carefully so that it will act only upon reaching the extreme end of the return stroke; otherwise the continual backward drag would soon break the cutting edge or dislodge the tool. Such good results were obtained with this attachment, that little hand polishing was required to finish the work. J. E. L.

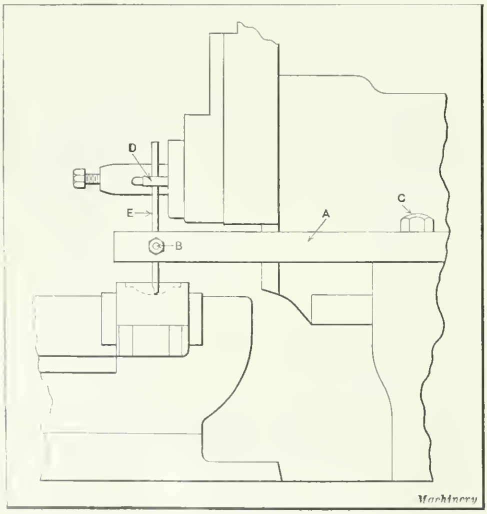


Fig. 2. Shaper equipped to machine Curved Surface of Mold shown in Fig. 1

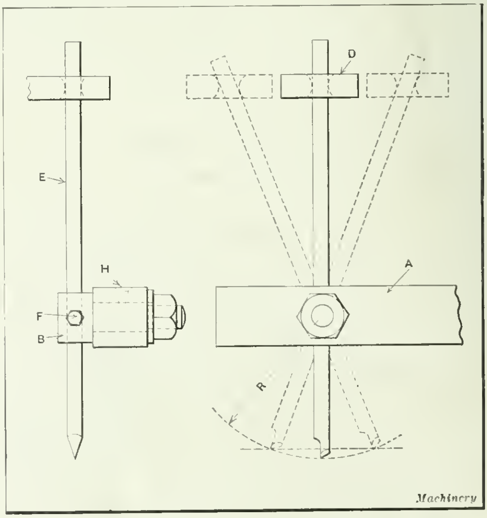


Fig. 3. Diagram showing Principle of Operation of Shaper Attachment

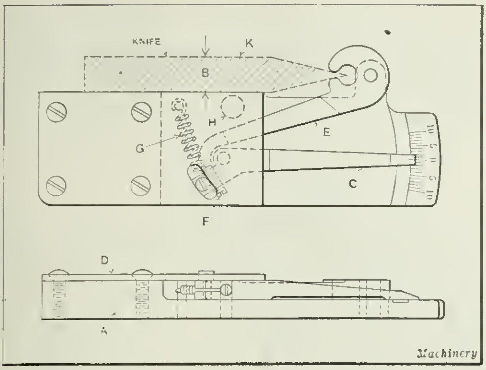


Fig. 1. Gage for testing Position of Knife Edge in Respect to Sides of Blade

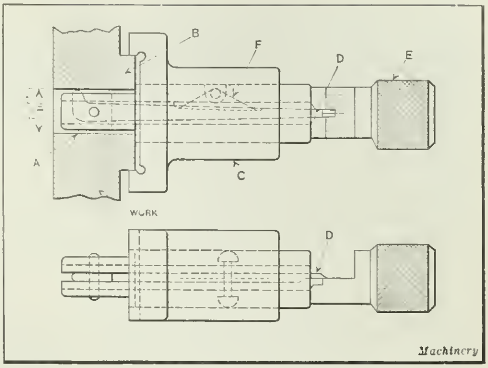


Fig. 2. Gage for testing Concentricity of Hole and its Position in Tongue

INDICATING GAGES

In Fig. 1 is shown an indicating gage for determining whether or not the cutting edge of a knife blade is located in a central position in respect to its sides. The cross-sectional shape of the knife *K* to be tested is indicated by dotted lines. The cutting edge of the knife in this particular case must be within the limits of plus or minus 0.002 inch of the center of the blade. To grind this type of knife without the aid of an indicating gage would be rather difficult, as there is no means of easily determining the amount to be ground from each side of the blade. With the aid of the indicating gage, however, the grinding becomes a comparatively simple problem.

While the gage shown is used for gaging knife blades of the shape indicated, it is not limited to this particular type of work, but may be used for gaging other work of a similar nature. The thickness *B* of the work governs the size of gage required. The base *A*, gaging lever *E*, and indicating lever *C* are made of tool steel. Cover *D* is also made of tool steel and is ground to a thickness of 3/32 inch. A master knife of the same shape as the work is made from pack-hardened machine steel for use in adjusting the gage after it has been assembled. Pack-hardened machine steel screw *F* is used for adjusting the indicating lever to zero. Spring *G* is made of 0.010-inch music wire, and stop-pin *H* which limits the travel of arm *E*, is also made of pack-hardened machine steel.

The gaging lever *E* measures 2¼ inches from the fulcrum point to the point of contact with screw *F*, held in indicating arm *C*, and ½ inch from the fulcrum point to the point of contact with the knife. This gives a lever ratio of 4½ to 1. The indicating lever *C* measures 2½ inches from the fulcrum point to the reading edge and ¼ inch from the fulcrum point to the point of contact of screw *F* on gaging lever *E*, thus giving a ratio of 10 to 1, making a total ratio of 45 to 1. Thus, if the knife blade has been ground incorrectly, and the edge is 0.001 inch off center, the indicating lever will move 0.045 inch at the reading edge. This means that the 0.001-inch graduations on the scale must be spaced 0.045 inch apart.

Another type of indicating gage for testing the concentricity of a reamed hole and its position in a tongue is shown in Fig. 2. The 7/16-inch reamed hole *A* is required to be concentric with, or at the center of, tongue *B* of the work. The holder or base *C*, the shell or plunger *E*, and the indicating lever *D* are made of tool steel. The indicating lever measures 2⅝ inches from the fulcrum point to the reading edge, and 3/16 inch from the fulcrum point to the point of contact in the reamed hole. This gives a ratio of 14 to 1. Thus if the hole is not concentric with the tongue and is exactly 0.001 inch off center, the reading edge of the indicating lever will move 0.014 inch. The 0.001-inch graduation marks on the scale must, therefore, be spaced 0.014 inch apart. A spring *F* made of 0.010-inch music wire is located in the plunger *E*, as shown, the ends of the spring resting in a groove cut in the side of indicating lever *D*.

Natick, Mass. Edwin V. Christensen

DRILLING MACHINE ATTACHMENT FOR FACE-MILLING OPERATION

The faces *A* of the inner hubs of some gray iron castings, such as shown in Fig. 1, were successfully milled on an upright drilling machine by the use of the attachment shown in Fig. 2. This attachment, consisting of a fixture and milling head, should be of particular interest to designers, as the principle upon which it is designed can be readily embodied in the design of tool equipment for similar work. A noteworthy feature of the fixture is the method of locating and holding the work, which permits rapid loading and unloading.

No clamps or similar holding devices are used. The work is simply held in place by pins *C*, no particular attention being paid to centering, as this is taken care of by the pilot *E* on the milling head. This pilot automatically enters the hole *F* before the cutters come into action, thus locating and holding the work in the proper position during the milling operation. To unload the fixture, it is simply necessary to raise the milling head until the end of pilot *E* clears the top of the work and withdraw pins *C*, so that the casting will drop out of place.

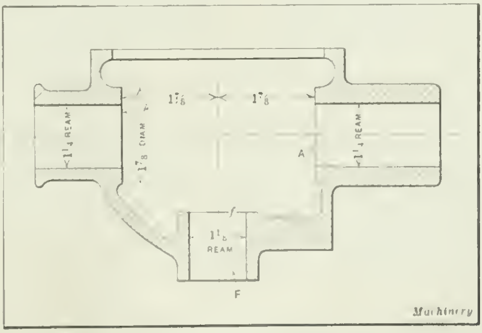


Fig. 1. Gray Iron Casting machined at A by Equipment shown in Fig. 2

The fixture consists of two main parts, part *A* being the milling head proper and *B* the base of the work-holding and guiding fixture. The fixture is of the so-called "open-front" box type and is well ribbed, and of heavy construction. Body *B* is made of cast iron, and all other parts such as pins *C* and bushings *D* are of hardened and ground steel. Flats *G* are milled on pins *C*, and headless set-screws located at the front of the fixture hubs, and extending through the bushings, act as stops which prevent the pins from being completely withdrawn from the fixture. This obviates the possibility of the pins dropping out of place and being lost in the tool-crib. The upper portion of the fixture, which guides the milling head, is of rectangular shape. A cap, not shown, is fitted to the front face. This cap has hardened steel guide plates on each corner similar to those shown on the corners at *H*, in contact with part *A*. These plates are the only parts of the fixture which come in contact with the milling head.

The milling head is of simple but rigid construction. The body *A* is made in one piece from a machine-steel forging. The cutters *S*, which are of special design, are made from high-speed steel. They are keyed to arbor *I* by standard keys, not shown in the illustration. All gears, bushings, etc., are hardened, ground, and carefully fitted in place to insure accuracy and long wearing properties. The driving shaft *J* has a taper shank which fits the drilling machine spindle and is doweled in place to prevent it from falling out due to the weight of the milling head.

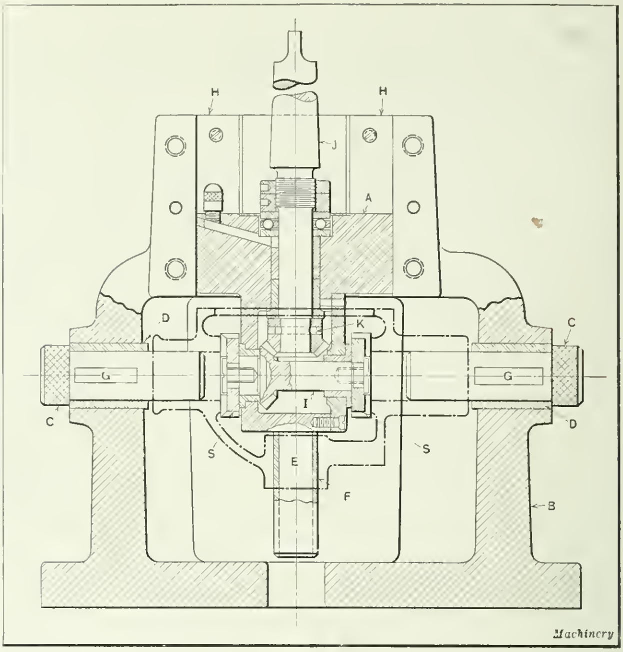


Fig. 2. Drilling Machine Attachment for milling Faces A of Casting shown in Fig. 1

As there is always a possibility of the operator feeding the cutters into the work with such force that either the cutters or gears might be damaged, the driving gear is fastened to shaft *J* by means of a soft cold-rolled steel pin *K*, which is of such diameter that it will shear off when the milling head is overloaded or improperly handled. The pin can, of course, be easily replaced. This precaution was found necessary as the fixture illustrated was used by semi-skilled operators. The equipment described in the preceding was designed by the writer and built in the factory of Gustave Lidseen, Chicago, Ill., where it has given entire satisfaction for a long period of service, so that there is nothing experimental or doubtful about it.

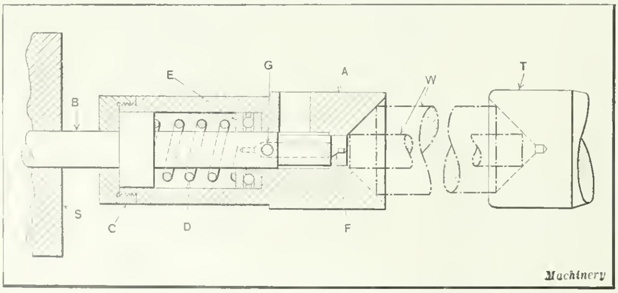
Chicago, Ill. C. J. Hueber

BENCH LATHE ATTACHMENT FOR CENTERING PLUG GAGE BLANKS

The centering device illustrated was designed to provide a means of rapidly centering blanks for taper plug gages, to be used in testing Briggs pipe threads. The centers in these blanks were required to be of uniform depth. The fulfillment of the latter requirement enabled the blanks to be threaded in such a way that the thread would start at the same point on the taper plug of each gage. Referring to the illustration, part *A* is a female center which is free to rotate about arbor *B* held in the spindle *S* of a bench lathe. Threaded collar *C* retains the female center on the arbor, and spring *D*, acting against the center *A* through the thrust bearing *E*, serves to keep the work in line with the centering tool at the beginning of the cut. The centering tool *F* is locked in the spindle by the set-screw *G*, and can be adjusted to center the work to any required depth. The end of spindle *B* is grooved to provide for the removal of chips from the end of the work, which is shown by dot-and-dash lines at *W*. The female tailstock center shown at *T* has grooves cut on the inside or centering surface so that it will prevent the work from turning. This center is held in a lever-operated tailstock.

The operation of the device is as follows: With the tailstock set at the proper distance from the headstock, the operator places a plug blank in line with the two centers and brings the female tailstock center toward the headstock, thus clamping the work in place between the two centers. This operation centralizes the work, and a further movement of the tailstock lever in the same direction forces the head center *A* to slide to the left on spindle *B*. This brings the tool into contact with the work. The pressure on the tailstock lever is continued until the end of spindle *B* comes in contact with the end of the work, thus gaging the depth of the center. The spring forces the work against the grooved inner cone of the female tailstock center so that it will remain stationary during the centering operation. The simplicity of the device is obvious, and the speed of operation made possible by eliminating the time required in clamping the work by means of the devices usually employed makes it adaptable for the performance of all classes of light centering work.

B. S.

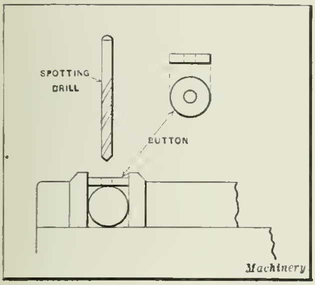


Bench Lathe Attachment for centering Plug Gage Blanks

SHOP AND DRAFTING-ROOM KINKS

DRILLING HOLES THROUGH ROUND SHAFTS

In the accompanying illustration is shown a convenient method of drilling holes through the center of round shafts. The button in the upper right-hand corner is used to locate the spotting drill, while the shaft is held in position by vise jaws. The buttons can be made in several sizes to correspond with the diameters of standard shafting. They should be about 0.001 inch smaller than the shafting, so that they can be removed without disturbing the piece clamped in the vise. The holes in the different buttons can all be made for the same size spotting drill. The buttons should, of course, be removed after spotting, and a drill of the required size used to drill the hole.

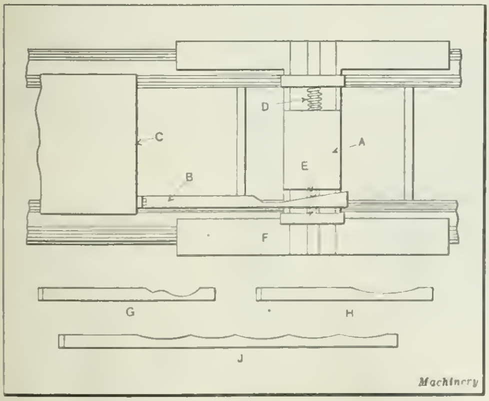


Drilling Holes through Round Shafts

Brooklyn, N. Y. **Howard House**

TAPER-TURNING ATTACHMENT FOR LATHE

The taper-turning attachment shown in the accompanying illustration is adapted either for taper turning or for use in turning bars to irregular shapes. The attachment consists of a templet *B* which actuates tool-slide *A*. The left-hand end of this templet is bent up and attached to the headstock *C*. A spring *D* keeps pin *E* in contact with the templet as the carriage moves back and forth. Pin *F*, driven into a screw-cutting stop attached to the carriage supports the straight side of the templet. When using this attachment the cross-feed screw is, of course, removed. By attaching different templets in place of templet *B* it is possible to turn bars to irregular shapes. For instance, the templet shown at *G* is designed for use in turning machine handles, and the templet shown at *H* is used for turning pulleys, while the one shown at *J* was designed for use in turning a four-step cone pulley.



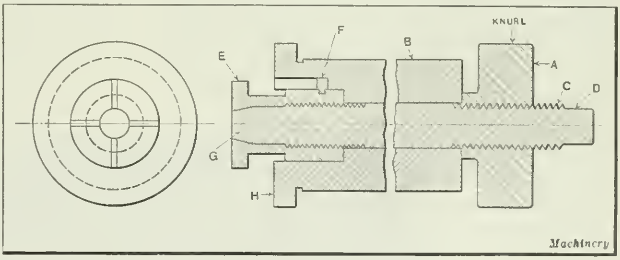
Taper-turning Attachment for Lathe

Providence, R. I. **John T. Slocomb**

CUTTER-HOLDING DEVICE FOR UNIVERSAL GRINDER

In the accompanying illustration is shown a cutter-holding device that the writer has found useful when grinding milling cutters having acute angles. It was designed for use on a small universal grinding machine, and is of such simple construction that it requires little explanation. Bushing *B* is made to fit the grinding machine headstock, and was inserted in place of the original bushing, which was bored to take a No. 1 Morse taper. The cutter to be ground is mounted on expansion arbor *E*, fitted in bushing *B*. A key *F*, driven into part *E*, fits into a slot or keyway cut in bushing *B*, and prevents *E* from turning.

A wrench which fits the squared end *D* of screw *C* is employed to expand bushing *E* so that it will grip the cutter. After arbor *E* has been expanded, knurled nut *A* is screwed up until the cutter is held tight against face *H* of bushing *B*. Expansion arbor *E* is spring-tempered, and end *G* of spindle *C* is casehardened. Though designed primarily for holding milling cutters while grinding their cutting edges, this device can also be used for holding various kinds of work for different machining operations.



Device for holding Milling Cutters while grinding their Cutting Edges

Millersburg, Pa. **Roy A. Dressler**

* * *

FINANCING FOREIGN CREDITS

One of the well-known machine tool building firms in this country is extending credits to customers in France and Belgium upon a plan which might later be employed also in other foreign countries. According to this plan, responsible concerns pay 4 per cent of the purchase price monthly during the first year, 3½ per cent monthly during the second year and 2½ per cent monthly during the third year, the total payment thus amounting to 120 per cent of the cash price, allowing for interest on the credit extended. Any installments paid in advance at any time are subject to a 10 per cent discount. If, on account of more favorable exchange, the customer wishes to pay up at any time, he can secure for himself a substantial saving by the discount allowed. In one of the countries mentioned, the agent of the American firm referred to is able to pay cash for the machines in the first place, and is then selling the machines to his customers upon the terms mentioned.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, June 14

AT the time of writing, production in almost every branch of the engineering trade is virtually at a standstill. This condition is largely due to the present coal dispute, although there are other causes that influence the situation considerably: Production costs are at a high level, and unbalanced exchange rates enable Continental producers to offer goods in the home markets at prices below those quoted by British makers. For example, it is stated that German street car rails can be delivered in Sheffield at below the actual cost of the coal required to make them in that city.

Price Reductions

So far as the machine tool trade is concerned an effort to stimulate new business has been made by a general reduction in prices of from 10 to 15 per cent. Thus far, however, the results obtained by this action are hardly worth recording, and it is probable that still further and more substantial reductions will have to be made before anything of a material nature develops. Machine tool manufacturers will find it extremely difficult to make greater reductions in the price of their products at this time, as the reductions that have been made thus far have had to come out of their own profits, owing to the fact that iron and steel prices remain at the same level, and, unfortunately, cannot be reduced under present conditions. Iron and steel is costing the producer more than it can be sold for, and authorities state that unless the price of coal is brought down to something like £1 a ton at the mine, production cannot be resumed on a satisfactory basis. Nevertheless, there is a strong undercurrent of optimism that matters will work out all right in the end, and judging by the inquiries received during the last week or so, a general improvement in the situation is expected before long.

In the small tool trade, prices of late have depreciated considerably, and manufacturers are now quoting twist drills at 47½ per cent less 12 per cent to wholesalers, below list prices. Most other kinds of small tools are quoted less 30 per cent and 30 per cent and 12 per cent below list prices to retailers and wholesalers, respectively. The automobile industry is much more active than it has been, the demand for low and medium priced cars being particularly evident.

Magneto Industry

Protective measures are being taken by the British Government to safeguard what are regarded as the key industries, and magneto manufacturers are anxiously watching developments. There will hardly be any difference of opinion as to the policy of safeguarding so vital an industry, the development of which in this country is due entirely to the war. Formerly we produced probably not more than 5 per cent of the magnetos used here, and Germany supplied most of the remaining 95 per cent, though some other countries made attempts to obtain a portion of the trade. British manufacturers are now, however, in a position to produce for themselves all the magnetos the country is likely to need for some time to come.

Overseas Trade in Machine Tools

The official reports of the total overseas trade in machine tools for the first four months of this year show that the imported tonnage is settling down toward pre-war level, while the exported tonnage is well maintained at far above pre-war level. The value per ton of the imports has been strongly maintained during the fall in quantity, but a sharp decline in value took place in April. This may prove to be a passing occurrence, but it more probably indicates a break in the high prices that have been paid to the United States manufacturers. Actually for the first four months of 1921, the total weight of imported machine tools was 1728 tons, the total value of which amounts to £430,224 (about $107,555 present exchange) which is equal to a ton value of £249 ($62.25). During the same period, exported machine tools amounted in weight to 9509 tons, and their value is placed at £1,383,704 (about $345,926) which equals a ton value of £146 ($36.50). The ratio of imports to exports for the period referred to is: imports, 100 tons; exports, 550 tons; imports, £100; exports, £322; value per ton of imports, £100; and value per ton of exports, £54.

As compared with March the reports for April show that the imports of grinding machines have increased by 90 per cent, while exports have dropped by half. Imports of milling machines remain about the same, though exports in this class have dropped by 80 per cent. Drilling machines remain on practically level terms, but in lathes a drop of 35 per cent is noted in exports. There is also a drop of 2 per cent in the export of planers and shapers; other classes of machines are practically unaltered, except presses, and punching and shearing machines, where a drop in exports of about 45 per cent is noted.

Labor Conditions

A serious, though not yet critical, situation has arisen in connection with the drastic wage cuts proposed by the employers to come into operation on June 16. A deputation to the Ministry of Labor representative of thirty-three unions, including the Amalgamated Engineering Union and the Boilermakers Union, has asked for an inquiry. The cuts proposed are, for time-workers, a reduction of 6s ($1.20) per week and the cancellation of the 12½ per cent increase granted in 1917; and for piece-workers, a reduction of 15 per cent and the withdrawal of the 7½ per cent increase granted in 1919. Members of the deputation explained that these percentages work out at 15s 11d (about $3) per week reduction for skilled time-workers, anything from this figure up to 24s ($4.80) per week for skilled piece-workers, 14s ($2.80) for semi-skilled men, and 13s ($2.60) for unskilled men. A strike or lock-out now, as a result of these demands, would mean the complete stoppage of the engineering trades, and a further meeting between the employers and the men's representatives is to be arranged by the Ministry of Labor.

International Standardization

A conference of the secretaries of the various standardizing organizations at present in existence has recently been held in London. Secretaries from the United States, Norway, Holland, Canada, Belgium, Switzerland, and Great Britain were present. The object of the conference was the exchange of ideas looking toward the establishment of closer relationship, and from this point of view it was eminently successful. Each secretary gave a brief report of the general organization of the work in his own country, the methods adopted in arriving at the standards, as well as the principles followed to insure their adoption.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Sellers 35-foot Boring and Turning Mill. William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa. 1065
Bevington Wire Straightening and Cutting Machine. Bevington Metal Stamping Co., 1545 E. 18th St., Cleveland, Ohio 1066
Webster & Bennett Duplex Boring and Turning Mills. Alfred Herbert, Ltd., 50 Church St., New York City... 1067
Cincinnati Fixture Dogs. Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio 1068
Simplex Measuring Irons. Simplex Tool Co., Woonsocket, R. I. 1068
Black & Decker Portable Electric Grinder. Black & Decker Mfg. Co., Baltimore, Md. 1068
Geometric Self-opening Die-head. Geometric Tool Co., New Haven, Conn. 1069
Besly Double-spindle Ring-wheel Grinding Machine. Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill. 1069
Bath Micrometer Internal Thread Gage. John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. 1070
Keeler Cylinder Reboring Machine. Central City Machine & Tool Co., Syracuse, N. Y. 1070
Stamets Gantry Type of Drilling Machine. William K. Stamets, Jenkins Arcade Bldg., Pittsburg, Pa. 1070
Improved Pratt & Whitney Measuring Machine. Pratt & Whitney Co., Hartford, Conn. 1071
Sacrey Oil-grooving Machine. Philadelphia Engineering & Machine Co., 1130 Race St., Philadelphia, Pa. 1071
Simplex Vertical Drawing-board. Simplex Tool & Instrument Co., 820 N. Third St., Camden, N. J. 1071
Grand Rapids Tap and Drill Grinding Machines. Grand Rapids Grinding Machine Co., 29 Ottawa Ave., Grand Rapids, Mich. 1072
Colburn Railroad Boring Mill. Colburn Machine Tool Co., 1038 Ivanhoe Road, Cleveland, Ohio 1072
Jones Boring, Drilling, and Milling Machine. Jones Machine Tool Works, Philadelphia, Pa. 1073
Brown & Sharpe Machinists' Tools. Brown & Sharpe Mfg. Co., Providence, R. I. 1074
Landis Cylinder Grinding Machine. Landis Tool Co., Waynesboro, Pa. 1075
Pratt & Whitney "Trus-form" Snap Gages. Pratt & Whitney Co., Hartford, Conn. 1076
Twist Drill Grinder. Oliver Instrument Co., Adrian, Mich. 1076
Houston, Stanwood & Gamble Lathe. Houston, Stanwood & Gamble Co., Cincinnati, Ohio 1077
Pearson-Scott "Iron Man." Pearson-Scott Co., 1523-1529 E. Washington St., Indianapolis, Ind. 1078
Precision Grinding Wheel Truing Machine. Precision Truing Machine & Tool Co., Cincinnati, Ohio 1079
Pawling & Harnischfeger Tilting and Rotary Table. Pawling & Harnischfeger Co., Milwaukee, Wis. 1079
Landis Special Grinding Machine. Landis Tool Co., Waynesboro, Pa. 1080
Niagara Power Squaring Shear. Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y. 1080
Anderson Gear-cutter Grinding Machine. Anderson Die Machine Co., Iranistan Ave. near Admiral St., Bridgeport, Conn. 1081
Lawrenz "Normal" Drafting Compass. E. Lawrenz, 2533 McClellan Ave., Detroit, Mich. 1081
Wayne Drill Chuck. Wayne Tool Mfg. Co., Waynesboro, Pa. 1082
Attachment for Oliver Pattern Milling Machine. Oliver Machinery Co., Grand Rapids, Mich. 1082
Poliakoff Machine Shop Rule. R. Poliakoff, 709 Sixth Ave., New York City 1082

Sellers 35-foot Boring and Turning Mill

ONE of the largest boring and turning mills ever constructed, intended primarily for finishing mammoth castings for hydro-electric units has been built by William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa. This machine, shown in Fig. 1, has a capacity for work up to 35 feet in diameter and up to 18 feet 6 inches in height.

Bed and Table Construction

The bed of the machine is made in two sections, because if it were made in one piece its size would be such as to make shipment impossible. The main section is equal in depth to the base of the uprights and extends the length of the machine, while the second section is semicircular in shape and is bolted to the front of the main casting. The assembled bed weighs approximately 50 tons. Two annular bearings on the bed support the table and facilitate its rotation. These bearings are supplied with oil under pressure from a pump connected to the main driving mechanism of the machine. A vertical hole is bored at the center of the bed to receive a split bushing into which a tapered spindle at the center of the table is inserted. This bushing may be adjusted to eliminate lost motion or to compensate for wear, and is lubricated by oil coming from the inner of the two annular bearings. The table is also made in two castings, the diameter of the assembled table being 19 feet 10 inches, and the weight about 40 tons. It is provided on the upper surface with twenty-four radial slots, and is driven by means of a large external spur-gear ring, bolted to it.

Table Drive

A 50-horsepower variable-speed motor, for driving the table and feeding the saddles on the cross-rail and their tool-slides, is placed at the back of the left-hand upright. This motor has ten speeds, ranging from 400 to 1200 revolutions per minute. From the motor pinion, power is transmitted to the table through a drive giving four speed changes. This arrangement gives a choice

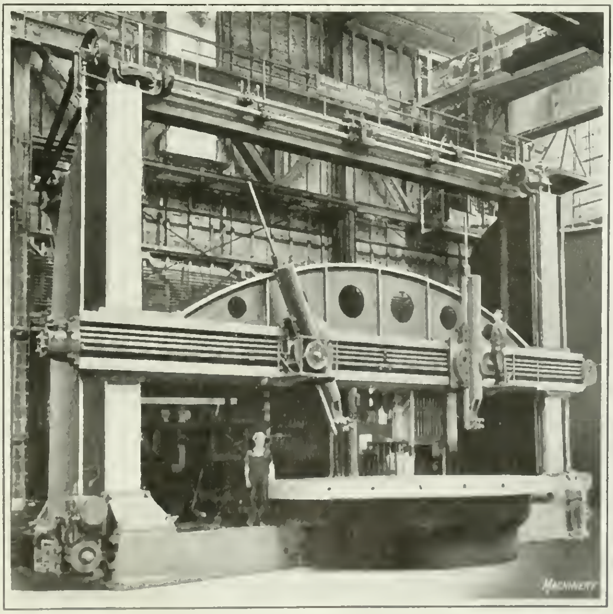


Fig. 1. Huge Boring and Turning Mill built by William Sellers & Co., Inc.

of forty speeds for the table covering a range of from 0.19 to 6 revolutions per minute. The clutches for operating the various gears in the speed-change unit are controlled by levers near the motor, and all clutches are interlocking so as to prevent the meshing of two gear trains at one time. The gears are of large proportions and have cut teeth, while all shafts in the unit are short so as to eliminate shaft deflections which might result in chatter and an unsatisfactory finish on the work. From the speed-change unit, power is transmitted to the table through reduction gearing, the last shaft of which is vertical and provided with a pinion that meshes with the ring gear on the table.

Uprights and Cross-rail

The uprights are 12 feet deep at the base and have faces 24 inches in width. At the top they are tied together by means of a cast-iron cross-girt of box construction. The cross-rail is made straight at the back instead of curved as is the common design, and is clamped in position by the use of pneumatic clamps. This construction is said to provide more than ample strength at the points where the greatest torsional stresses occur. The cross-rail is clamped on each end at the back on a vee on the insides of the uprights and at the front on the outsides of the uprights. A large arch-shaped girder is bolted on the top of the cross-rail to eliminate any deflection which might be occasioned by the large span of the uprights. Adjustable wedges at the ends of the girder enable the cross-rail to be made level.

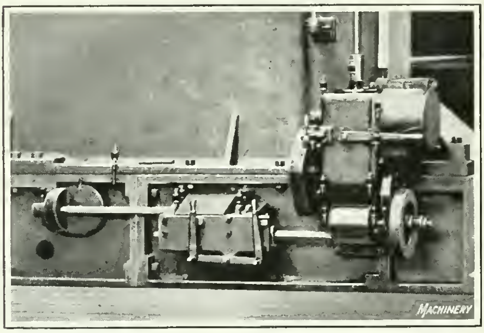


Fig. 2. Feed-change Gear-boxes on Left Side of Machine

Cross-rail Clamps, and Raising and Lowering Mechanism

Two clamps are provided at each of the clamping points on the cross-rail previously mentioned so that there is a total of eight clamps. These are all operated instantaneously by the manipulation of a lever on a valve situated on the right-hand upright within easy reach of the operator. The cylinders actuating the clamps are connected to the valve by flexible hose. After the cross-rail has been clamped, the air pressure on the cylinders may be released by again operating the valve lever, the clamps being so designed that they cannot loosen until air is applied in the reverse direction to that in which it was applied in tightening them. This feature is essential in pneumatic clamps for a machine of this type, because the length of the operation may necessitate the cross-rail to be clamped during a period when air under pressure might not be available. This clamping arrangement saves a large amount of time as compared with the time required for loosening a number of nuts.

The raising and lowering of the cross-rail to accommodate the work is accomplished by means of a 20-horsepower reversing motor bolted on the back of the left-hand upright, which drives a pulley on a shaft extending across the face of the cross-girt. The top of the cross-girt is accessible by means of a ladder attached to the left-hand upright, and rails are provided to afford safety to a workman when walking on the cross-girt. At the center of the cross-girt the pulley shaft is connected through a clutch to a lower shaft, which also extends the length of the cross-girt and is connected at each end through bevel gearing to a vertical screw on the uprights. The clutch is operated by means of a shaft extending from the middle of the cross-girt to the right side of the machine, from which it is connected with a lever near the bottom of the upright. By operating this lever the screws may be rotated so as to raise or lower the cross-rail, the direction of movement depending upon the rotation of the motor pulley.

Feeding Movements and Rapid Traverses

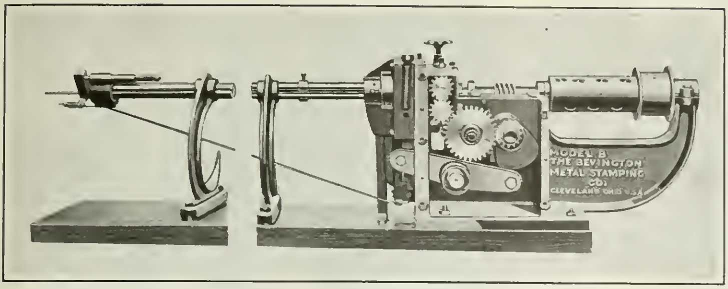
The horizontal feeding movements of the two saddles on the cross-rail, and the vertical feeding movements of the tool-slides are obtained from the table drive, and so the feeds are always in a certain relation to the table rotation. The final shaft in the speed-change unit of the table drive extends through the base at the left side, and by means of bevel gearing drives a shaft extending toward the front of the machine and into a feed-change gear-box. This arrangement is shown in Fig. 2. At the front of this gear-box a second shaft extends forward, and is connected through bevel gearing with a vertical feed-change gear-box. This second shaft also drives a shaft running beneath the base to the right-hand side of the machine where it is connected with a vertical gear-box identical with the one at the left.

A shaft extends from the top of each vertical gear-box to the top of the corresponding upright, and drives a gear in a tumbler gear unit on the end of the cross-rail. By the operation of levers at the side of either saddle, power may be transmitted either to the screw for feeding the saddle horizontally or to the shaft which drives the mechanism for feeding the tool-slide. The horizontal and vertical feeds range from 1/64 to 1½ inches per revolution of the table, the entire vertical movement of the tool-slides being 7 feet. The control shafts, tool-slide feed-shaft, and saddle screw for each saddle extend only to the middle of the cross-rail. The provision of a vertical gear-box on each upright permits the tool on one saddle to be fed at a different rate from that on the other saddle, while the horizontal gear-box on the left side of the machine is employed to change from the range of roughing feeds to the range of finishing feeds.

Rapid traverse of the saddles and tool-slides is effected by means of the motor used for raising and lowering the cross-rail. Directly in back of the vertical shaft on the left-hand upright, but hidden in the illustration by this shaft, is a second vertical shaft, which is driven at the top by the pulley shaft on the cross-girt. There is a similar vertical shaft on the right-hand upright. These two vertical shafts are also connected by gears to the tumbler gear units on the cross-rail ends and cause rapid rotation of the saddle screws or the tool-slide feed-shafts when the levers on the saddles are properly set. The saddle levers are duplicated by levers on the tumbler units, so that the point of operation is optional. The motor on the left-hand upright is operated by push-buttons on the saddles. A feature of the saddle construction is that no counterweights are required for the tool-slides, as a split nut is provided, which has a spring that constantly maintains contact on both sides of the thread of the portion of the screw in the nut. The tool-slides may also be fed by hand through the handwheels provided. It will be observed that the slides are reinforced by a tubular section in front of the guiding surfaces which furnishes exceptional resistance to tool pressures.

BEVINGTON WIRE STRAIGHTENING AND CUTTING MACHINE

The Bevington Metal Stamping Co., 1545 E. 18th St., Cleveland, Ohio, has developed the automatic wire straightening and cutting machine shown in the accompanying illustration. This machine has a capacity for wire ranging



Automatic Wire Straightening and Cutting Machine made by the Bevington Metal Stamping Co.

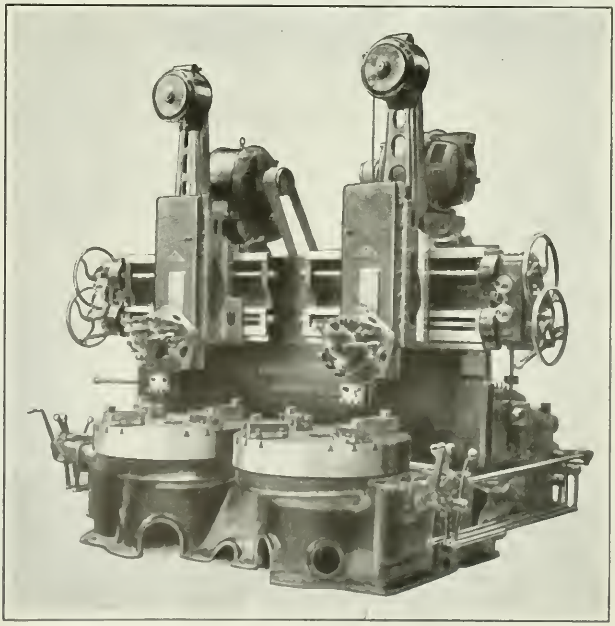
from 5/32 inch in diameter to No. 20 Washburn & Moen gage, ¾ horsepower being required for its operation. All bearings are interchangeable and made of bronze, except those for the arbor, which are ball bearings. The feed-rolls and cutting dies are made of special tool steel and heat-treated, while the straightening dies are made of either iron castings, wood, babbitt, or brass, the material depending upon the wire being handled. The interchangeable feature of all bearings renders the making of repairs a simple proposition. Bearings, cutting and straightening dies, and feed-rolls are kept in stock for immediate shipment. As the machine is provided with ball bearings, it is practically noiseless in operation. The machine is made in various lengths to suit the length of wire to be cut.

WEBSTER & BENNETT DUPLEX BORING AND TURNING MILLS

A departure from established practice in boring mill design has been introduced by Webster & Bennett of Coventry, England, their machine being of the duplex type, that is, having two tables and two boring heads fitted with revolving turrets. When the duplex table type of machine is employed, both turret heads can be fully employed at the maximum speed, the tables being quite independent of each other in all particulars, thus enabling boring and turning operations to be performed simultaneously and at correct speeds for the central bearing hole and for the outside diameter of a wheel, or for similar combinations of conditions. A very great proportion of boring mill work requires two settings, and when using a machine of the duplex type, both settings proceed simultaneously, each head being tooled for its own set of operations. Thus there is a constant flow of finished work leaving the machine, and the operator is not handicapped by an increasing pile of partly finished material surrounding his working area. These new duplex mills are made in two sizes with 20-inch and 42-inch tables.

Among the features of the design of this machine the following may be mentioned: Power is supplied to a single pulley fitted with a friction clutch, and from this pulley the drive is carried through speed-change gears. It is impossible to change the positions of any of these gears until the clutch on the driving pulley has been disengaged. Either a positive feed or rapid power traverse is instantly obtainable; and the automatic horizontal, vertical, and angular feeds are positive, reversible, and interlocked. Provision is made for holding the feed safety clutch in position by means of a powerful spring, which is set to withstand the pressure exerted by the heaviest cut that a tool will take. Any tool pressure beyond this causes the clutch to slip, and so prevents damage to the feed mechanism through accident or carelessness. The position of adjustable micrometer collars is controlled by spiral springs which, although they maintain a constant pressure on the collars, enable the operators to readily make the desired adjustment for setting tools and sizing the work by revolving the collars. There is an automatic trip motion with graduated dials, geared to the feed by means of friction clutches which are engaged or disengaged by knurled knobs at the front of the dials. When the zero mark on the dial is brought opposite the pointer, the feed motion is automatically cut out. To facilitate setting the tools over the work, rapid power traverse is provided for the turrets in all directions, and this quick movement is interlocked with the automatic feeds to avoid danger of damaging the mechanism.

All feed-screws and worms are furnished with ball thrust bearings, and the turrets are balanced by compensating springs, the tension of which is adjusted by revolving a worm-shaft located above the balance box. This tension should be such that little effort is required for moving the turret-slide either up or down by turning a handwheel. As a result, the fatigue factor is largely eliminated and the operator's efficiency is maintained constant throughout the day. An improved tool-binder holds boring-bars, etc., accurately in place without bruising them. All slides are furnished with narrow guides: and all control levers are centralized, so that they are easily accessible from the operating position. Two levers control the automatic feed and rapid traverse motions in all directions. Both the spindle bearing and thrust ring are liberally proportioned. The downward thrust is taken on a large double-coned bearing of anti-

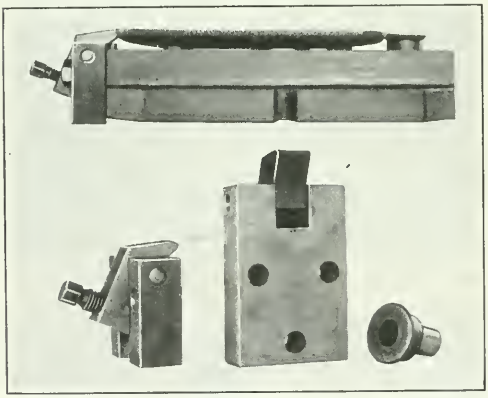


Duplex Boring and Turning Mill built with 20- and 42-inch Tables by Webster & Bennett, and sold in the United States by Alfred Herbert, Ltd.

friction metal, and with due care in lubricating, it is claimed that this bearing will last almost indefinitely. Filtered oil is supplied to all gears and bearings by means of sight-feed and other types of lubricators, all of which should be filled with a good quality of lubricating oil at the beginning of each working day. The gears are made of steel or phosphor-bronze, and all bearings are fitted with liners. The handwheels are fixed in position, and the only loose crank or spanner is the chuck key used when operating the machine. As a single pulley delivers power to each table, no countershaft is required; but if so desired, individual motor drive can be employed. Alfred Herbert, Ltd., 50 Church St., New York City, has the sales agency for these machines in the United States.

CINCINNATI FIXTURE DOGS

Special dogs have been placed on the market by the Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio, for clamping work on fixtures. The lower portion of the illustration shows two sizes of the adjustable type and one size of the stationary type, while the upper portion shows a small sized adjustable dog and a stationary one being used to clamp a part on a fixture. The adjustable dogs and holders are made of machine steel and casehardened, the stationary dogs being made of an alloy steel and hardened.

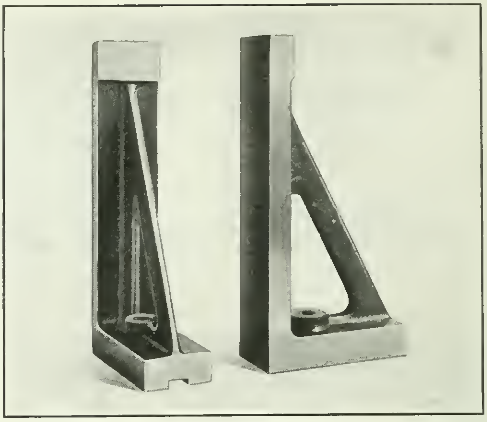


Application and Details of Special Fixture Dogs designed by the Cincinnati Engineering Tool Co.

By using these dogs for clamping work a fixture can often be designed and built cheaply, due to the dogs permitting the use of a simple casting which requires little machining; the fixture can be more easily cleaned as there are no projecting walls to retain chips; and the work can be clamped close to finished surfaces, this being especially advantageous when the work has large rounded ends as shown in the illustration. When a set-screw is used for clamping work, the point is likely to be worn eccentric, so that the set-screw tends to lift the work from the fixture instead of clamping it. The adjustable dogs positively clamp the work on the locating points, and so trouble of this kind is avoided.

SIMPLEX MEASURING IRONS

The Simplex Tool Co., Woonsocket, R. I., makes the measuring irons shown in the accompanying illustration, which are intended to facilitate many kinds of accurate machining operations. When clamped to a machine table or a surface plate by means of the hole through the bottom of the irons, they form accurate surfaces from which to measure in the checking of work. The irons are rigidly designed and made narrow so as to occupy a minimum amount of space on the table or surface plate. They are made of close-grained iron castings, and have the front face and bottom ground accurately and square. The sides are also machined. The following sizes of irons are carried in stock: 12 by 6 by $2\frac{1}{2}$ inches, and 22 by 8 by 4 inches.



Machine and Surface-plate Measuring Irons made by the Simplex Tool Co.

BLACK & DECKER PORTABLE ELECTRIC GRINDER

A one-half horsepower portable electric grinder, which embodies all the features of the portable electric drill manufactured by the same concern, has recently been placed on the market by the Black & Decker Mfg. Co., Baltimore, Md. A pistol grip and trigger switch gives the operator entire control over the tool at all times without the necessity of shifting his hand. Although the grinder is essentially a portable tool, it is supplied with a quickly detachable base and an adjustable tool-rest, as shown in Fig. 2, to enable it to serve as a bench tool. An important feature of this grinder is the fact that it can be driven by either direct or alternating current. Forced air cooling is provided; the gears and shafts are made of chrome-nickel steel; and the housing is an aluminum alloy casting. The housing effectively protects the driving mechanism from dust and other foreign matter.

Besides the detachable base and tool-rest previously mentioned, the equipment supplied with this grinder includes two 5- by 1-inch grinding wheels, one of which is fine and the other coarse, a wire-brush wheel, and a cloth buffing wheel. With these parts, the tool can be used in automobile garages and service stations, and in machine shops and foundries, for removing dust and paint from metals, polish-

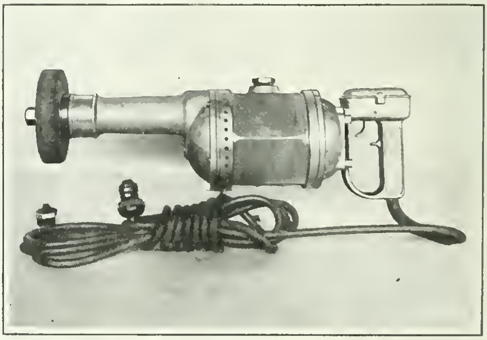


Fig. 1. Portable Electric Grinder made by the Black & Decker Mfg. Co.

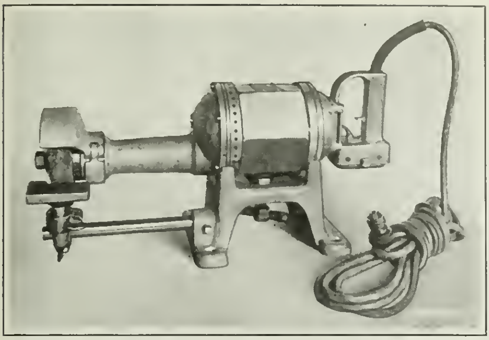


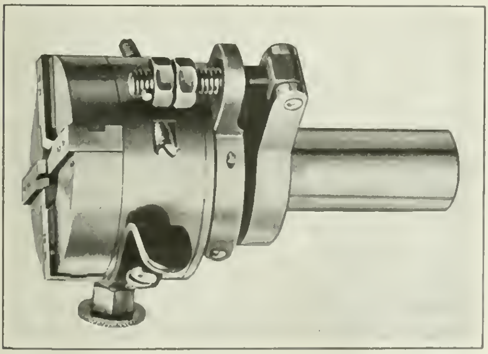
Fig. 2. Detachable Base and Tool-rest which facilitate the Use of the Portable Grinder as a Bench Tool

ing metal parts, sharpening tools, smoothing castings and welds, and cutting off rivet heads. The speed of the wheel-spindle under no load is 3200 revolutions per minute. The weight of the tool without the base is 21 pounds.

GEOMETRIC SELF-OPENING DIE-HEAD

A style D S self-opening, adjustable die-head designed primarily for use on Brown & Sharpe automatic screw machines, but which is adaptable to other machines as well, has been placed on the market by the Geometric Tool Co., New Haven, Conn. The die-head floats to suit the part being threaded, thus preventing stripping and shaving of the threads, and making a close camming of the machine unnecessary. The lever trip provided reduces the force of tripping, and accordingly lightens the strain on the threads being cut. Buffer springs allow the die-head to yield slightly when the chasers come in contact with the work, and thus assure a smooth thread from the start. The tripping point is adjusted by means of two check-nuts. Shock and wear are reduced to a minimum by a spring closing attachment, and push-buttons obviate trouble in inserting the chasers.

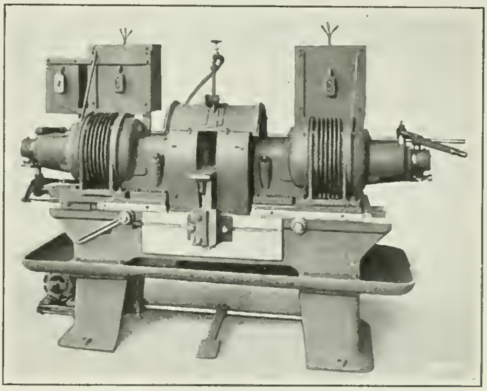
No faceplate is necessary, and so it is possible to use projecting chasers for cutting threads close to a shoulder. The chasers have long bearings in the die-head, and are supported by hardened keys which prevent tilting and a subsequent cutting of taper threads. There are four chasers in each size of die-head. The die-head is provided with a shank to fit the particular machine on which it is to be used. It is made in three sizes, namely, 5/16, 9/16, and ¾ inch. The 5/16-inch size has a capacity for work ranging from 1/16 to 5/16 inch in diameter, up to 1¼ inches long, having 18 or more threads per inch; the 9/16-inch size handles work ranging from ⅛ to 9/16 inch in diameter, up to 1¼ inches long, having 12 or more threads per inch; and the ¾-inch size is suitable for work from ¼ to ¾ inch in diameter, up to 1¾ inches long, having 10 or more threads per inch.



Style D S Self-opening Adjustable Die-head developed by the Geometric Tool Co.

BESLY DOUBLE-SPINDLE RING-WHEEL GRINDING MACHINE

A Type 1 direct-motor-driven double-spindle ring-wheel grinding machine, which has recently been placed on the market by Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill., is shown in the accompanying illustration. The principle of operation is to grind simultaneously both sides of a part parallel, either by dry or wet grinding. The machine is equipped with two 7½-horsepower alternating-current motors of a fully enclosed type. A push-button control is provided for stopping and starting the motors, the starters being attached directly to the motor frames. The motors are mounted on plates which slide on vees planed on top of the bed. This arrangement permits the motors to be moved longitudinally to accommodate different widths of work, the movements being accomplished by means of racks and pinions. The left-hand motor plate has an adjustment feature which makes it possible to keep the grinding wheels in true alignment.



Duplex Motor-driven Ring-wheel Grinding Machine developed by Charles H. Besly & Co.

The wheel-spindles are slid endwise through their bearings to feed the wheels to the work. These spindle movements are obtained through racks and pinions operated by either a hand- or a foot-lever. Both spindles are actuated simultaneously through a connecting-rod and lever at the rear of the machine. However, this rod may be disconnected, so that the right-hand spindle can be locked in a stationary position, while the left-hand spindle is operated to and from the work by manipulating the foot-lever. At the rear of the machine, a spring is attached to a lever that is drawn out when the spindles are moved toward the work, and when the foot- or hand-lever is released this spring causes the spindles to be returned to their starting positions. The endwise movements of the spindles are controlled by micrometer stop-screws.

The bearings are made from heavy phosphor-bronze castings which have large flanges for taking the thrusts. Hardened steel thrust collars are provided, and these are automatically oiled. The hood is centrally located on the machine and as the hood casings are attached to the motor heads, they are moved with the motors. The top section of each hood is hinged so that it may be thrown back to enable the grinding wheels to be adjusted or changed. A T-slot is machined on the front side of the bed for attaching work-rests and other fixtures, while the rear of the bed is also designed to enable such attachments to be made.

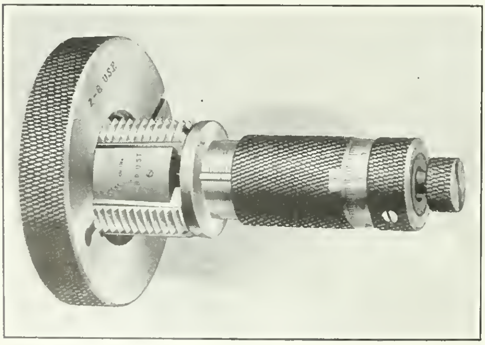
In the illustration, the machine is equipped for wet grinding and has a plain work-rest, but rocking, swinging, or sliding work-rests may be furnished. A direct-connected motor-driven pump is attached to a leg of the machine directly under the water pan. The starting apparatus of this pump is also controlled by a push-button. The pressed-steel chucks with which the machine is equipped are intended for ring wheels 18 inches in diameter, with faces ranging from 1½ to 4½ inches in width, but 20-inch diameter disk wheels may also be used. The maximum distance between the ring wheels is 10 inches, and the height from the floor to the center of the spindles, 39 inches.

BATH MICROMETER INTERNAL THREAD GAGE

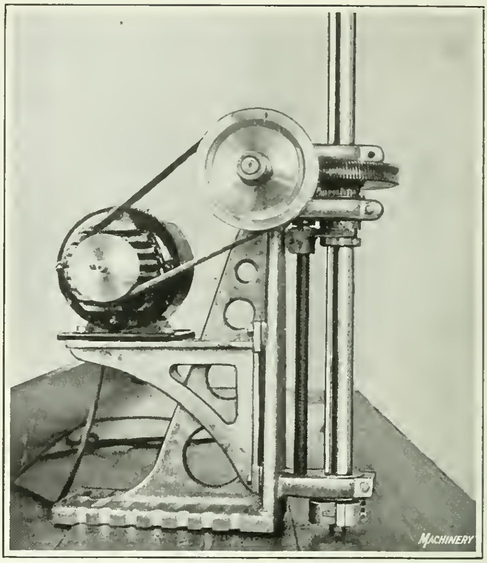
In April MACHINERY, a description was published of the micrometer plug gage then introduced by John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. This concern has now developed the micrometer internal thread gage here illustrated, which contains the same features as the micrometer plug gage referred to, and enables the measurement of internally threaded parts to be readily accomplished in increments of 0.0001 inch; for instance, it enables the determination of the exact amount that a tap cuts over size. The four measuring jaws are held in alignment by closely fitting dovetailed slots in a slide which is operated by a micrometer screw. The moving parts are lapped and fitted so well, it is stated, that the gage is as rigid as a solid plug, and this rigidity causes different persons to obtain the same reading on a given piece.

Three distinct steps are taken in the manufacture of this gage to secure a measuring contact that will be as nearly perfect as possible. The jaws are first ground and lapped when set to the nominal size. They are again ground when set to the smallest size, and, finally, when set to the largest dimension. The subsequent grinding relieves the threads on each side of the center of the measuring jaws. In this way, the threads on the jaws are freed from interference due to the difference between the helix angles obtained at the largest and smallest settings of the gage.

When wear occurs on the measuring jaws, the gage may be referred to a master ring gage and the wear taken up by means of the graduated collar which is provided with serrations that enable adjustments of 0.0001 inch to be made. The gage enables studies to be made of the variations in the products of automatic screw machines, the action of taps when used with different cutting compounds, the effect of every thousand pieces on a tap in regard to wear, etc. The gage can be furnished with any number of threads per inch and in nominal sizes of from 1 to 5 inches in diameter.



Micrometer Internal Thread Gage, which is a Product of John Bath & Co., Inc.



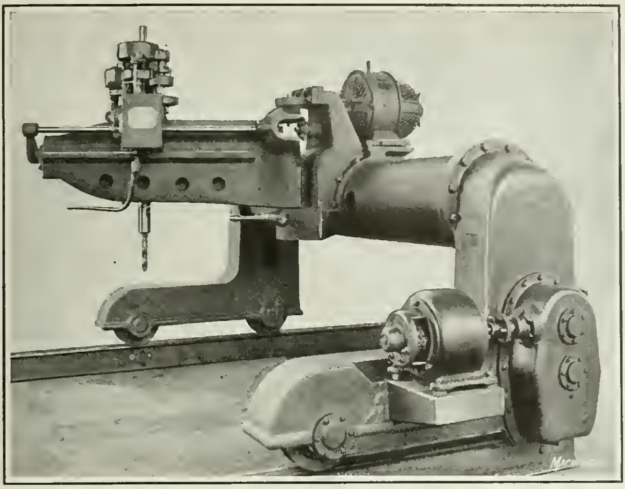
Keeler Automotive Cylinder Reboring Machine built by the Central City Machine & Tool Co.

KEELER CYLINDER REBORING MACHINE

To provide for reboring motor car engine cylinders without requiring the engine to be removed from the car, the Central City Machine & Tool Co., Syracuse, N. Y., has recently developed an equipment known as the Keeler auto reboring machine. It enables a garage man to do the entire job of reboring in his shop, and saves the time required to remove and reassemble the engine in the car. The machine is provided with three bronze bearings supporting a boring-bar. These bearings are split to take up wear and keep the machine in perfect alignment. The boring-bar is driven by a worm-gear that insures a uniform drive from the motor, which is of ¼ horsepower capacity and may be provided for alternating or direct current. Three cutter-heads are furnished for cylinders from 2¾ to 4½ inches bore, and they are constructed with a cam adjustment that gives a smooth equal movement. The four inserted cutters are placed opposite each other, and revolve on the boring-bar, which is accurately centered. This construction equalizes the pressure of the cutters during the entire operation. The cutters are made of "Rex AA" high-speed tool steel. This machine is the invention of L. S. Keeler of the Central City Machine & Tool Co.

STAMETS GANTRY TYPE OF DRILLING MACHINE

To meet the requirements of builders of tank, gondola, and other types of steel cars, as well as miscellaneous products where it is required to drill holes near the center of large steel plates, William K. Stamets, Jenkins Arcade Bldg., Pittsburg, Pa., has recently developed what is known as a gantry type of drilling machine, which is shown in the accompanying illustration. There is not a sufficient demand for drilling machines of this type, and the requirements which they must fulfill vary too widely to justify any manufacturer attempting to produce these gantry type machines as a standard product. The principle of design is one which lends itself especially well to the handling of those classes of work for which the present machine is intended, and it is the practice to build each machine to meet the special requirements of the shop in which it is to be used.



Gantry Type of Drilling Machine built by William K. Stamets

From the illustration it will be seen that this drilling machine is mounted on a track, the gage of which is wide enough to permit the drill to straddle the plates in which holes are to be drilled. Of course, the span of the drill and the gage and the length of the track can easily be adapted to the requirements of each user. Provision is made for traversing the drill on the track by means of a motor and adjustable controller. A drilling head is mounted on the radial arm which swings on its support on the cross-beam. Only one such radial arm and one drilling head are shown in the illustration, but two, three, or four arms and heads could just as readily be employed. Two arms can be used on each side of the beam, or if the span were increased, a larger number than four radial arms could be employed. More than one drilling head could be mounted on each radial arm if so desired. The motive power of the drill is supplied by a motor mounted on the beam, and with direct current an adjustable-speed motor can be used, while a multi-speed motor can be employed with an alternating current, permitting a wide range of speeds through the combination of electrically controlled changes with the mechanical changes of the drilling head.

IMPROVED PRATT & WHITNEY MEASURING MACHINE

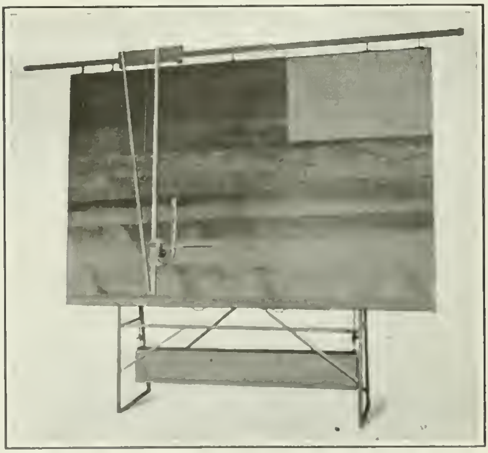
Several noteworthy improvements have recently been made in the design of precision measuring machines built by the Pratt & Whitney Co., Hartford, Conn. Pedestals can be supplied for the 36- and 48-inch sizes. These pedestals facilitate mounting, and in addition two brackets are furnished which support a wooden shelf mounted between the channels, thus affording a convenient place for holding work to be measured, etc. A tangent screw has been provided for the measuring head that facilitates making very fine adjustments of the index-circle. This was formerly accomplished by a knurled knob at the rear, but the tangent screw with its multiplied leverage supplies an easy movement, so that it will be easier to bring the anvil up to the measuring point without going by. A magnifying glass has been mounted over the index-circle, so that the measurement can be seen more accurately. When desired, a vernier may be added to the zero line for the index-circle, which will provide greater accuracy. The microscope on the objective tube has been improved, and a small electric light has been added at the bottom, to illuminate the cross-line of the microscope and the objective line which is etched on the plug of the standard bar.

SACREY OIL-GROOVING MACHINE

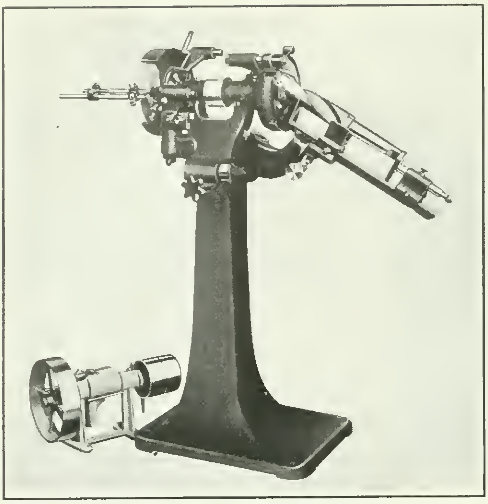
In January MACHINERY a description was published of the Sacrey oil-grooving machine which had recently been placed on the market by the Philadelphia Engineering & Machine Co., 1130 Race St., Philadelphia, Pa. Since developing the original machine, this firm has improved the design in the following respects. The feed mechanism has been simplified considerably. There is a long handle for manipulating the hand feed, and a short vertical button-shaft for manipulating the automatic feed. Another noteworthy improvement is the addition of a segment to provide for cutting double loops in a single operation. There is a lever at the base of the machine, which is a spindle-clamping lever that secures the spindle for cutting straight grooves or keyways, and eliminates any possibility of the spindle revolving. This machine may be driven by a belt from a tight and loose pulley, or it may be equipped with a direct-connected electric motor drive. When the latter arrangement is used, a ¾-horsepower motor and the gear and pinion for transmitting the power to the machine constitute a compact and effective drive.

SIMPLEX VERTICAL DRAWING-BOARD

The Simplex Tool & Instrument Co., 820 N. Third St., Camden, N. J., has recently added to its line of drafting outfits, the Style C movable vertical board shown herewith. This board is equipped with a Simplex drafting machine. It is regularly made 42 inches in width and to any length desired. The board is intended for use in making large drawings such as require a draftsman to be in a standing position while developing them. The board is counterweighted, and slides up and down on a pedestal, this being especially advantageous when a draftsman wishes to work at the top of a large drawing. The drafting machine is operated entirely by the left hand, thus leaving the draftsman's right hand free to use a pencil. The drawing-board may also be supplied with a frame to enable it to be attached to a wall, instead of being placed on the floor as shown in the illustration. This frame holds the board so rigidly that it does not vibrate when in use.



Vertical Drawing-board made by the Simplex Tool & Instrument Co.



Combination Tap and Drill Grinding Machine built by the Grand Rapids Grinding Machine Co.

GRAND RAPIDS TAP AND DRILL GRINDING MACHINES

Two styles of combination tap and drill grinding machines have been developed by the Grand Rapids Grinding Machine Co., 29 Ottawa Ave., Grand Rapids, Mich. The two sizes of the style illustrated are known as Nos. 10A and 10B. This machine is the same as the Style B2T which was described in MACHINERY for July, 1918, except that the plain tool-rest on that machine has been replaced by the tap grinding attachment. The two sizes of the second style of machine are known as 20B and 20C. On this style, the tap is held vertically and fed across the face of a cup-shaped wheel. These machines were designed to meet the requirements of shops in which the investment in two single-purpose machines would not be warranted.

Diamond truing devices are furnished for dressing the grinding wheels. In the case of Nos. 10A and 10B machines, two truing devices are furnished, one for the tap grinding wheel, and the other for the drill grinding wheel. Only one truing device, however, is supplied on Nos. 20B and 20C, as both the wheels on these machines are cup-shaped. The drill-holders on this line of machines are equipped with a safety stop which automatically places the drill-holder in the proper relationship with the face of the grinding wheel. The No. 10A machine has a capacity for drills from No. 52 to ¾ inch in diameter, and for taps from No. 6 to 1½ inches in diameter. The taper on taps is limited by the width of the grinding wheel, which is 1½ inches on regular equipment. The No. 10B machine has a capacity for drills from ¼ to 1½ inches in diameter, the tap capacity being the same as on the 10A machine. The No. 20B machine is suitable for drills from ⅛ to 1½ inches in diameter, and for taps from ¾ to 3 inches in diameter, while the No. 20C machine is suitable for drills from ¼ to 2½ inches in diameter, and for taps of the same sizes as the No. 20B machine. These machines are intended for operation at a spindle speed of 1600 revolutions per minute.

COLBURN RAILROAD BORING MILL

To meet the requirements of locomotive building and railroad shops in performing turning and boring operations on engine wheels, the Colburn Machine Tool Co., 1038 Ivanhoe Road, Cleveland, Ohio, and the Dale Machinery Co., 54-60 Lafayette St., New York City, and 541-547 W. Washington Blvd., Chicago, Ill., have recently cooperated in the development of a 90-inch machine, front and side views of which are shown in Figs. 1 and 2. The first six machines of this type were built on order for the American Locomotive Co.'s various plants in the United States, and this firm's standard specifications for a heavy-duty wheel boring and turning mill of the movable cross-rail type were adopted as a guide for the designers.

It will be apparent from the illustrations that, in general, the design of this boring mill follows established practice in the construction of machines of the movable cross-rail type. However, there are certain details to which the manufacturers call especial attention, and among these the following may be mentioned: Power is delivered to a single pulley from a 42½-horsepower 3 to 1 variable-speed motor which runs on 220-volt direct current. The driving pulley on the machine is 44 inches in diameter by 12 inches face width, and it carries a 10-inch belt. This pulley runs free on its shaft, connection to the gearing being accomplished by means of an Edgemont clutch, which is of the disk type and will transmit somewhat over 100 horsepower. The chief advantage of this arrangement is that the clutch is disengaged, and the brake applied with the same lever, making it unnecessary to overcome the momentum of the high-speed motor armature and the pulley and the belt. This allows the operator to stop the table instantly or move it around slightly when setting tools or work.

From the driving pulley, power is transmitted through gears which are enclosed in the bed of the machine and run in oil. Provision for efficient lubrication is one of the important features on a machine that is intended for heavy duty. Sight-feed lubricators are used to deliver a constant supply of oil to the spindle driving gears and feed-change gears. All gears are made of steel with cut teeth, so that

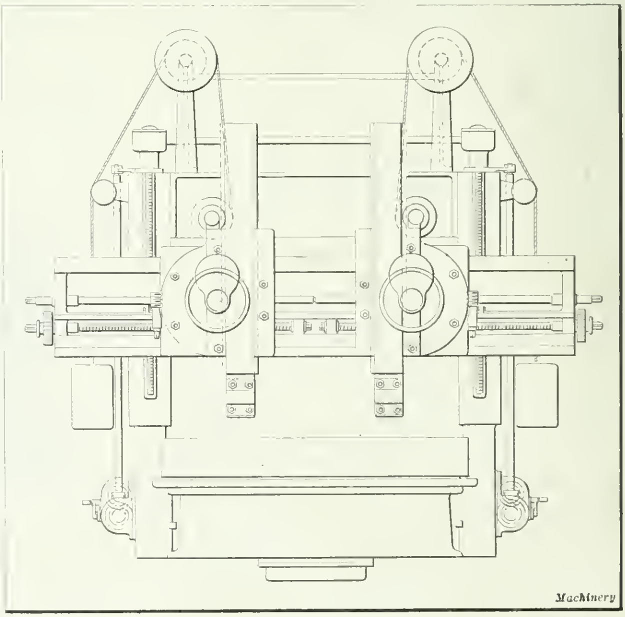


Fig. 1. Heavy-duty 90-inch Railroad Boring and Turning Mill built by the Colburn Machine Tool Co.

they possess ample strength and durability, and in this connection it is of interest to know that the full back-gear ratio is 104 to 1 with a maximum gear speed of only 1064 feet per minute. The table is driven by a pinion meshing with an internal gear which affords an advantageous condition of tooth contact.

The machine has demonstrated its capacity for taking a maximum cut of ½ by ⅛ inch in steel, with a cutting speed of 60 feet per minute. In working out the design, the fact has been constantly borne in mind that this machine is intended for severe service. For instance, the bed is of box form, reinforced with ribs and flanges. A cast-steel trough surrounds the bed to provide for catching cutting compound as it drips from the table. Large fitted bolts connect the bed and housings, which are also of box form and reinforced with ribs and flanges. The spindle is mounted on the table and has a suitable tapered bushing in the bed, which is provided with means of adjustment to compensate for wear. A powerful built-in independent four-jaw chuck is provided on the table; and in common with other gears in the drive, the table gear and pinion run in oil. All gears and other running members of the mechanism are effectively guarded.

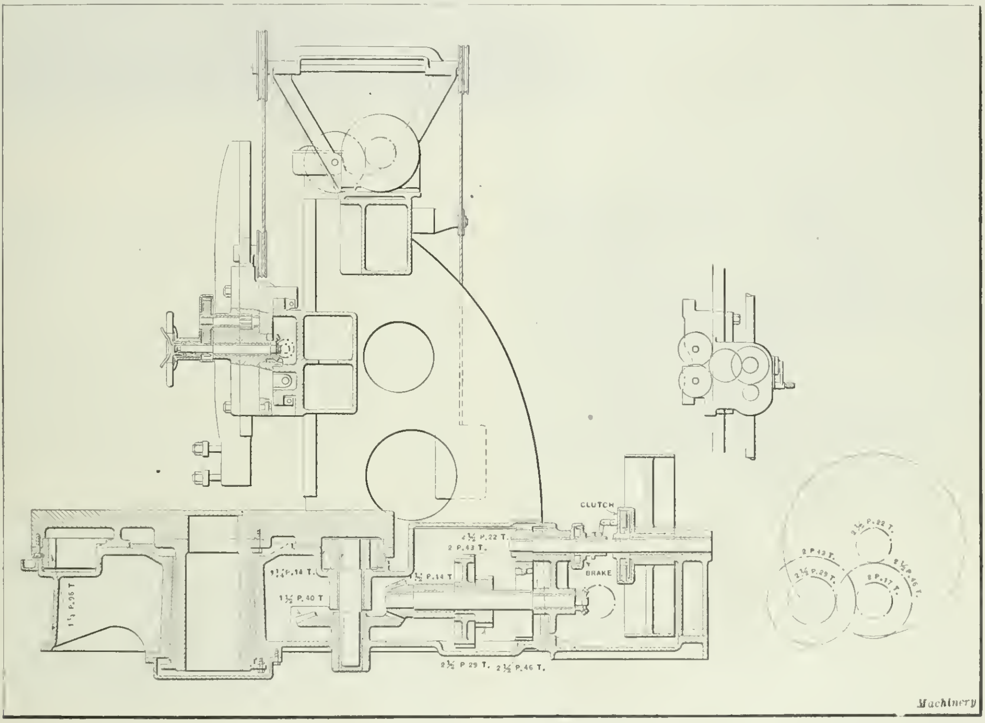


Fig. 2. Section through the Colburn Boring and Turning Mill shown in Fig. 1

A 5-horsepower independent motor provides for elevating and lowering the cross-rail, which is equipped with two independent saddles that are made right- and left-hand to adapt them for working close together. Either saddle may be moved to the center of the table for use in the performance of boring operations. All wear between the cross-rail and saddles, except on the face of the cross-rail, may be taken up with gibs made of cast iron. The cross-rail is of the narrow guide type. It is made of cast iron, and the saddles are made of steel. The rams are made of steel with cut rack teeth, and both swivels have adjustment up to 30 degrees on each side of the vertical position. Swiveling is accomplished by means of a worm and ratchet adjustment. Rapid hand movement is provided for the rams, and they are equipped with counterbalances that are arranged to exert a direct pull on the rams in any angular position. All feed gears are made of steel with cut teeth, and the feeds are reversible. Changes of feed are accomplished by sliding gears and clutches.

It will be of interest to mention a few of the important dimensions of this machine, which are as follows: Maximum swing, 91½ inches; maximum distance between table and cross-rail, 46 inches; spindle travel, 42 inches; diameter of table, 87 inches; diameter of track, 52 inches; width of track, 6 inches; diameter of spindle, 18 inches; length of spindle in bearing, 28 inches; table speed with back-gears in, 1½ to 4½ revolutions per minute; table speed with back-gears out, 6 to 18 revolutions per minute; number of available table speeds, 32; minimum vertical feed, 0.037 inch per table revolution; maximum vertical feed, 1¼ inches; minimum horizontal feed, 0.022 inch; maximum horizontal feed, 0.672 inch; number of available vertical and horizontal reversible feeds, 8. The approximate weight of the machine, including the motor, is 67,000 pounds.

JONES BORING, DRILLING, AND MILLING MACHINE

For use in handling such work as boring cylinders, motor housings, and other classes of horizontal boring mill work, the Jones Machine Tool Works, Philadelphia, Pa., has developed a horizontal boring, drilling, and milling machine of the planer-table type. The long table allows the operator to set up a similar piece of work while one is in the process of machining, and it also enables such work to be done as milling the faces of flange fittings and similar work that can be bolted down in a row on the table. This machine may be driven by either a constant- or a variable-speed motor located at the base of the column. Power is transmitted to the vertical driving shaft through spur and bevel gears, and the vertical shaft drives through a set of heat-treated steel bevel gears and sliding speed-change gears to the bull gear and quill, and thence to the spindle. All of these gears are fully enclosed in the saddle which is shown in Fig. 2. The saddle is raised and lowered on the column by a bronze nut revolving on a steel screw, the movement being obtained by means of either the handwheel, power feed, or rapid traverse. Provision is made for traversing the main column on its base by hand, power feed, or rapid traverse, the movement being controlled from the saddle. Power for traversing the column is transmitted from the saddle gearing to a bronze nut and steel screw; operation by hand from the floor is also possible. A steel scale is set in the front vertical shear to facilitate setting the spindle in line with the outboard column bearing.

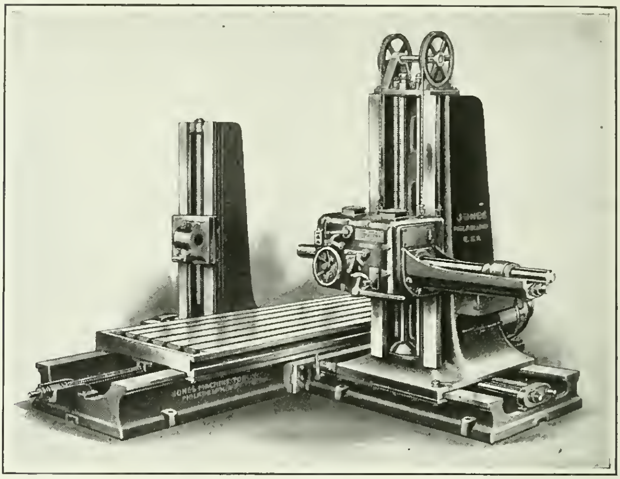


Fig. 1. Horizontal Boring, Drilling, and Milling Machine of the Planer-table Type, built by the Jones Machine Tool Works

The table is also operated from the saddle by hand, power feed, or rapid traverse, and there is also a hand feed from the floor. As in the case of the column movements, power is derived from the saddle gearing and transmitted to a revolving bronze nut and steel screw. There are T-slots in the top of the table for bolting down the work, and a dovetail is machined on the table face for use in holding down special index-plates and fixtures. The outboard column support is hand-operated for both horizontal traverse on the base and saddle traverse on the column, and there is a steel scale on the face of the shear for aligning the bearing with the spindle. A platform (not shown in the illustration) is slipped into position on the saddle when handling work that takes the operator from the floor. The central control on the saddle gives the operator complete control of the machine while on the platform, and this feature reduces the time required in the performance of the various jobs for which a machine of this type is adapted.

Fig. 2 shows the centralized control of the saddle. All levers are conveniently located and within easy reach of the operator. This illustration also shows the method of fastening on the faceplate, which may be furnished when required. All sliding speed-change and feed-gears, except the bull gear, which is made of electric steel, are produced from 0.60 to 0.70 per cent carbon steel and heat-treated. All gear shafts are made of steel and run in bronze bearings provided with sight-feed lubrication. The bull gear, in addition to being carried by a steel quill, runs in a large conical bearing that takes the thrust when using a faceplate, milling cutters or facing attachments. The quill runs in large bronze bearings located at each end of the saddle, and drives the spindle by two splined keys placed diametrically opposite each other. The front end is provided with a cone bearing adjustment to take up the wear of the spindle, and the rear end is arranged for a ball bearing thrust and adjusting nut.

The spindle is made from 0.60 to 0.70 per cent carbon steel and has a standard Morse taper bore at the front end. It is supported by the quill and a steel clamp bushing which runs in the bronze-bushed rear slide. Thrusts in either direction are taken by large bronze thrust washers located on the faces of the rear slide. The feed to the spindle is accomplished by a bronze nut in the rear slide, acting in conjunction with a steel screw. As in the case of other movements, it is operated by a handwheel, power feed, or rapid traverse. Power feed gears are all located in the front cover of the saddle, and are provided with a friction safety device. The rapid traverse is also of the friction type, and provides against breakages, should the spindle, saddle column, or table become jammed when at the end of one of their respective traverse movements.

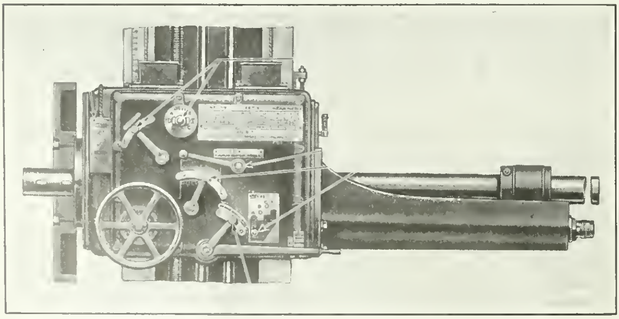


Fig. 2. Close-up View of the Saddle of the Machine shown in Fig. 1

BROWN & SHARPE MACHINISTS' TOOLS

The Brown & Sharpe Mfg. Co., Providence, R. I., has made additions to its line of machinists' and toolmakers' tools, and improvements to some of the older tools. One of the additions is the depth gage No. 607 shown in Fig. 1, which is furnished with three measuring rods. The micrometer screw has a movement of 1 inch, and by means of the rods, measurements ranging from 0 to 3 inches may be made. The gage handle is graduated in thousandths of an inch. Any measuring rod is easily placed in position by unscrewing the cap at the top of the gage, withdrawing the rod which happens to be in place, and then inserting the one to be used. When the cap is again screwed in place, the shoulder at the top end of the rod is brought against a finished seat. These shoulders on the rods are adjustable. The depth gage is obtainable with either a 2½- or 4-inch base.

The tempered hook rules Nos. 320 and 325 are now supplied with a hook that is reversible and has a shoulder which facilitates the setting of calipers and dividers. The

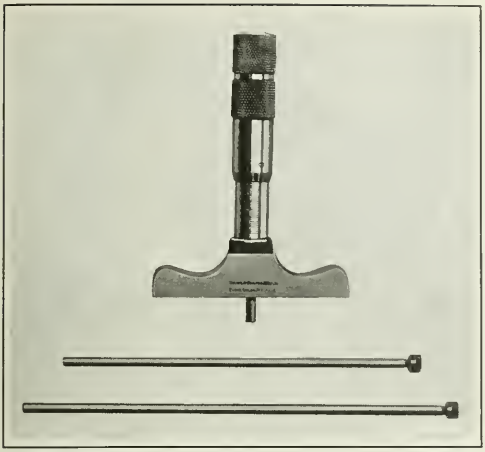


Fig. 1. New Design of Depth Gage made by the Brown & Sharpe Mfg. Co.

hook is held squarely and firmly on the rule by means of a screw, and while it cannot be pulled off unintentionally, it is easily removed to permit the rule to be used alone. An improvement has also been incorporated in the center heads furnished with combination squares and sets. Both arms of the center head are now ground to an equal length, so that their outer edges are equi-distant from the edge of the scale which runs through the middle of the center head. This improvement permits the employment of the center heads with work of large diameter, and thereby greatly increases their range.

The vernier calipers Nos. 570 and 571 and the 10-inch vernier height gage No. 585 are now made so that measurements can be read directly, without the necessity of making additions or deductions. Outside measurements are read from a vernier on one side of the measuring bar, and inside measurements from a vernier on the other side. Points are placed on the bars and slides of the calipers for use in setting dividers, etc. A No. 644 thickness gage which has blades that are longer than on the regular line of thickness gages is now being made. It has nine blades, 3 inches long, ½ inch wide, and of the following thicknesses: 0.0015, 0.002, 0.003, 0.004, 0.006, 0.008, 0.010, 0.012, and 0.015 inch.

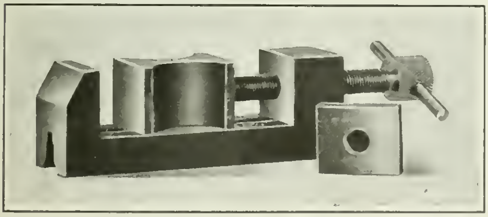


Fig. 2. Improved Design of Toolmakers' Vise made by the Brown & Sharpe Mfg. Co.

The toolmakers' vise No. 752 has been redesigned as shown in Fig. 2. This vise is handy in drilling, fitting, and laying out work on surface plates. It is casehardened and the base is ground. The steel movable jaw is provided with a tongue which slides in a slot in the base, the tongue being held in place by means of a strap. This feature prevents the jaw from lifting when work is being clamped. The strap can be removed to enable the jaw to be placed upside down on the base. When this has been done, tapered pieces can be clamped. The maximum distance between the jaws of the vise is 2 inches. There is a V-groove suitable for holding work ranging from 9/32 to 11/16 inch in diameter in the base, so that the tool can be used as a V-block. Each vise is provided with two movable jaws.

Another tool of interest is a No. 753 toolmakers' vise clamp, which is similar in appearance to the vise just described. However, it is not provided with the V-groove in the base, the tongue on the jaw, nor the corresponding slot in the base. These vise clamps are convenient for holding work to be drilled, and they are often used in pairs.

LANDIS CYLINDER GRINDING MACHINE

All makes and types of automobile cylinders that are cast en bloc, as well as a miscellaneous variety of irregular castings, may be ground on the No. 5 cylinder grinding machine shown in Fig. 1, which is a recent development of the Landis Tool Co., Waynesboro, Pa. The center of the grinding wheel spindle is located 10 inches above the top of the work-carriage, and so large castings may be handled without special fixtures. The grinding wheel spindle which is regularly furnished provides for the grinding of holes up to 15 inches in depth, and it is equipped with two wheels 2½ and 3½ inches in diameter, respectively. The spindle has an eccentric adjustment ranging from 1/16 to 1 1/16 inches, the adjustments allowing the grinding of holes as large as 5⅝ inches in diameter with a 3½-inch wheel. The eccentric adjustments are obtained by altering the relative positions of two eccentric sleeves, one of which is within the other. Extra wheel-spindles and sleeves may be furnished for grinding holes 20 and 22 inches deep or with diameters larger than 6 inches.

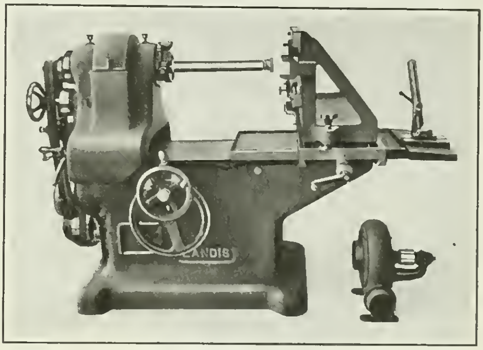


Fig. 1. Automobile Cylinder Grinding Machine developed by the Landis Tool Co.

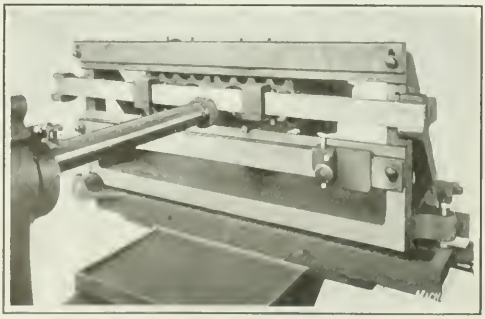


Fig. 2. Close-up View of the Work-carrying Fixture for the Machine shown in Fig. 1

The work-carrying fixture, shown in Fig. 2, is an angle-plate of an open design, which has two adjustable clamping bars to which the work is securely held by means of two heavy clamps. A feature of this fixture is the arrangement provided for quickly and accurately aligning the work in a vertical position in relation to the center. A bar having two adjustable centering brackets fits into two slots milled in the frame of the work-carrying fixture. Before clamping the work on the fixture, these centering brackets are inserted in the hole to be ground, in order to ascertain its exact size. They are then set to this dimension, and the centering bar is placed on the fixture. When the work is mounted on the fixture, it is placed over the two centering brackets, and thus accurately aligned. After the work has been clamped in position, the aligning bar is removed. A minor adjustment can be made by means of a screw, if the work has not been absolutely aligned by the means described.

Cross movements of the work-carrying fixture are obtained through the operation of a screw which is provided with a dial graduated in thousandths of an inch to facilitate accurate settings when changing from one cylinder to another. The work-carriage has a cross movement of 27½ inches, which is sufficient to enable the grinding of any motor block in one set-up. The work-carrying fixture is mounted on a carriage which operates on flat and dovetailed guides. These guides are lubricated by rollers running in pockets filled with oil. The longitudinal movement of the carriage is automatic, a reversing motion being obtained by the provision of two self-locking adjustable dogs. The carriage has a constant traverse of 10 inches per minute. The machine may be arranged for either a direct motor drive or to be driven from an overhead countershaft. With motor drives, a 3-horsepower motor, operating at 1150 revolutions per minute, furnishes ample power. The net weight of this machine is about 2900 pounds.

PRATT & WHITNEY "TRUS-FORM" SNAP GAGES

A line of what are known as "Trus-form" adjustable limit snap gages embodying several new features of design, has recently been added to the line of tools manufactured by the Pratt & Whitney Co., Hartford, Conn. These gages are constructed along the same general lines as a roof truss, with the metal placed where it affords maximum rigidity. This frame of triangular cells has the flanges and ribs in tension or compression, forming a light and stiff construction. The outer rib with its broken lines affords a sure grip for the fingers, even when they are oily. A unique adjustment is provided for the anvils as shown in Fig. 2. Two opposed screws pull in opposite directions like the screws of an independent lathe chuck, and by pulling one against the other the finest adjustment is easily made, this adjustment being positive in either direction. When both screws are tight, the anvil is securely locked against shake in any direction. It cannot be jarred loose and may readily be sealed. The holes in which the anvils work are accurately line-reamed, and the anvil faces are lapped square before assembling.

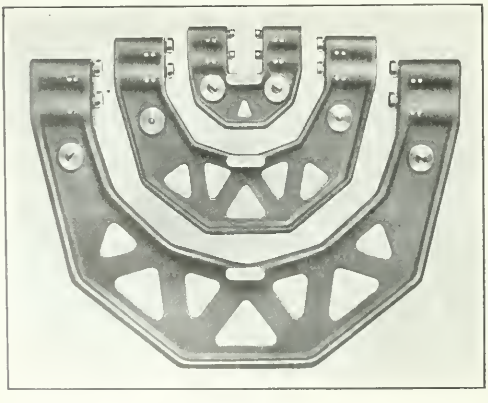


Fig. 1. "Trus-form" Adjustable Limit Snap Gages made by the Pratt & Whitney Co.

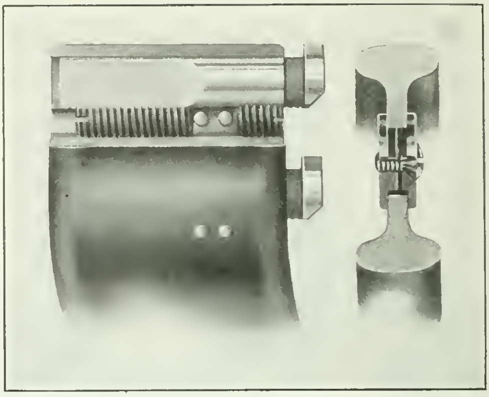


Fig. 2. Adjustment of the Anvils and Arrangement of Marking Plates on Pratt & Whitney Snap Gages

Except for the most exacting work, no lapping is necessary after assembling. New anvils may be substituted at any time, and they are strictly interchangeable. In sizes over ½ inch, all anvils have heads which permit of gaging to within 1/32 inch of a shoulder. In the smallest size, as an extra, two special anvils with offset heads may be used in the "Go" position, where it is necessary to work close to a shoulder. These are not needed in the "Not Go" positions. For marking sizes, tool numbers, operation numbers, etc., two pairs of brass buttons are secured by through screws in the manner shown in Fig. 2. They are readily removed to a bench plate for stamping, and they may be filed off and re-marked. One pair may be used for any permanent marking and secured by riveting over or soldering the point of the screw. Gages of this type are made to cover a range from 0 to 12 inches in fifteen different sizes, as follows: 0 to ½, ½ to 1, 1 to 1½, 1½ to 2, 2 to 2¾, 2¾ to 3½, 3½ to 4¼, 4¼ to 5, 5 to 6, 6 to 7, 7 to 8, 8 to 9, 9 to 10, 10 to 11, and 11 to 12 inches.

TWIST DRILL GRINDER

A twist drill grinding machine producing a ground drill point automatically and employing a different principle from that used in the past has been brought out by the Oliver Instrument Co., Adrian, Mich. This machine is of an entirely new design, and the point it produces is so shaped that, according to tests carefully made, drills ground on it will penetrate metal at a very rapid rate. The outstanding feature of the machine is the simplicity of operation and adjustment. All the operator has to do is to clamp the drill in the holder, and turn it to the correct grinding position, which is done by simply setting the lip horizontal, either by a gage on the machine or by the eye. After the drill has been clamped in the holder, the machine works automatically. It will grind two-, three-, and four-lipped drills with equal ease, simply by moving a handle to the proper position on a segment marked for the number of lips. No adjustment is required for different sizes of drills.

The drill to be ground is held by its shank in a spindle capable of rotating. The grinding wheel arbor revolves in ball bearings mounted in an oscillating cradle, which also has an axial movement controlled by a cam in the body of the machine, these movements being so related that the wheel traverses the cutting lip of the drill until the point of the drill approaches the periphery of the wheel, the drill remaining stationary during this movement. When the drill approaches the periphery of the wheel it revolves automatically, the wheel moving forward. This motion has two effects; it increases the lip clearance toward the center of the drill, and it forms the clearance at the heel. It also cuts out the metal in the front of the chisel point where the drill lip usually drags, and produces a chisel point that is shorter, because of the angle at which it is ground.

The drill-holder consists of a rotating spindle provided with a taper hole to accommodate standard taper sleeves. The nose of the spindle is threaded to receive a chuck for holding straight-shank drills up to 1½ inches in diameter. The machine is so built that the spindle is permanently held at an angular position that will produce the proper point and clearance angles, the spindle being revolved by means of gearing. The drill to be ground is inserted in the spindle much in the same way as it would be inserted in a spindle for drilling, the only adjustment necessary being to set the lip horizontal as already mentioned.

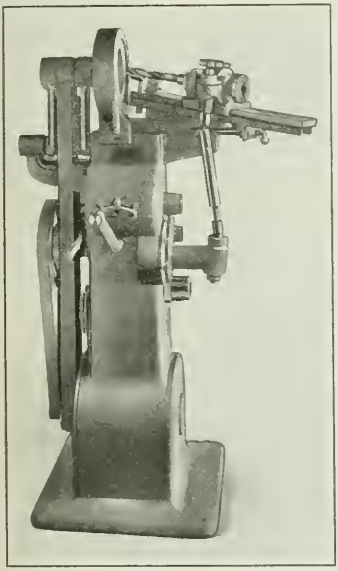


Fig. 1. Improved Type of Drill Grinding Machine built by the Oliver Instrument Co.

The operation of the machine is simple, because after the drill has been placed in the chuck and the lip set horizontal, the drill is simply brought into contact with the grinding wheel by turning the screw-feed back of the drill. The drill point is always in plain sight of the operator, so that he can see when the drill has been sufficiently sharpened. The motions of the machine are all obtained by mechanisms of simple design, with all gearing running in oil. A special mechanism is provided which automatically stops the machine in the proper position for setting the drill, so that the relative motions of the wheel and drill cannot change.

The machine is made either for belt drive or for individual motor drive. The countershaft and driving pulleys for belt drive are assembled in one unit and bolted to the pedestal, use being made of a foot-pedal belt-shifter. The speed of the countershaft is 1000 revolutions per minute. When individual motor drive is used, the motor is housed in a dustproof compartment in the base of the pedestal, the motor speed being 1750 revolutions per minute. The base of the pedestal is 20 by 20 inches, and the over-all length parallel to the slide is 32 inches. The height is 52 inches.

In order to prove that the drill point produced by this new type of twist drill grinder will penetrate metal at a very rapid rate, a simple testing device, as shown in Fig. 2, was made and applied to a drilling machine. As will be noted, the power required for feeding is obtained by weights attached to a rope wound about a circular segment which is mounted on the feed-spider of the machine. The edge of the segment is graduated so that it is possible to read off a given distance of penetration of the drill. By using a stop-watch and noting the time required for drills ground in different ways to penetrate a certain distance in the same piece of material, it has been found possible to test accurately the efficiency of the drill point that this new twist drill grinder produces.

In tests made it was shown that a 1-inch diameter new drill with the original grinding would require 1 minute and 48 seconds to penetrate a given distance, while when reground by the machine described, the same depth of hole was drilled in 1 minute and 18 seconds. In the case of a 1 1/16-inch drill, the respective figures were 1 minute and 45 seconds as compared with 1 minute and 17 seconds. Another new 1-inch drill required 1 minute and 29 seconds to penetrate to the same depth as the reground drill penetrated to in 51 seconds; and in another case a new ¾-inch drill required 1 minute and 7 seconds to penetrate the same distance as the reground drill penetrated in 53 seconds. It is interesting to note that the results obtained in the test made were not erratic, but quite uniform and consistent, the gain in penetrating rapidity obtained through regrinding the drill on the new twist drill grinding machine being a percentage not varying appreciably within certain given limits.

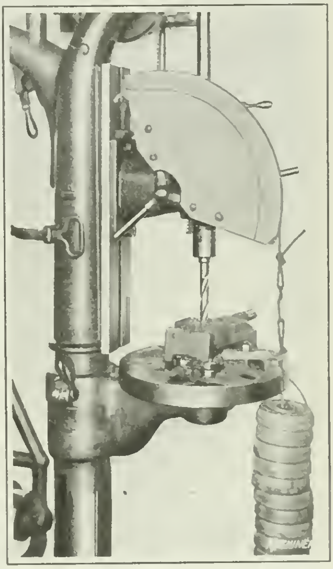


Fig. 2. Machine used for testing Drills ground on Machine shown in Fig. 1

The tests made indicate that the drill point permits of drilling more holes per hour than would otherwise be possible. As the point cuts more easily, it is also reasonable to assume that less power is required, and therefore drill breakages would be reduced. Another important point is that the operator requires no skill in producing the correct drill point, because the grinding machine performs its work independently of the operator after the drill is set with its lip horizontal.

HOUSTON, STANWOOD & GAMBLE LATHE

A newly designed heavy-duty triple-geared lathe of 60-inch swing has just been built by the Houston, Stanwood & Gamble Co., Cincinnati, Ohio. This machine is shown in the accompanying illustrations. The bed is a one-piece casting, 42 feet long, and the total weight of the lathe is approximately 40 tons. The machine is driven by a 35-horsepower variable-speed motor mounted on the headstock. An additional motor is furnished on the left end of the apron, affording rapid power traverse to the carriage. Two steady-rests are provided, the larger having a capacity for work from 23 to 37 inches in diameter, and the smaller, for work from 2 to 23 inches in diameter. The jaws of these steady-rests have bronze shoes.

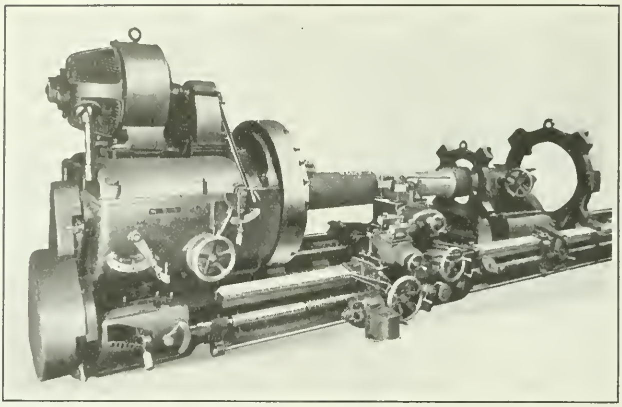


Fig. 1. Triple-geared 60-inch Lathe built by the Houston, Stanwood & Gamble Co.

The various spindle speeds are obtained by operating the levers and handwheel on the headstock, and the different positions of these are designated by letters to enable an operator to determine a speed readily by referring to this speed plate on the headstock casting. The majority of the headstock gears have a pressure angle of 20 degrees. Lubricant is delivered to the headstock by means of a pump mounted at the rear of the lathe, which is driven from the motor shaft. To insure that the oiling system is functioning properly, an indicator is located on an oil-feed line from the pump to the headstock. This indicator has an aluminum wheel which spins rapidly when oil is flowing. The wheel may be observed through a glass at the front of its container. A device is provided to prevent oil from flowing up on the motor pinion and leaking out through the housing. Fig. 2 shows a rear view of the gear-box located on the bed beneath the headstock, and gives an idea of its rigid construction.

Starting, stopping, and reversing of the motor on the headstock are controlled from a controller mounted on the right-hand end of the apron. The action is transmitted through the horizontal shaft near the bottom of the bed and through sprockets and a chain at the right-hand end of the bed, which connect with a second horizontal shaft at the rear. A long ratchet lever is provided at the left-hand end of the apron for exerting great pressure during a hand adjustment of the carriage, or for use in feeding the carriage along the bed under heavy cuts. A full-swing rest is mounted at the left-hand end of the carriage. Power traverse of the carriage is obtained by operating a lever on the apron, which engages a friction clutch. By moving this lever toward the operator, a positive clutch is engaged, which allows the carriage to be traversed by hand. The controller of the traversing motor is so constructed that the operator must hold the controller handle in position in order to run the motor. When the handle is released, it springs back to a neutral position. The friction clutch lever also springs to a neutral position when released.

A detailed view of the rear of the apron is shown in Fig. 3. There is an interlocking mechanism between the half-nuts for the feed-screw, the bevel gears, and the large outer bearing of the rack pinion. The rack pinion has stub teeth with a 20-degree pressure angle. The front and back walls of the apron are doweled and bolted together so that a practically solid box is obtained, which prevents the shifting of bearings out of alignment. The feed mechanism in the apron is driven through a positive angular-tooth clutch. This clutch permits feeds to be instantly engaged or disengaged without excessive strain on the operator's wrist. Both the front and back walls of the apron are bolted to the carriage.

At the right-hand end of the bed in Fig. 1, there will be noticed several supports for the lead-screw and control rod. One of the chief advantages of this type of support is that only a few seconds are required to remove a support and replace it at any position along the bed. Each support is furnished with bronze bearings for the lead-screw and control-rod, these bearings being accurately located on the hanger and fastened to it by means of a bolt. In a test on the lathe, a cut 1⅞ inches deep was taken on a 16-inch diameter, 0.50 per cent carbon, hammered steel forging, at a feed of ¼ inch per revolution and a speed of 15 feet per minute. The cross-sectional dimensions of the tool used were 2 by 3 inches, and its length, 20 inches.

PEARSON-SCOTT "IRON MAN"

The productivity of hand screw machines and turret lathes may be considerably increased by the application of an auxiliary mechanism known as the "Iron Man," which enables such machines to be made fully automatic in their operation. This device has been recently developed by the Pearson-Scott Co., 1523-1529 E. Washington St., Indianapolis, Ind., and is shown in Fig. 1 located at the right-hand end of a hand screw machine and connected to the various members, the operation of which it controls. Fig. 2 shows a close-up view of this device with the various covers removed, so that an idea of its construction may be obtained. This device does not interfere with hand operation of the machine, as it can be disconnected in a few minutes.

The mechanism consists essentially of a large disk with holes in it by means of which flat cams may be secured to it. These cams make contact with rollers mounted on cross-

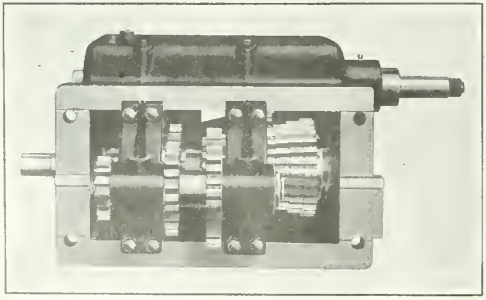


Fig. 2. Rear View of Gear-box on the 60-inch Lathe shown in Fig. 1

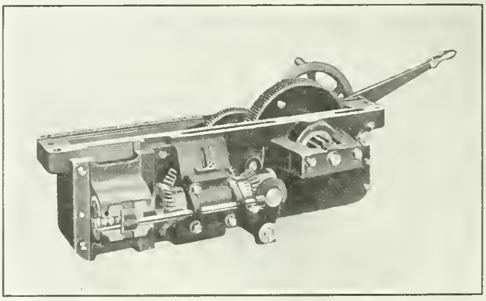


Fig. 3. Detail View of the Mechanism contained in the Lathe Apron

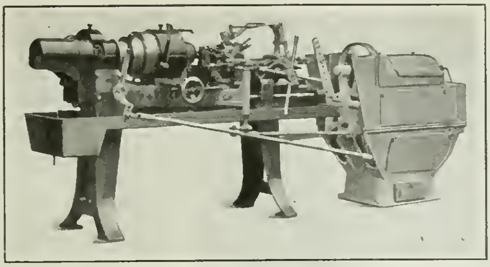


Fig. 1. Device built by the Pearson-Scott Co. for the Automatic Operation of Hand Screw Machines

heads that are attached to the ends of rods, the opposite ends of which are connected to the different units on the machine. The periphery of the disk has teeth in it which engage a worm mounted on a horizontal shaft. Thus, when this shaft is being driven, the disk is revolved. The cams are so placed on the disk that the various operations are performed in the proper sequence, one part being completed with each revolution of the disk. The locating of the cams on the disk is a simple matter, as the disk sides are stenciled with the shapes of the cams in the manner illustrated in Fig. 2, and the holes are drilled so that a cam will not fit in any other place except that in which it belongs. Twenty cams are supplied with each device, and this number is generally sufficient for one job. The indexing cams are never changed.

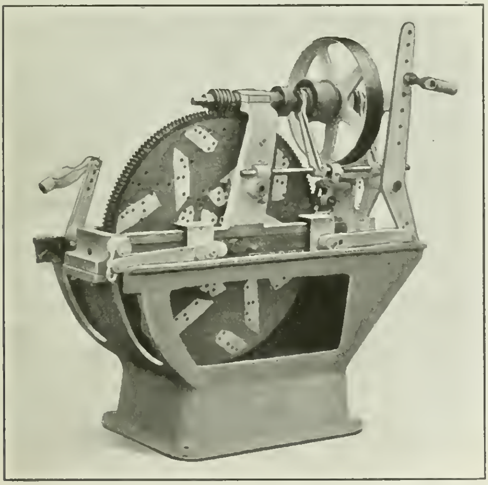
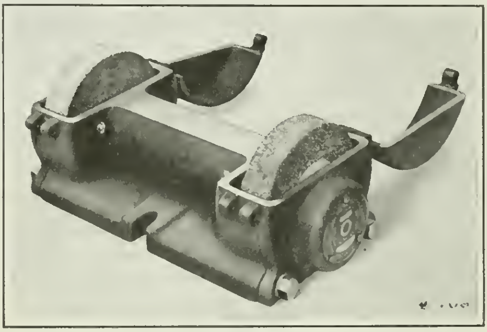


Fig. 2. Close-up View of the "Iron Man" with the Covers removed

The device may be located either at the right-hand end of the machine, as shown in Fig. 1, or at the left-hand end, and it may be used for driving simultaneously two machines doing the same kind of work. In case any of its members become clogged with dirt or chips so that they cannot function, or if the belt slips, damaging of the mechanism is avoided by the provision of a safety shearing pin. The countershaft supplied with the equipment is of a special design which will furnish the proper speed necessary for the material being worked, and which also regulates the feed. Automatic devices are provided for locking and unlocking the turret for indexing; setting dies for the cutting of threads; and controlling the feeding of stock. These units may also be supplied for attachment on hand-operated machines. The stock-feed control affords a stroke up to 12 inches. Attention is particularly called to the fact that the "Iron Man" does not necessitate the use of special left-hand tools. From two to six machines provided with this device may be tended by one operator.

PRECISION GRINDING-WHEEL TRUING MACHINE

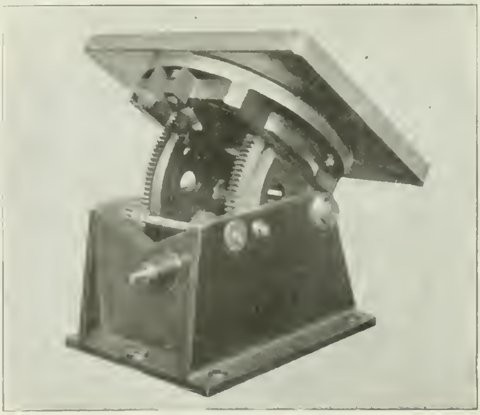
The illustration shows a machine for truing grinding wheels of surface grinding machines, which is suitable for wheels up to 6 inches in diameter. This machine is a product of the Precision Truing Machine & Tool Co., Cincinnati, Ohio, and is known as the No. 23 truing machine. It is provided with two wheels which may be of different grades, so as to make it possible to use the machine for dressing grinding wheels on which different classes of finish are required; or one wheel may be used for roughing and the other for finishing a wheel. Hinged covers are provided to protect the wheels when they are not in use. The wheels are 4 inches in diameter, and have faces 1 inch in width.



Duplex Grinding-wheel Truing Machine made by the Precision Truing Machine & Tool Co.

PAWLING & HARNISCHFEGER TILTING AND ROTARY TABLE

As a means of speeding up work and reducing machine shop costs, a new work-table for use with floor type boring, drilling, and milling machines, which is known as a universal tilting and rotary table, has recently been put on the market by the Pawling & Harnischfeger Co., Milwaukee, Wis. This accessory makes it possible to carry on machining operations on five sides of a piece and at any angle,



Universal Tilting and Rotary Table for Use with Boring, Drilling, and Milling Machines, built by the Pawling & Harnischfeger Co.

with but one set-up. In the accompanying illustration the table is shown in one of its positions. It has an elevation of 90 degrees, and can be revolved a full 360 degrees at any position, whether flat or elevated.

There is a graduated dial conveniently placed to enable the operator to locate the work accurately. The table top is elevated by means of two coarse-pitch spur gear segments driven by means of a worm and pinions; and it is revolved independently by a bevel gear and pinion. One revolution of the ratchet handle revolves the table 30 degrees, and one revolution of the elevating handle elevates the top 2½ degrees. Adjustment along the bed plate parallel to the spindle travel is accomplished by means of a rack and pinion. The T-slots or table edges are used for locating the work, and the top of the table is provided with a trough to catch cutting compound.

LANDIS 4-A SPECIAL GRINDING MACHINE

A machine designed for grinding all parts of automotive engines, except cylinders cast en bloc, has been placed on the market by the Landis Tool Co., Waynesboro, Pa. This machine is known as the No. 4-A special, and is shown in Fig. 1. Particularly interesting features of this machine are the fixtures for supporting crankshafts while they are being ground. These fixtures are provided with balancing weights which can be moved in and out from the center of rotation to suit the throw of the crankshaft. The headstock fixture is illustrated in Fig. 2, and the tailstock in Fig. 3. Each fixture is equipped with a three-jaw universal chuck to grip the corresponding end of the crankshaft. The mechanism for locating the chucks to suit the different sizes of crankshaft throws is operated by a small crank. The member which this crank rotates is provided with an indexing dial.

The work-carrying fixtures are centered and brought into alignment through the use of locating pins. The crankshaft is then placed in the chucks and trued radially by the use of a truing device, after which the chuck jaws are drawn up fairly tight and the truing device removed, preparatory to the grinding operation. The regrinding of four-throw crankshafts is accomplished in from 1 to 1½ hours, while six-throw crankshafts are ground in from 1½ to 2 hours. Wheels 24 inches in diameter are used. The machine is driven by a 5-inch belt from a small countershaft, about 5 horsepower being required.

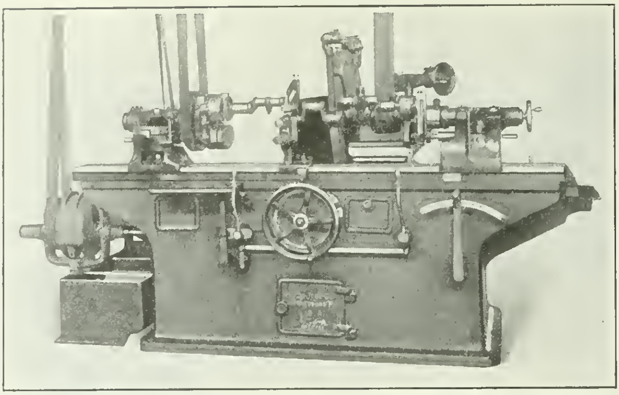


Fig. 1. Machine built by the Landis Tool Co. for grinding Automotive Engine Parts

NIAGARA POWER SQUARING SHEAR

The No. 8-H power squaring shear illustrated has been added to the line of shears built by the Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y. This machine is equipped with a set of gages that insures the accurate squaring of sheets, thus making possible their convenient handling and welding. The cross-head is of a heavy box construction, is guided in liberally proportioned ways, and is counterbalanced. The main shaft and eccentrics are forged in one piece of a tough grade of steel. The clutch block is equipped with removable hardened and ground striking jaws, as well as with hardened backlash jaws. The clutch wheel also has removable hardened and ground striking faces and a backlash pin. Two center bearings are supplied for the main shaft, and these are placed as close as possible to the eccentric and hold-down cams, so as to obtain the maximum support.

The hold-down cams bear against hardened steel rollers which are lubricated through hollow pins, and the hold-down rods are provided with springs to compensate for various thicknesses of plates. Self-adjusting brakes lined with asbestos are supplied, these brakes being made in hinged halves and equipped with automatic springs which compensate for wear. The knife chuck is provided with pockets that enable the knife bolts to be easily removed from the top. The chuck has T-slots on top to accommodate gages, and on the front for gage brackets. A screw and set-screw on each end of the knife chuck facilitate adjustments of this member. The housings are of massive construction and do not require stay-rods for cutting to the maximum capacity; however, stay-rods and stay-rod lugs

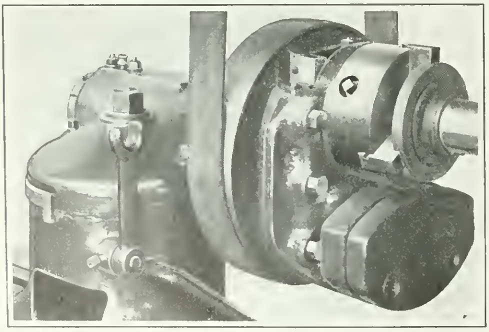


Fig. 2. Crankshaft Fixture on Headstock of Grinding Machine shown in Fig. 1

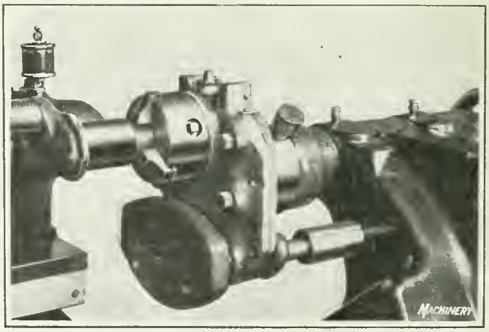
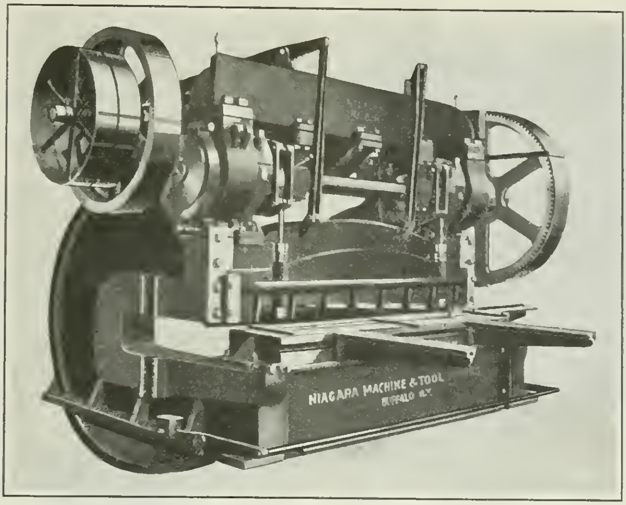


Fig. 3. Tailstock and Crankshaft Fixture on Grinding Machine shown in Fig. 1

are supplied if desired. The counterbalance rods are located outside of the housings, and so do not interfere with work being passed through the machine. The counterbalance weights are located below the floor line to comply with the safety codes of some states.

The gage equipment includes front, side, bevel, slitting, and patented automatic screw-adjusting back gages. The driving mechanism is placed overhead out of the way of the operator. The capacity of this machine is mild steel up to 5/8 inch in thickness: its nominal cutting length. 8 feet; the horsepower required for its operation. 30; the weight of a 24-inch gap machine. 27 tons; and the weight of a 36-inch gap machine, 30½ tons.



No. 8-H Power Squaring Shear built by the Niagara Machine & Tool Works

ANDERSON GEAR-CUTTER GRINDING MACHINE

To facilitate the grinding of tooth faces of small gear-cutters, such as are used on automatic gear-cutting machines employed in the manufacture of clocks, the Anderson Die Machine Co., Iranistan Ave. near Admiral St., Bridgeport, Conn., has brought out the machine shown in the accompanying illustrations. In Fig. 1, this machine is shown mounted on a base to which the driving motor and switch are also attached. However, it may be arranged for being driven by other means if desired. Referring to Fig. 2, it will be observed that the cutter to be ground is placed on spindle *A* which is mounted on bracket *B*. Located on this bracket there is also a finger *C*, which, by means of two adjusting screws. can be made to bear on the periphery of the gear-cutter close to the face to be ground.

On the lower end of spindle *A* there is mounted a worm-wheel which is rotated by a worm secured on the shaft to which handle *D* is attached. By rotating this handle, a tooth face can readily be positioned so that the proper amount of stock will be removed by the grinding wheel.

Gage *E*, Fig. 1. is furnished to permit the location of the grinding wheel so that the tooth faces will always be ground radially with the center of the cutter. In using this gage, it is placed on bracket *B* with spindle *A* projecting through its hole, and then the wheel-head is adjusted until the edges of the wheel come in contact with two straight faces on the gage. After the grinding wheel has been located in this manner, the setting of the wheel-head is undisturbed, and the tooth faces are then ground by swinging the entire fixture on which the cutter is supported, around spindle *A*. A stop-screw is furnished to regulate the amount that a tooth face is to be ground.

A diamond truing device is furnished with the machine. This device is mounted on the cutter-spindle and is also operated to and from the wheel through turning handle *D*. When it is necessary to form the wheel, the diamond nib may be removed from the truing device and inserted in handle *F*. The spindle of the grinding wheel is hardened and ground and provided with ball bearings. A Webster Whitcomb watch-lathe collet chuck holds the grinding wheel.

LAWRENZ DRAFTING COMPASS

To facilitate the drawing of accurate circles E. Lawrenz. 2533 McClellan Ave., Detroit. Mich., has recently developed a compass known as the "Normal" for the reason that the pencil or pen point is held perpendicular to the plane of the paper. Since the scope of this instrument is for circles from 1/16 inch up to 12 inches in diameter, and with the extension bar up to 24 inches in diameter, it will be evident that sufficient range is provided to meet all average requirements. Two ruling pens are furnished in the same case with the compass and its auxiliary fittings. The features of these instruments are as follows: The center leg and the describing leg are always parallel, that is. normal to the plane of the paper, so that the centers about which the circles are described are not enlarged but remain small and accurately

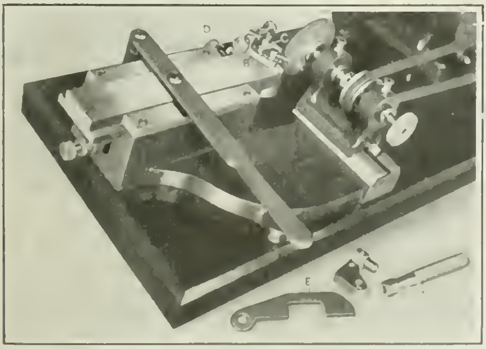


Fig. 1. Machine developed by the Anderson Die Machine Co. for grinding Small Gear-cutters

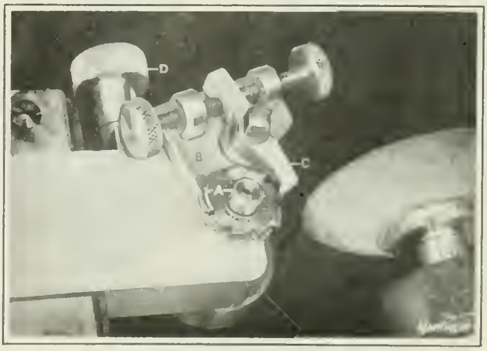


Fig. 2. Mechanism on Gear-cutter Grinding Machine, which locates the Tooth Faces to be ground radially

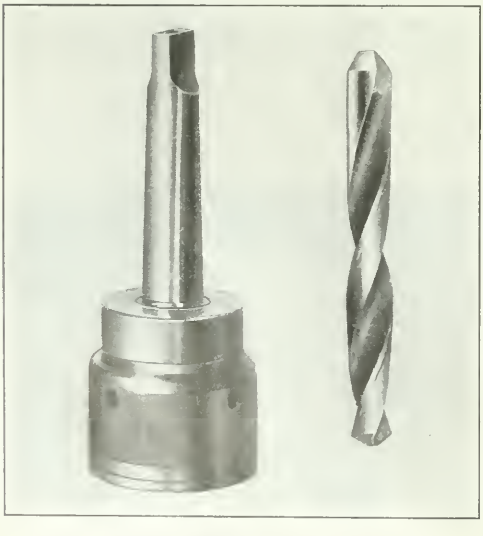
The "Normal" Drafting Compass recently developed by E. Lawrenz

placed, no matter how many circles may be drawn about the same center. The instrument may be quickly and easily set to any radius, and as readily clamped in that position, so that it is impossible for the compass to change its position.

There is no shake or backlash in any of the pivots about which different members turn, because they are of conical form, made of steel, and carefully hardened and ground. All of the adjusting screws are heat-treated and hardened, and the legs are rustproofed. There are two methods of rustproofing used for this purpose—one, the Parker process which leaves the arms jet black; and the other, electrosherardizing which leaves the arms gray, due to the coat of zinc which is amalgamated with the surface of steel.

WAYNE DRILL CHUCK

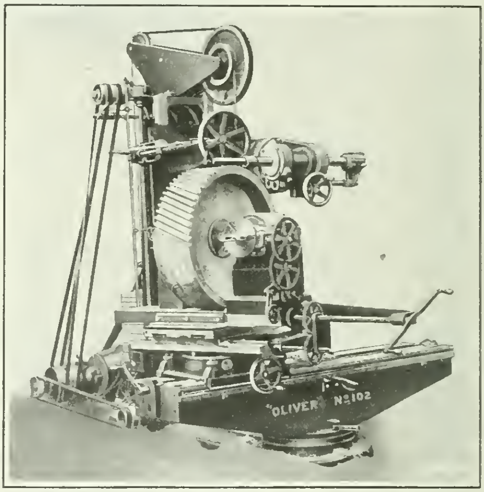
For use in holding twist drills with broken shanks, the Wayne Tool Mfg. Co., Waynesboro, Pa., has recently developed the chuck which is shown in the accompanying illustration. The design is especially simple, the chuck consisting of only seven parts, namely, the shank, casing, two pawls, two screws, and a casing plate. The drill is ground to a 60-degree point at the broken end, which allows it to automatically center itself in a 60-degree recess in the shank; and upon turning the casing, the drill is locked in place by two pawls gripping it above the grooves. No wrench is required to tighten or release the chuck.



Chuck made by the Wayne Tool Mfg. Co. for holding Drills with Broken Shanks

ATTACHMENT FOR OLIVER PATTERN MILLING MACHINE

The Oliver Machinery Co., Grand Rapids, Mich., has produced an attachment for its No. 102 pattern milling machine, consisting of a complete set of appliances for cutting teeth on the patterns of spur, spiral, bevel, and worm gears. This outfit consists of a special 14-inch universal dividing head, tailstock, index-plate, index-chart, 6-inch faceplate, 12-inch faceplate, a set of raising blocks, change-gears, quadrants, and a mechanism for driving the dividing head. The attachment is so designed that in turning a pattern for a spiral gear, the pattern is rotated according to the angle of the spiral as the cutting tool progresses across the face of the pattern.



Cutting a Spiral Gear Pattern on a Machine built by the Oliver Machinery Co.

POLIAKOFF MACHINE-SHOP RULE

For the use of estimators, draftsmen, shop foremen, and machinists in solving a number of problems connected with the machining of bar work on a lathe or grinding machine, R. Poliakoff, 709 Sixth Ave., New York City, has recently developed a universal machine-shop rule, opposite sides of which are shown in Figs. 1 and 2. Its use enables problems to be solved without any calculations whatever. Reference to the illustrations will make it apparent that in addition to the special graduations provided for the solution of shop problems, one side of this rule is furnished with inch and millimeter graduations, so that it may also be used as a measuring rule.

There are six typical problems which can be solved with the Poliakoff rule. With the graduations furnished on the same side as the inch and metric scales, it is possible to find answers to the following problems: (1) Given the diameter of a bar or of a grinding wheel in inches, and the cutting or grinding speed in feet per minute; find the number of revolutions per minute of the bar when worked on a

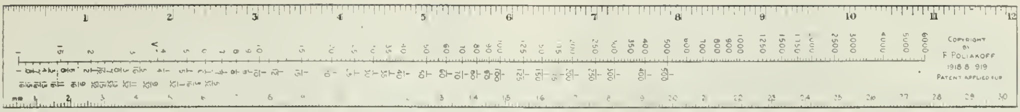


Fig. 1. Universal Machine-shop Rule developed by R. Poliakoff for Use in solving Four Classes of Machine Shop Problems

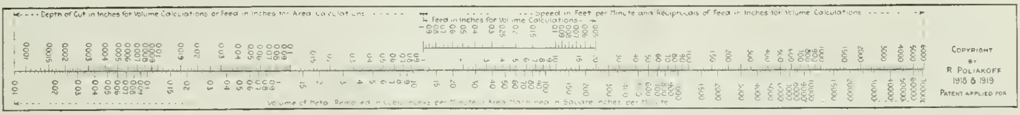

Depth of Cut in Inches for Volume Calculations or Feed in Inches for Area Calculations
Feed in Inches for Volume Calculations
Speed in Feet per Minute and Reciprocals of Feed in Inches for Volume Calculations
Volume of Metal Removed in Cubic Inches per Minute or Area Machined in Square Inches per Minute
Copyright
by
R. Poliakoff
1918 & 1919
Patent applied for

Fig. 2. Opposite Side of the Poliakoff Machine-shop Rule, used for solving Two Classes of Problems

lathe or of an abrasive wheel used for grinding the work. (2) Given the diameter of a bar or grinding wheel in inches, and the number of revolutions per minute of the work or of the wheel; find the cutting or grinding speed in feet per minute. (3) Given the cutting or grinding speed in feet per minute, and the number of revolutions per minute of the work that is being turned or of the grinding wheel; find the diameter in inches that can be turned or the proper diameter of the wheel. (4) Given the length of a bar in inches, the feed in inches per revolution, and the number of revolutions per minute; find the time in minutes required to turn or grind the bar. Using graduations on the opposite side of the rule, shown in Fig. 2, the following problems can be solved: (5) Find the volume of metal removed in performing a machining operation. (6) Find the area of the work that has been machined.

In solving all of the six preceding problems, it is noteworthy that the graduations on the rule are used more as a chart than as a scale, that is to say, known values are located on the proper scales, and the results are read directly from the rule, without requiring any computations to be made.

NEW MACHINERY AND TOOLS NOTES

Expansion Reamer: New Britain Tool & Mfg. Co., New Britain, Conn. A six-blade expansion type of reamer adapted for use in garages and other shops. The ends of the blades are ground down to serve as a pilot. The range of sizes is from 15/32 inch to 4 1/16 inches.

Motor Drives for Hammers: C. C. Bradley & Son, Inc., Syracuse, N. Y. A line of motor drives adapted for use on the hammers of this company's manufacture. Motors for alternating or direct current and with various voltages, phases, and cycles can be furnished.

Metal-cutting Band Saw: Clark Machine Works, Belmont, N. Y. A metal-cutting band saw designed to meet the demand for a compact sprue-cutting saw for use in brass foundries and shops where brass, bronze, aluminum, or any of the softer metals are required to be cut.

Drill Chuck: Skinner Chuck Co., New Britain, Conn. A pinion geared three-jaw drill chuck having the gearing exposed, whereas other models of this company's manufacture have the gears enclosed. At present the chuck is made in one size having a capacity of 0 to 17/32 inch.

Aligning Reamer: Chadwick & Trefethen, Portsmouth, N. H. A new type of Critchley aligning reamer similar to the six-blade adjustable reamer of this company's manufacture. The reamer is supplied with an adjustable bushing that forms a pilot for accurately aligning the tool.

Power Hacksaw: Frontier Machine Tool Co., Inc., 122 Lakeview Ave., Buffalo, N. Y. A belt-driven power hacksaw provided with an automatic stop and a positive clutch in the driving mechanism. The normal speed is 65 strokes per minute, and the cutting capacity is 5½ by 6 inches, using blades from 8 to 14 inches in length.

Tool Grinder: Frontier Machine Tool Co., Inc., 122 Lakeview Ave., Buffalo, N. Y. A belt-driven wheel-stand type of grinder, which carries two wheels 15 inches apart. Guards and rests are provided for the two 12- by 2-inch wheels. The height to the center of the spindle is 39 inches and the weight without the countershaft is 195 pounds.

Coolant Pump: Alemite Die Casting & Mfg. Co., 2640 Belmont Ave., Chicago, Ill. A line of coolant pumps made in five sizes with capacities ranging from ½ to 10 gallons per minute when run at their rated speed of 300 revolutions per minute. These pumps have only four moving parts, the crank head, rotor, oscillator, and the extension.

Portable Pneumatic Grinder: Keller Pneumatic Tool Co., Grand Haven, Mich. A portable pneumatic grinder known as the No. 22-G, which is provided with a rotary-piston type of motor. The tool is built in two sizes, the smaller weighing 5¾ pounds, and the larger 18 pounds. The wheel is guarded and a well shaped grip is attached at the end of the motor housing.

Compressed Air Blower: New Jersey Meter Co., Plainfield, N. J. A small blower which transforms a small volume of high-pressure air into a large volume of low-pressure air for the operation of rivet forges and similar equipment. A comparatively small amount of air is utilized through the compressed air line, the greater portion of the air being drawn in from the outside.

Vertical Bulldozer: Beatty Machine & Mfg. Co., Hammond, Ind. A vertical bulldozer especially adapted for railroad steel car construction and repair work, being used for the pressing and forming of such parts as diaphragms, stakes, end sills, etc. It is built in sizes up to and including 500 tons ram pressure, with a distance between housings ranging from 8 to 12 feet.

Box-form Table for Planer: G. A. Gray Co., Cincinnati, Ohio. A box type of table for the planers of this company's manufacture, which has been designed especially to facilitate cleaning, and to give a greater degree of rigidity. The top and bottom surfaces of the table are firmly tied together by a heavy continuous wall of metal running the entire length of the table on its center line.

Industrial Truck: Baker R. & L. Co., Cleveland, Ohio. A new series C line of electrical industrial tractors and trucks replacing the series B formerly built. Special provision for taking the heavy thrust of the axle and the driving breaking strains is made to insure a higher degree of flexibility that will enable the truck to be used on smooth or rough road surfaces with a small expenditure of power.

File Handle: Parker Supply Co., 785 E. 135th St., New York City. A file handle known as the "Shur-grip," which is provided with a casehardened flexible steel thread in the file opening, into which the tang of the file is screwed. The thread is designed to cut into the tang of the file like a die and to hold the file rigidly. These holders are made in three sizes for use with files from 6 to 18 inches long.

Automatic Screw Machine: New Britain Machine Co., New Britain, Conn. A ⅝- by 3¾-inch six-spindle automatic screw machine which is similar in construction to the machines previously manufactured by this company. The machine carries six end-working and four side-working tools. The capacity of the chuck is ⅝ inch for round stock, 0.443 inch for square stock, and 0.542 inch for hexagon stock. The length of feed is 3¾ inches, and the length that can be milled is 3 inches.

Internal Grinding Attachment: Hjorth Lathe & Tool Co., 27 School St., Boston, Mass. An internal grinding attachment that can be used on practically any of the plain or universal grinding machines now on the market. The attachment is driven from a ceiling countershaft, and the spindles are of two types—one for deep and large holes, and one with tapered arbors for small holes; the latter accommodates small emery wheels and diamond grinding plugs.

Heat-treating Furnace: Bellis Heat-treating Co., Blake and Valley Sts., New Haven, Conn. A triple-unit furnace developed for the heat-treatment of high-speed steels. It is provided with burners in all three chambers, those in the outer chambers being used for bringing the furnace quickly to the working temperature. They are then shut off, and the relative heats maintained by the flame from the central chamber passing through flues. Either gas or oil burners may be furnished.

Air-operated Hoist: Denver Rock Drill Mfg. Co., 39th Ave. and Williams St., Denver, Col. An air-operated hoist known as the "Model 250 Waughoist." The cylinders of the air engine are enclosed in an oil- and air-tight case which protects the engine from the atmosphere and serves as an oil reservoir. The hoisting capacity is 500 to 1000 pounds at the rate of 68 to 143 feet per minute, depending upon the weight of the load. The drum holds 1000 feet of 1/4-inch rope or 225 feet of 1/2-inch rope.

Shaping and Slotting Machine: Jones Machine Tool Works, Philadelphia, Pa. A vertical shaping and slotting machine made in two sizes with 6- or 10-inch stroke and equipped for either belt or motor drive. The 6-inch machine has three speed changes, while the 10-inch machine has four. The saddle, cross-slide and rotary tables are supplied with power feeds of the intermittent ratchet-feed type. The rotary table is graduated in degrees and has an indexing plate with spring stop for accurate spacing.

Burning-in and Running-in Machine: Phoenix Mfg. Co., Eau Claire, Wis. A machine designed to burn in and run in the main bearings on all makes of motor cars, trucks, and tractors. The burning-in operation is done at a speed of 200 revolutions per minute, and the running-in operation at a speed of 600 revolutions per minute. Ford and Fordson fixtures are regularly furnished, but other fixtures for different types of motors can be supplied. The machine weighs 2200 pounds, and occupies a floor space of 29 by 78 inches.

Cylinder Reboring Machine: Phoenix Mfg. Co., Eau Claire, Wis. A cylinder reboring machine designed for reboring motor cylinder blocks and which can be used either as a hand machine or with power. By the use of this machine, cylinders can be rebored without removing them from the chassis. Cylinders from 3 3/8 to 4 1/4 inches in diameter can be bored with the cutter-head furnished with each machine, and cylinders up to 5 inches in diameter can be bored by using extra blades. The total weight of the machine is 160 pounds.

Quick-change Lathe: A. V. Carroll Machine Tool Co., Norwood, Cincinnati, Ohio. A 14-inch quick-change-gear lathe, the swing of which is 16 1/2 inches over the bed, 19 inches over the gap, and 11 inches over the carriage. The head is equipped with either a three- or a four-step cone pulley or with either single or double back-gears as desired. Twenty-four changes of feed, either to the right or to the left, can be obtained by means of a conveniently located lever. The machine can be supplied with beds 6, 8, 10, or 12 feet in length.

Oil-grooving Machine: Fischer Machine Co., 310 N. 11th St., Philadelphia, Pa. An oil-grooving machine designed for cutting either straight or helical oil-grooves on the internal surfaces of bearings up to 15 inches in diameter and 15 inches in length. In appearance, this machine resembles an engine lathe, except that it is provided with a crank mechanism like that of a shaper, which imparts a reciprocating movement to the boring-bar in which the oil-grooving tool is held. In reality, the machine combines the standard features of an engine lathe and a crank shaper. Six spindle speeds ranging from 14 to 111 revolutions per minute are available. The swing over the bed is 19 inches, and the net weight of the machine is 3000 pounds.

* * *

BRIQUETTING PRESS FOR CAST-IRON CHIPS

A machine for forming the chips from turning, boring, and filing operations on cast-iron parts into briquettes, has been developed by the Danish Machine Co., Copenhagen, Denmark, and was described in a recent number of *Engineering*. It is claimed that in the production of ordinary iron castings, up to 15 per cent brisquettes can be made use of, and for special castings such as engine cylinders, the proportion can be further increased. The resulting iron is claimed to be compact and tough and to produce stronger castings than when pig and scrap iron are used alone. In addition, the briquettes provide a convenient means for introducing silicon or manganese into the metal. The press employed for this purpose can be used in a machine shop prior to sending the briquettes to a foundry, or the briquettes can be made in foundries from cast-iron chips purchased from a number of machine shops. The press has a vertical ram operated by a horizontal pneumatic cylinder through the medium of a toggle mechanism. The table of the press is provided with a mold attached to a pivoted arm, and the mold is filled with a mixture composed of chips, 5 per cent slaked lime and 5 per cent water. When filled on the side of the table, the mold is swung around under the ram for pressing, and afterward returned to its original position where a small auxiliary pneumatic cylinder is provided for the purpose of ejecting the finished briquette. The air pressure used is from 90 to 100 pounds per square inch.

The finished briquettes are in the form of truncated cones each weighing about 6 1/2 pounds. After pressing, the briquettes are placed on drying trays, where they are allowed to remain for some days until they are sufficiently hard to be handled, when they are piled out-of-doors for from two to four weeks, according to the state of the weather until they are sufficiently hard for transportation to the cupola. When placed in the furnace they should first be covered with a layer of coke in order to prevent them from being crushed by the pig iron or large pieces of scrap. The melting of the briquettes takes place from the outside, and a thin skin, which forms over the surface, prevents the absorption of sulphur and other impurities. The percentages of manganese, phosphorus and sulphur are not altered during melting, but those of carbon and silicon are reduced rather rapidly. The variation of carbon within small limits, however, has no effect on ordinary mixtures of iron, and it need not be considered unless the proportion of briquettes in the charge exceeds 10 per cent. On the other hand, it is desirable to add a certain quantity of silicon to the chips used for making the briquettes. The wastage in melting amounts to about 20 per cent so that each briquette produces over 5 pounds of iron. An unskilled operator can produce from 120 to 150 briquettes per hour.

* * *

STAMPING FOREIGN MAIL

Time and again the Department of Commerce and the trade journals have pointed out the inconvenience to foreign correspondents of receiving mail from America with insufficient postage. Recently several correspondents in South America and Europe have written to MACHINERY complaining that American manufacturers do not stamp foreign mail with sufficient postage and that they have to pay double the missing postage abroad in order to receive their mail.

Every business house having foreign correspondence should inaugurate some system which will insure that the mail clerk will not overlook the proper stamping of foreign mail. Some firms have adopted the method of using different colored envelopes for domestic and foreign mail, so that the mail clerk automatically distinguishes the two kinds. In other instances, a rubber stamp is used, marking "foreign postage" in the corner where the stamp is affixed. Any method is good so long as it prevents sending mail abroad without sufficient postage, as this may prejudice the receiver against the firm sending the mail.

* * *

The next convention and exhibit of the American Foundrymen's Association will be held in the spring of 1922, in either April or May, instead of in the fall of the year as has been the custom for a number of years. The change was decided upon by the board of directors because of the difficulty of obtaining hotel accommodations and adequate exhibition facilities in the fall. The place, which will be selected by the convention and exhibits committee, and the exact date will be announced later.

* * *

Information has been received through the Department of Commerce that the Conference of American Chambers of Commerce in China, which was to have been held at Shanghai during the spring, has been postponed until September. It is hoped that all American Chambers of Commerce will send representatives, and where there are no American Chambers of Commerce, and where American interests are represented through other American associations, that these associations will name delegates qualified to participate in the activities of the conference.

HOLDING WORK ON THE VACUUM CHUCK

For holding pieces made of various magnetic and non-magnetic materials on grinding and milling machines, shapers, planers, lathes, etc., vacuum chucks sold by the Crescent Pump Co., Detroit, Mich., are used in essentially the same manner as magnetic chucks are employed for holding pieces made of iron or steel. The upper surface of a vacuum chuck consists of a flat plate perforated with small holes leading to an inside chamber which is coupled up to an exhaust tank. The high vacuum in this tank is maintained by means of a Crescent roto-piston vacuum pump, one of which can operate several chucks at the same time. Each chuck is supplied with a control valve, and as a result, the vacuum chuck is controlled by manipulating a valve in the same way as the magnetic chuck is operated by an electric switch.

From the preceding description, it will be apparent that both in shape and in its method of application, a vacuum chuck is quite similar to the type in which magnetism is employed as the holding force. A special point is made of the ability of the vacuum chuck to hold such non-magnetic materials as brass, bronze, fiber, glass, stellite, white metal, wood, rubber, etc. Iron and all kinds of steel can also be held equally well. It will be apparent that work can be carried by a chuck of this kind without marring a finished surface, and so it is the common practice where pieces are to be finished exactly parallel, to first accurately grind one side, and then chuck from this surface to provide for grinding the opposite side exactly parallel with the one previously ground. Thin pieces can be held without pulling them out of shape and without straining; and no trouble is experienced with this type of chuck from either the tools or the work becoming magnetized.

What is known as a "universal" top plate is ordinarily supplied with each chuck, but special plates can be made to meet the requirements of unusual classes of work. These top plates are easily removed, so that a chuck may be readily adapted for various jobs without serious loss of time. A gasket made of gum rubber, of varying thicknesses according to the roughness of the part to be held is used between the chuck and the work. In this gasket, holes are cut ¼ to ¾ inch smaller than the size of the work. Each hole in the rubber is placed over one or more holes in the chuck plate, so that when a piece of work is laid over the hole, the vacuum pulls it down firmly on the rubber, which prevents leakage of air between the work and the face of the chuck. A gasket of this kind is used for holding rough work only; for machining the second face, the work is held on its previously ground surface, and so a gasket made of paper should be used in place of the rubber one. Held in this manner, finishing cuts may be made within a limit of accuracy of 0.0002 inch

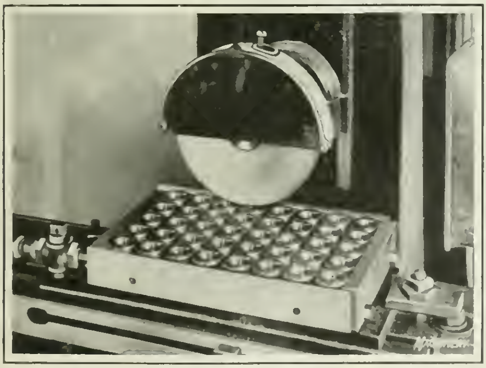


Fig. 1. Application of a Rectangular Vacuum Chuck in the Lincoln Motor Car Co.'s Plant, for holding Non-magnetic Bronze Washers while performing a Grinding Operation

By making special chuck plates and cutting out the surface 1/32 inch deep over areas ¼ to ⅜ inch smaller than the pieces of work to be machined, the rubber gasket need not have large holes cut in it. Instead, it is laid over the face of the chuck and a hole is punched through the rubber or paper, corresponding in position to each small hole in the depressions on the surface. The depression 1/32 to 1/16 inch deep which is cut in the chuck face surrounding each hole affords sufficient clearance so that the air pressure above the work becomes effective in holding it firmly in place on the chuck. For machining the second face, no gasket is needed with routed out plates. When one of these chucks is used for taking heavy cuts, adjustable side plates are applied in the same manner as on magnetic chucks. Crescent vacuum chucks are made in 6- by 8-, 7- by 12-, and 7- by 18-inch rectangular sizes; and in addition, there is a rotary chuck measuring 16 inches in diameter. Special top plates are made for these chucks, to meet the requirements of the user. Special applications of this principle are made to suit all classes of work and machinery. In Fig. 1, one of the rectangular Crescent vacuum chucks is shown set up on a machine used for grinding bronze washers in the Lincoln Motor Car Co.'s plant in Detroit, Mich., and one of the rotary vacuum chucks is shown in Fig. 2 grinding stellite cutter blades in the Kokomo, Ind., plant of the Haynes Stellite Co.

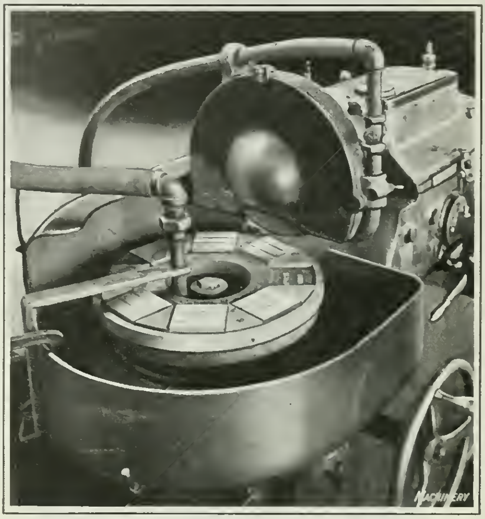
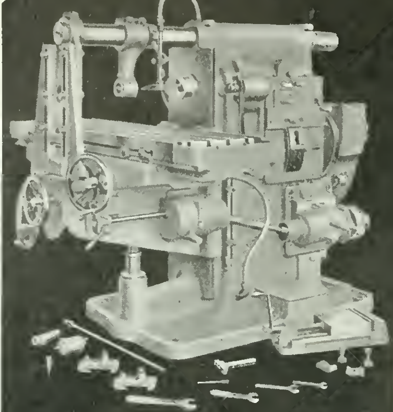
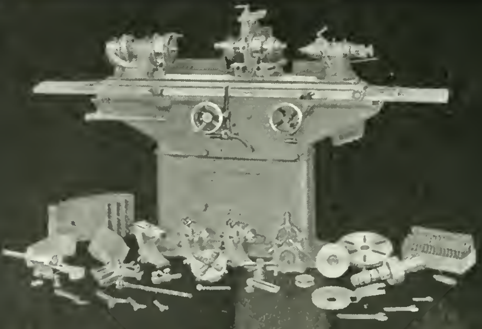


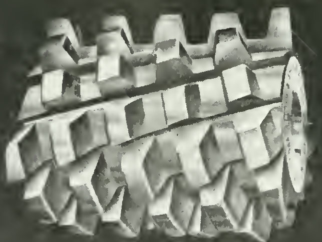
Fig. 2. Application of a Rotary Vacuum Chuck in the Haynes Stellite Co.'s Plant for holding Stellite Cutter Blades while performing a Grinding Operation

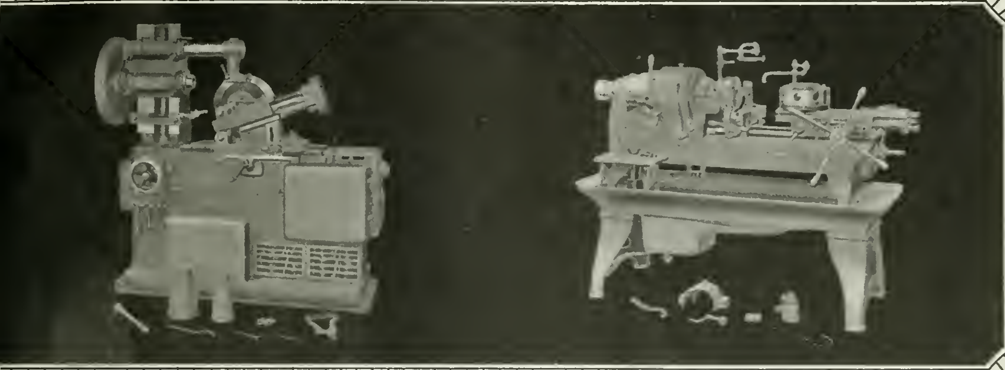
* * *

The United States Civil Service Commission announces open competitive examinations for foreman mechanic in the air mail service. The applicant must have had either three years experience in the assembling, installation, testing, repairing, etc., of gasoline engines on automobiles, or have completed an apprenticeship or its equivalent as a machinist, and in addition must have had at least one year's experience in the installation, testing, and maintenance of airplane motors. Two years' experience in installation, testing, and maintenance of airplane motors will be considered a satisfactory equivalent of the above requirements; or one year's experience as rigger or repairman assigned to the building, maintenance, or repair of the structure of airplanes. Applicants should apply to the Civil Service Commission, Washington, D. C., for Form 1312, stating the title of the examination desired. Filled-in applications must be received by the Civil Service Commission not later than July 12.









WHETHER it's a Milling Machine, Grinding Machine, Gear Cutting Machine or Screw Machine, or whether it's one of the three thousand different cutters and hobs or 1,000 Machinists' Tools, if it's a Brown & Sharpe Product—it's built with skill and care, and pride in craftsmanship, and the High Standard of Brown & Sharpe Quality, known world-wide, stands out predominant.

Established 1833

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

PERSONALS

Lionel A. Wharrad, director and technical adviser of the British Needle Co., Ltd., Redditch, England, has recently come to the United States on a visit with a view to making business connections in this country.

P. R. Letts has been appointed office manager of the industrial bearings division of the Hyatt Roller Bearing Co., New York City, to succeed G. J. Traendly, who is now office manager of the General Motors Corporation of New York.

Charles Copeland, assistant treasurer of E. I. duPont de Nemours & Co., Wilmington, Del., has been elected a member of the board of directors and secretary of the company to fill the vacancies caused by the death of Alexis I. duPont.

Robert E. Belt, secretary-treasurer of the American Malleable Castings Association, Cleveland, Ohio, and Addison Boren, manager of the works accounting bureau of the Yale & Towne Mfg. Co., Stamford, Conn., have been appointed directors of the Industrial Cost Association.

H. N. Wieting, formerly with Berry Bros., has become associated with the sales organization of the Hilo Varnish Corporation, Brooklyn, N. Y. Mr. Wieting's headquarters will be in South Norwalk, Conn., his territory comprising the states of Connecticut and Massachusetts.

Oskar Kylin has recently been appointed general sales manager of the Foster Machine Co., Elkhart, Ind. Mr. Kylin has been chief engineer and a member of the executive board of the company for the last five years, and will still retain these positions in connection with his new duties.

Ralph S. Cooper, vice-president and general sales manager of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., who has just returned after spending eight months in Europe establishing branch offices and agencies for the company, has been appointed general manager. Mr. Cooper will fill this position in addition to his other duties.

J. O. G Gibbons, formerly with Westinghouse, Church, Kerr & Co., and now engaged in private practice, has joined forces with **C. E. Brown**, who for the last few years has been a United States ordnance engineer, forming a partnership as consulting engineers, under the name of Gibbons & Brown. The firm has offices in the Ordway Building, Newark, N. J., and is specializing in power plants and industrial problems.

Nelson A. Gladding, vice-president and general manager of sales of E. C. Atkins & Co., Inc., Indianapolis, Ind., was elected president of the American Supply and Manufacturers Association at the annual meeting in Atlantic City on May 18. Mr. Gladding was previously president of the association in 1912-1913, and has served as a member of the advisory board of the American Hardware Manufacturers' Association, of which he was president in 1913-1914. Mr. Gladding has been connected with E. C. Atkins & Co., manufacturer of silver steel saws, for thirty-five years. He was manager of the Memphis branch of the company for twelve years, and since 1898 has had general charge of sales at Indianapolis.

* * *

OBITUARIES

J. Frank Brown, a member of the sales organization of the Hilo Varnish Corporation, Brooklyn, N. Y., died June 17. Mr. Brown had charge of the Pittsburg territory of the company.

R. E. Lamar, of the sales organization of the Hilo Varnish Corporation, Brooklyn, N. Y., died June 6. Mr. Lamar had charge of the dealer trade in Philadelphia and adjacent towns.

William A. Kyte, sales manager and member of the board of governors of the Foster Machine Co., Elkhart, Ind., died May 24 at his home in Elkhart. Mr. Kyte was born at Middlebury, Ind., on March 1, 1878, and his association with the Foster Machine Co. started in 1905. His death was due to heart trouble, following an illness dating from last Jauuary.

Frank H. Wheeler, one of the pioneers in the development of the motor car industry, died at his home in Indianapolis on May 27. He had been in ill health and had been unable to take an active part in the business for some time. In 1902 Mr. Wheeler and Mr. George Schebler, inventor of the Schebler carburetor, organized the Wheeler-Schebler Carburetor Co. The original small shop developed into a plant employing a large force of skilled workmen. In addition to his connection with the Wheeler-Schebler Carburetor Co., Mr. Wheeler was president of the Langsencamp-Wheeler Brass Works and vice-president of the Stutz Fire Engine Co. of Indianapolis.

NEW BOOK ON USE OF CUTTING COMPOUNDS

Cutting Compounds and Distributing Systems. By Edward K. Hammond. 119 pages, 6 by 9 inches; 44 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

A study of current practice in the lubrication of metal-cutting tools shows that in many factories where the most modern methods of manufacturing are employed, little is known concerning approved methods of cooling metal-cutting tools by means of oils and compounds. This is doubtless due to the fact that it is difficult to place this subject upon a scientific basis, owing to the numerous variable factors involved.

The supplying of oils or compounds to the cutting tools of machines of different types and to plants differing in size and arrangement, requires a careful study of local conditions because different shops have different problems. The object of this treatise is to present definite useful information concerning the characteristics and uses of oils and compounds for various metal-cutting operations, specifications for the purchase of oils and compounds, methods of distributing, means for applying to the tools and work, methods of collecting after use, recovering oil from chips, filtering and sterilizing, and many other phases of this subject.

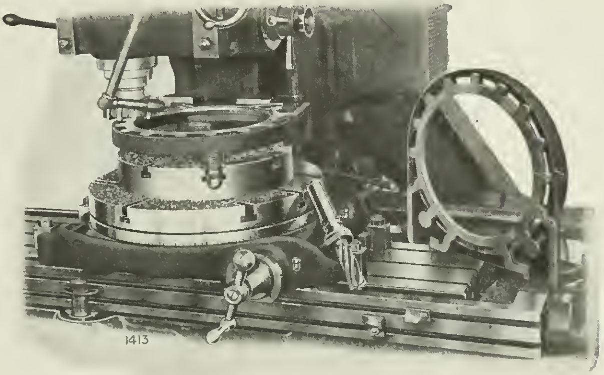
* * *

CENSUS OF THE MACHINE TOOL INDUSTRY

A preliminary statement of the general results of the 1920 census of manufacturers has been issued by the Bureau of the Census, Department of Commerce, furnishing statistics concerning the value of machine tools manufactured during the year 1919. Reports were received from 403 establishments engaged principally in the manufacture of this class of machinery. The products for the year were valued at $212,225,000. Of these establishments, 102 were located in Ohio, 46 in Massachusetts, 33 in Connecticut, 32 in Pennsylvania, 31 in Michigan, 29 in New York, 28 in Illinois, 24 in Wisconsin, 15 in Indiana, 14 in New Jersey, 13 in Rhode Island, 7 in Kentucky, 6 in Vermont, 5 each in Minnesota and Missouri, 3 each in Maine and New Hampshire, 2 in California, and 1 each in Delaware, Iowa, Kansas, Maryland, and Washington. The value of the different classes of machines was as follows:

Lathes:		
Engine	$22,630,000	
Turret	10,141,000	
Bench and other	4,094,000	
		$36,865,000
Milling machines:		
Plain	$ 6,470,000	
Universal	6,025,000	
Vertical	2,370,000	
Automatic	1,232,000	
Other	2,776,000	
		18,873,000
Grinding machines:		
Plain	$11,600,000	
Universal	2,066,000	
Other	1,725,000	
		15,391,000
Drilling machines:		
Radial	$ 5,702,000	
Multiple-spindle	1,999,000	
Sensitive	1,975,000	
Upright	1,754,000	
		11,430,000
Screw machines:		
Automatic	$ 7,076,000	
Hand	3,159,000	
		10,235,000
Boring machines:		
Horizontal	$ 4,438,000	
Vertical	4,330,000	
		8,768,000
Planers		8,129,000
Presses:		
Punching	$ 5,400,000	
Other	957,000	
		6,357,000
Gear-cutting machines		6;257,000
Hammers:		
Pneumatic	$ 3,070,000	
Other	1,882,000	
		4,952,000
Shapers		4,231,000
Pipe machines		3,178,000
Shears		1,566,000
Broaching machines		1,395,000
Bending machines		942,000
Portable tools		10,908,000
All other machine tools		26,075,000
All other products		36,673,000

Our Service Department replaced two boring mills with one No. 4 Vertical Cincinnati Miller and cut the time from 55 to 9½ minutes

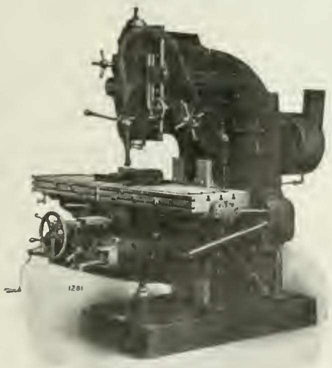


This is the end frame of an electric motor.

The large diameter is 20 in.

The diameter of the bore is 14½ in.

The rough casting is chucked on a 24-in. circular milling attachment.



This is the sequence of operations—

A 7½-in. face mill does the facing with one revolution of the attachment.

The work passes the cutter at the rate of 12½ in. per minute.

Our rapid traverse of 100 in. per minute clears the work from the cutter.

The quick change collet enables the operator to replace the face mill with an end mill in 30 seconds.

The knee is lowered until the end mill clears the work.

Note that in all adjustments the entire range of feeds is at the operator's finger tips and changes can be made in a second.

The work is carried to the cutting position at 100 inches per minute and stopped in place by an adjustable dog.

The end mill is lowered into the frame.

The frame passes the mill at 14¾ in. per minute.

The bore is finished with one revolution of the attachment.

The time from floor to floor is 9½ minutes.

Let our Service Department show you how to cut your production cost.

The Cincinnati Milling Machine Company

Cincinnati, Ohio, U. S. A.

COMING EVENTS

September 7-28—Shipping, Engineering and Machinery Exhibition, Olympia, London, W., England. General Manager, Frederic W. Bridges, 36-38 Whitefriars St., Fleet St., London, E.C.4.

September 14-16—Annual convention of the National Association of Cost Accountants in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary's address, 233 Woolworth Bldg., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

September 28-October 8—New York Electrical Exposition at the 71st Regiment Armory, Park Ave. and 34th St., New York City. For information relating to exhibits, apply to Norman Maul, the Electrical Show Co., 130 E. 15th St., New York City, Room 828.

October 3-4—Regional meeting of the American Society of Mechanical Engineers in Cleveland, Ohio.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

American Engineering Standards Committee, 29 W. 39th St., New York City. Annual report covering the activities of the committee for the year 1920.

School of Mines and Metallurgy of the University of Missouri, Rolla, Mo. Catalogue for 1920-1921, containing calendar, courses of study, and other related material.

University of Vermont, Burlington, Vt. Bulletin for 1920-1921, containing catalogue, announcements, courses of instruction, and general information.

Polytechnic Institute of Brooklyn, Livingston and Court Sts., Brooklyn, N. Y. Catalogue of the College of Engineering for 1921-1922 containing calendar, courses of study, and general information.

NEW BOOKS AND PAMPHLETS

Some Conditions Affecting the Usefulness of Iron Oxide for City Gas Purification. By William A. Dunkley. 62 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 119 of the Engineering Experiment Station.

The Functions of the Engineering Experiment Station of the University of Illinois. By Charles Russ Richards. 21 pages, 6 by 9 inches. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill., as Circular No. 9.

Thermal Expansion of Copper and Some of its Important Industrial Alloys. By Peter Hidnert. 159 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 410 of the Bureau of Standards. Price, 25 cents.

Gasoline Automobiles. By James A. Moyer. 261 pages, 5 by 7½ inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $2.

The purpose of this book, as stated in the preface, is to present briefly and clearly the essential principles of automobile construction and operation, with the intention of furnishing practical help to drivers who desire to learn how to locate the cause of operating troubles and remedy them. The uses of the various parts of an automobile are explained, so that an operator will be able to anticipate repairs, and when repairs actually become necessary will know where to begin work. In dealing with carburetors and ignition devices, not all types are explained, but considerable space is devoted to an explanation of the principles underlying commonly used equipment and systems. A series of symbols has been adopted for the carburetor, which should make it easy to understand any type mentioned after a careful study of one type The book contains ten chapters headed as follows: Automobile Types and Parts; Automobile Engines; Gasoline and Substitutes; Gasoline Carburetors; Automobile Ignition; Magnetos and Ignition Testing; Electric Starters; Clutches, Transmissions, and Differentials; Lubrication and Cooling Systems; and Automobile Troubles and Noises.

Patternmaking. By Edward M. McCracken and Charles H. Sampson. 111 pages, 11 by 8 inches Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2.

The purpose of the present book is to give students such a knowledge of the principles of patternmaking as will enable them to make any of the common types of patterns. The authors have made an effort to illustrate a definite principle in each pattern. The patterns selected are difficult enough to awaken interest on the part of the student, and yet are not so difficult as to cause the interest to be sacrificed merely to illustrate a point. Chapters are included covering the use of tools, information concerning woods of various kinds, and the principles of molding. The course is especially intended for use in technical, trade, and vocational schools who desire to present a practical course in patternmaking, the principal feature of the work being the large number of exercises for the student. The book is divided into two parts, the first section containing the text matter and general information, and the second part containing exercises for the student covering thirty different classes of patterns. In the text are discussed types of patterns; patternmaking methods; pattern details; hand tools; machines used by the patternmaker; molding; and foundry equipment.

NEW CATALOGUES AND CIRCULARS

Hauck Mfg. Co., 1718 Sansom St., Philadelphia, Pa. Bulletin 112 containing data relating to Hauck burners for foundries, and boiler, machine, and repair shops.

Warner Elevator Mfg. Co., Cincinnati, Ohio. Sheets for loose-leaf catalogue, illustrating push-button control apparatus for elevators, and Type EA direct-current controllers.

Foster-Johnson Reamer Co., Elkhart, Ind. Circular describing the features of construction of the Kylin adjustable general-purpose reamer. Price list and specifications are included.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Booklet illustrating and describing C-H magnetic clutches and their application. The illustrations show different types of installations of these clutches.

I. B. Williams & Sons, Dover, N. H. Catalogue of Williams belts, covering the line of flat and round belting, rawhide and tanned lace leather, Goodyear welting, and other products of this company.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has published its annual report for the year 1921, covering the gross earnings, manufacturing and selling costs, net income and other related data.

Griscom-Russell Co., 90 West St., New York City. Bulletin 1140, descriptive of the Stratton receiver-type steam separator, which is designed to remove water from steam by the utilization of centrifugal force.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Circular 36, illustrating and describing the "Thor" portable electric drill stand, for use with Nos. 000, 00, 0, 01, 1, and 2 "Thor" electric drills.

Larson Tool & Stamping Co., Attleboro, Mass. Circular illustrating Larson socket sets, single- and double-end spark plug sockets, triple socket wrenches, demountable rim braces, valve lifters, and valve grinding tools.

Oilgear Co., 60 Twenty-seventh St., Milwaukee, Wis. Bulletin 2, describing the Oilgear feed control system and its application to machine tools. This circular also contains dimension diagrams of Oilgear feed-control units.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin 6X, listing the features and uses of the P & H excavator crane No. 206, for handling machinery, excavating, dredging, digging foundations, etc.

Peter Gerlach Co., Cleveland, Ohio. Catalogue showing the line of machines built by this concern for the manufacture of barrels and kegs, which includes saws, jointers, stave planers, heading machines, dowel borers, rounders, presses, etc.

Condensite Co. of America, Bloomfield, N. J. Circular listing some of the advantages of "Condensite," a material which is applicable, in many cases, for parts where the design makes it impractical to use wood, metal, fiber, rubber, and other plastics.

J. E. Snyder & Son, Worcester, Mass. Catalogue illustrating and describing Snyder upright drilling machines, which are made in sizes ranging from 20 to 46 inches, and in belt- and motor-driven styles. A list of the repair parts for these machines is included.

Gifford-Wood Co., Hudson, N. Y. Pamphlet entitled "Mechanical Handling in all Lines of Industry," illustrating installations of elevating and conveying machinery of different types for all classes of mechanical handling in a wide variety of industries.

Griscom-Russell Co., 90 West St., New York City. Bulletin 330, covering Reilly evaporators for marine service. The bulletin contains a general description, tables of capacities, weights, size of connections, etc., as well as instructions for installing Reilly evaporators.

Bausch & Lomb Optical Co., Rochester, N. Y. Circular descriptive of parallel tube binocular microscopes, which, while permitting the simultaneous use of both eyes, still accommodates the single objectives ordinarily used on compound microscopes of the monocular type.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Catalogue entitled "The Cutler-Hammer System—Safest in the World," illustrating and describing the new line of control apparatus which has recently been developed by this company for use with high-speed newspaper presses.

John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. Bulletin 15, treating of the Bath "Easy-cut" ground taps. In addition to a description of the characteristics and construction of these taps, tables of sizes established by the National Screw Thread Commission are included.

Davis-Bournonville Co., Jersey City, N. J. Circular containing information relative to gas welding and cutting, acetylene generators, welding and cutting torches, and pressure regulators. The pamphlet is illustrated with views of Davis-Bournonville equipment, accompanied by specifications.

One Minute Valve Grinder Co., Ranier, Minn. Circular illustrating and describing the "One-minute" valve grinder with which it is claimed, a valve of ordinary size can be ground in from twenty to forty seconds actual grinding time. The grinder is crank driven, no air or electricity connections being required.

Wayne Tool Mfg. Co., Waynesboro, Pa. Catalogue 5, containing illustrations and tables of dimensions and prices of the line of taper bridge reamers made by this concern. The catalogue also shows the Wayne countersink, and the Wayne drill chuck designed for the purpose of salvaging broken twist drills.

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. Circular containing facts concerning the Jackson belt lacer, and describing the operation of lacing a belt with this type of machine. The machine is made in four sizes, namely, 6, 12, 18, and 24 inches, and will lace a belt 24 inches wide and ½ inch thick.

Terminal Engineering Co., Inc., 17 W. 44th St., New York City. Circular describing the features of construction of "Tec" motor-driven trucks, and their application for industrial haulage. The illustrations indicate the wide variety of uses for which these trucks are adapted by the utilization of different special bodies.

Hyatt Roller Bearing Co., 709 Sixth Ave., at 41st St., New York City. Circular treating of the application and methods of installation of Hyatt roller bearings for all kinds of trucks. The illustrations show a large number of trucks equipped with these bearings. Copies of the bulletin will be sent without cost upon request.

Consolidated Tool Works, Inc., 296 Broadway, New York City. Catalogue B, containing data on the line of tools produced by this company, which includes hacksaw frames, smooth and jack planes, hand drills, breast drills, calipers and dividers, tap wrenches, and micrometers. Copies will be sent to those interested upon request.

Barnhart Bros. & Spindler, Monroe and Throop Sts., Chicago, Ill. Circular containing information relating to "Tenso" die-castings, including physical properties, comparison of lightness and hardness with other metals, and other characteristics. The circular shows a large number of parts which have been made from "Tenso" die-castings.

J. M. Ney Co., Hartford, Conn. Circular illustrating and describing the Ney "positive-grip" collet chuck, which represents a combination of the principles embodied in the usual three-jaw chuck, drill chuck, and draw-in collet type. The chuck is adapted for use on lathes of the standard or turret type, screw machines, and milling machines.

Manufacturing Equipment & Engineering Co., 136 Federal St., Boston, Mass. Circulars illustrating "Economizer" fountains and other types of drinking fountains for factory use; metal sanitary and fireproof shop equipment, including lockers, chairs, tables, stock racks, etc.; group wash-bowls and metal storage cabinets; and price list covering the foregoing equipment.

Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J. Catalogue treating of electric arc cutting and welding by alternating current, describing in detail the "Alternarc" portable welding and cutting machines, electrodes, supplies, and accessories. The application of the electric arc welding process for different classes of work is illustrated and described.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio. Catalogue 47, covering the standard line of hydraulic wheel presses made by this company. A general description is followed by illustrations and specifications for the different types of presses, which are made in vertical and inclined styles, with pressure capacities of from 50 to 600 tons. Copies of this catalogue will be sent free upon request.

Truscon Laboratories, Detroit, Mich. Technical Pamphlet No. 8, treating of the subject of waterproofing concrete. In addition to a discussion of why concrete requires waterproofing, and the properties the integral waterproofing must possess to operate effectively with concrete, the pamphlet contains specifications for waterproofing concrete. This booklet is distributed free to any engineer, architect, or builder upon request.

New Departure Mfg. Co., Bristol, Conn., announces that it is resuming the publication of the New Departure ball bearing engineering data sheets. The first of these bulletins, No. 129, contains calculations of bearing loads due to gears, covering the loads resulting from the five most commonly used types of gears—the straight spur gear, the helical spur gear, the straight bevel gear, the worm gear, and the spiral bevel gear.

"The nicest thing about PRAISE is that you have to
LIVE UP TO IT"
Therefore, every NEW user of the

"PRECISION"

Boring, Drilling and
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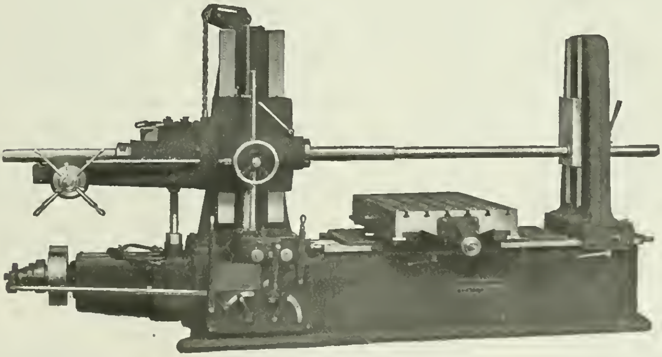

gets the benefit of the "other fellows"
praise (and there are very many of the
"other fellows".)

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

Peerless Machine Co., 1611 Racine St., Racine, Wis. Circular describing the operation and construction of the Peerless high-speed sample-section tire cutter, for cutting accurate sample sections from regular stock tires or straight molds. Circular of the Peerless high-speed rubber cutter, containing a partial list of users and letters of recommendation. Circular descriptive of Peerless high-speed heavy-duty metal-cutting saws, and Peerless power hacksaw blades.

Medart Patent Pulley Co., Inc., Potomac and DeKalb Sts., St. Louis, Mo., is distributing to those interested in the product of the company, a monthly publication known as "The Dart," which will contain material relating to Medart pulleys and power transmission machinery. The first number, published in June, contains an article on the production of commercial shafting by the use of the Medart shaft turning machines and automatic straightening and polishing machines.

Grand Rapids Grinding Machine Co., Grand Rapids, Mich., has published a book known as the "Grand Rapids Grinder Book," containing a discussion of the subject of drill grinding, and a detailed description of the constructural features of this company's drill grinders, cutter and tool grinders, and tap grinders. Illustrations and specifications of the different styles of machines are also presented. The book includes general information regarding the care and use of twist drills and the grinding of taps

Vanadium Corporation of America, 120 Broadway, New York City. Booklet entitled "Vanadium (the Master Alloy) in War and Peace," containing description and illustrations showing a large number of applications of vanadium steel in airplanes, locomotives, automobiles, and trucks, for crankshafts, steel springs, piston-rods, tool steel, steel forgings or castings subjected to high stresses, etc. An alphabetical list of some of the principal applications of vanadium steel is included on the last two pages of the book.

General Electric Co., Schenectady, N. Y. Bulletin 42019, descriptive of Curtis steam turbines for mechanical drive, such as the driving of circulating and boiler feed pumps, contrifugal pumps, fans, blowers, etc. A description of the principle involved in these turbines, and a summary of the different parts are presented. Bulletin 41311 A, treating of General Electric 60-cycle synchronous condensers for power-factor control. Calculations necessary in figuring on a synchronous condenser installation, a wiring diagram, and illustrations of actual installations are included.

Brown & Sharpe Mfg. Co., Providence, R. I. Catalogue 28, containing 375 pages, 5 by 7¼ inches, covering the Brown & Sharpe line of small tools. The catalogue describes over 1000 different machinists' tools. In addition to data on the various classes of tools, considerable general information and a large amount of tabular matter of practical use to the shop man are included. Among the tables presented are sizes of numbers of the U. S. standard gage for sheet and plate iron and steel, decimal equivalents of screw gage and of twist drill and steel wire gage, standards for wire gages, tap drill sizes for U. S. standard threads, cutting speeds for milling cutters, data for selecting cutters for bevel gears, etc. A revised price list for this catalogue has also been issued.

Carborundum Co., Niagara Falls, N. Y. Catalogue 6, containing 224 pages devoted to carborundum and aloxite wheels for all classes of grinding, and other products manufactured by this company for use in the metal-working fields. A brief outline of the history of the company and its various branches is given, which is followed by a description of carborundum, its characteristics and uses, as well as the characteristics and uses of aloxite. A description is also included of the manufacture of carborundum and aloxite wheels, illustrated with views showing the different steps in the process. Further material presented includes characteristics of grinding wheels, testing of grinding wheels, selecting wheels of proper grit and grade, protective devices, mounting of grinding wheels, and various rules and tabular material covering speed of wheels, diameters of pulleys, and related matters. A large part of the book is taken up with tables of prices for grinding wheels for use on various types of machines.

TRADE NOTES

Smith, McCrory & Co., Inc., announce the opening of advertising agency offices at 468 College Ave., Racine, Wis.

New Departure Mfg. Co., Bristol, Conn., moved the Chicago sales offices of the company on June 1 from 2721 S. Michigan Ave. to the People's Gas Bldg., at 122 S. Michigan Ave.

Standard Pressed Steel Co., manufacturer of "Standco" hollow set-screws, steel shaft hangers, milled cap-screws, etc., has moved its plant from Philadelphia to new quarters at Jenkintown, Pa.

Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn., announces that it has made sales connections with the Mayhew Steel Products Corporation, 291 Broadway, New York City, to handle the entire output of its factory.

Atlas Die Casting Co., Inc., has been organized at 41 Jackson St., Boston, Mass., with a capitalization of $200,000. The company will employ about 300 men when operating at full capacity. The president of the concern is Arthur M. Brewster, and the treasurer, Malcolm F. MacNeil.

A. H. Petersen Mfg. Co., Milwaukee, Wis., which has been engaged in the manufacture of tools and dies on a large scale for a number of years, has discontinued its tool and die business, and will devote its entire plant to the manufacture of "Hole Shooter" portable electric drills and other automotive devices.

Surface Combustion Co., 366 Gerard Ave., Bronx, New York City, announces that the Franklin Institute of the state of Pennsylvania, acting through its committee on science and the arts, after an investigation of the jet entraining apparatus made by this company, has awarded to the inventor, W. Barton Eddison, the Edward Longstreth medal of merit.

Geometric Tool Co., New Haven, Conn., manufacturer of special machinery and tools for cutting screw threads, has taken over the exclusive sale of the products manufactured by the Charles L. Jarvis Co. of Gildersleeve, Conn. This company's line consists of Jarvis high-speed tapping devices, quick-change chucks and collets, and combination tapping devices equipped with quick-change chucks.

Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill., manufacturer of Woodstock safety tapping chucks, has recently completed four new buildings of two- and three-story brick construction, including a new office building. Part of the factory will be used by the American Ironing Machine Co., manufacturer of mangles, extractors, etc., this company being owned by the Peter Bros. Mfg. Co.

Davis-Bournonville Co., Jersey City, N. J., announces that G. E. Price, Jr., purchasing agent, has resigned to fill a similar position in the Middle West. Owing to present business conditions the company has decided that the position of purchasing agent will not be filled at this time. Purchases will be made under the supervision of the works manager's office, and H. H. Meixsell will have direct supervision of purchases for the present.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., manufacturer of portable electric tools, electric air compressors, and special machinery, announces that the company has informed all the dealers handling its line that it will guarantee present prices for the remainder of the year. The Black & Decker Mfg. Co. states that it is able to do this because in the last seven years (since 1914) the total increase in the prices of its products has been only 38 per cent.

Herberts Machinery & Supply Co., Los Angeles, Cal., has leased a building at 403 East 3rd St., next to the one which the company now occupies. The additional floor space of 11,000 square feet afforded by the new building is required to care for the present business. This company recently sold fifty-eight heavy-duty Monarch lathes and ten Rockford lathes to the Clark-Turner Piston Co. of Los Angeles; this is believed to be the largest lathe order ever placed on the Pacific coast.

Terminal Engineering Co., Inc., 17 W. 44th St., New York City, manufacturer of "Tec" trucks and material handling machinery, announces the following changes in its organization: J. F. McGonigal, formerly with the Foamite Co., and J. H. Potter, mechanical engineer, have been added to the force. E. Lyle, for many years with the Columbia Graphophone Co., has been elected vice-president and is directly responsible for new business. E. Peck has been elected secretary and assistant treasurer.

Stein & Ellbogen Co., 31 N. State St., Chicago, Ill., announces that they have taken over the line of time- and motion-study watches and other instruments of precision formerly handled by Mortimer J. Silberberg, of Chicago. Among the instruments that will be handled are the so-called "split second" time-study watch, which has a double hand, and in addition to other features, permits the taking of observations on two totally different operations at the same time, or the taking of observations on two closely related operations, differing from each other.

Buffalo Forge Co., Buffalo, N. Y., is remodeling its entire fan shop. The new shop will cover 64,235 square feet, including 23,873 square feet of assembling galleries. The reconstruction work is being carried on without interfering with the regular fan construction. The entire machine equipment has been laid out so that all fan construction will proceed with a minimum of handling. The material racks are served by an electric railway truck with an automatic lift platform that permits sheets to be slid directly from the racks to the car and then run into position for the first machining operation.

Clark-Turner Piston Co., 1246 S. Los Angeles St., Los Angeles, Cal., manufacturer of the "De-luxe" light weight gray iron pistons, has recently moved the major portion of its machine shop into a new building several miles distant, the removal being accomplished without interfering with production. The rapid growth of the company, which was started less than two years ago, has necessitated the acquiring of additional space and the concentration of the plant in one locality. This company has appointed the Laystall Motor Engineering Works, Ltd., of London, England, as distributors of "Deluxe" pistons for Great Britain and Ireland.

George Schow Trading Corporation, 123 W. Madison St., Chicago, Ill., has been organized to carry on a general export and import business with all countries and to act as export representative for American manufacturers. The company will also serve as sole American agent for foreign manufacturers and exporters as well as purchasing agent for foreign accounts. Through its agents and representatives abroad, this concern has facilities for exhibiting the goods of American manufacturers. The service rendered includes publicity, selling service, creation of new markets, and appointing of agents and dealers.

Meldrum-Gabrielson Corporation of Syracuse, N. Y., has acquired a factory site at West Fayette and Niagara Sts., on which it will erect a $300,000 plant during the summer. It is planned to have the new plant in operation by November 1. The first building to be erected will be a steel, brick, and concrete structure, two stories high, in which the offices will be located. This company now occupies all the first two floors of the Brayton Industrial Building, in N. Franklin St., where it has extensive equipment for manufacturing special machinery and tools, one of its products being the Syracuse adjustable snap gage.

Simmons Method-Hob Co., Second St. and Duncannon Ave., Olney, Philadelphia, Pa., was recently incorporated under the laws of Pennsylvania for the manufacture of gear-cutting hobs and cutters by a generating process known as the Simmons method. The officers are as follows: Joseph M. Hottel, president and treasurer; I. Powell Thomas, secretary; and O. G. Simmons, vice-president and general manager. The plant is fully equipped, and hobs are now being delivered. The equipment consists of standard precision machine tools and several special generating machines, as well as a heat-treating and hardening department.

Reliable Tool Co., Irvington, N. J., is moving from 33 Ellis Ave., to its new plant at Coit St. and Ney Ave. This plant was constructed especially to meet the requirements of the company, and was designed to accommodate not over one hundred toolmakers, with a view to continuing this concern's policy of maintaining a personally conducted tool shop. The shop proper is on the ground floor, and is 55 by 90 feet. The office is on the second floor at the front of the building and is 55 by 20 feet; this includes a general office and drafting-room. On the main floor are located the wash-room, hardening room, and tool-crib. Considerable new machinery has been installed.

McDonough Mfg. Co., Eau Claire, Wis., announces that after a strike lasting for nearly eight months, the union machinists, helpers, and blacksmiths of the company voluntarily called off the strike and offered to return to work on an open-shop basis. The plant is now operating as an open shop, and will continue on this basis in the future. After being closed for nearly two months, the factory was reopened with non-union men, these men soon being joined by a number of the former employes who had previously belonged to the union. During the strike, production was maintained without interruption, although the plant was picketed for more than eight months.

Canton Foundry & Machine Co., Canton, Ohio, has moved its New York sales exhibition office from the Grand Central Palace to the Manufacturers' Exhibition Co.'s building at 45 W. 18th St., New York City. The company's complete line of machinery, comprising portable cranes, alligator shears, turntables, etc., is on display in the new headquarters. Owing to the fact that the International Purchasing Bureau has been acting exclusively for the last few years as the export division of this company, it has been decided, in order to give better service, to have the export division closely associated with the New York permanent exhibit sales office, and from now on these two concerns will work in conjunction with each other at the new offices.

Greenfield Tap & Die Corporation, Greenfield, Mass., announces that at a meeting of the board of directors in June it was voted to purchase the entire capital stock of the **Greenfield Machine Co.**, manufacturer of cylindrical and universal grinders, and of the **Morgan Grinder Co.**, Worcester, Mass., manufacturer of internal grinders. The products of the Morgan Grinder Co. and the Greenfield Machine Co., together with the machines now produced by the Greenfield Tap & Die Corporation, will constitute the Machine Division of the Greenfield Tap & Die Corporation. The latter company will operate both plants in their present location, although it is the intention to eventually move the Worcester plant to Greenfield. The organization of both plants remains the same as heretofore, the officers of the Morgan Grinder Co. being Ralph L. Morgan, president; L. M. Crittsinger, treasurer; and Charles E. Hildreth, general manager. The officers of the Greenfield Machine Co. are E. F. Smith, president, and Joseph G. Stevens, treasurer.

VOLUME 27

MACHINERY

NUMBER 12

AUGUST, 1921

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Do not fail to send your change of address promptly

Your new address should be in our hands before the 15th of the month preceding the next mailing of MACHINERY

We cannot duplicate copies of MACHINERY sent to your old address

Circulation for July, 1921, 21,000 Copies

Member Audit Bureau of Circulations

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It is understood that all contributed articles pertaining to machine shop practice and machine design are submitted exclusively to MACHINERY; when accepted and published, payment is made at our regular space rates unless other terms have been agreed upon.

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The Editor's Monthly Talk

In modern technical journalism, especially as exemplified in Machinery, the Advertising Department is notably succeeding in giving essential editorial character and value to the advertising pages. An examination of Machinery shows that mechanical advertising today is compiled, prepared and written in an entirely different manner from that of ten or fifteen years ago. It is prepared, not by advertising specialists alone, but by advertising specialists working in conjunction with engineering specialists, both contributing the essentials necessary for a finished display advertisement giving real information to the reader.

Therefore, instead of talking about the editorial pages today, let us scan those advertising pages in Machinery that are prepared in cooperation with the engineering service. These advertisements contain a storehouse of vital information, photographs of machines at work, drawings of the work to be performed, production figures and other valuable data pertaining to the job, not as it might be, but as it is. This information is obtained, not alone in the works of the manufacturer of the machine advertised, but mainly in the shops of his customers, where his machines or other equipment are in actual use. The men who gather these data are members of Machinery's staff. They are themselves practical machine shop men—they know a good job when they see it. Utilizing their shop knowledge, it is possible for them to gather and present technical facts instead of mere claims and opinions. That marks a distinct and important advance in advertising methods. It makes advertising authentic, matter-of-fact, readable, and of actual technical value, not only to the buyer who wants to know, but also to the technical reader who appreciates information on the latest shop practice. It is work essentially educational in character and value.

The Field Service Men and their Work

In past talks with Machinery's readers we have spoken of the extensive travels of the editors who cover thousands of miles seeking information in shops everywhere throughout the country where mechanical work of unusual interest is to be found. Today let us say something about the qualifications of the Field Service men and the work they do to lay the foundations of those advertising pages that contain what we are pleased to regard as essentially editorial data.

Before a man is found who is qualified for this specialized work, it is necessary to interview scores of experienced mechanics. Even then only a few of those carefully selected prove fitted for the duties required. These men must have technical training, shop experience, sound judgment and good common sense. They gain broad experience in their work as they regularly visit hundreds of factories in various parts of the country in quest of facts to be presented in Machinery's advertising pages. They come into personal contact with the men in charge of the country's production; they rub shoulders with the producers themselves—the workers; and few men are in a position to learn so much about the practical efficiency of all the different types of machine tools built. The first-hand knowledge thus acquired, fused with their qualifications as advertising advisors, and supplemented by photographs illustrating the job selected, furnishes the sure and definite basis upon which the specialists in the home office design and construct the advertisements which are submitted for the advertiser's approval. The result is advertising essentially instructive, authentic and technical, fundamentally of the same character as the material published in the reading pages of the periodical.

A Journey through the Advertising Pages

A comprehensive review of modern machine tools, devices and shop methods is thus made available in every number of Machinery, furnishing reliable information on production to those interested in the mechanical as well as the commercial side of the metal-working industries. The value of such material, compared with the old-time dry, hackneyed phrases, boasts and claims which characterized the advertising of other days needs no elaboration. A multitude of mechanical subjects, such as grinding practice, gear-cutting, production milling, drilling, planing, boring, forging and die-casting, are repeatedly dealt with in this instructive way by the cooperative efforts of the Service Department and the Advertising Department. The information presented is complete and comprehensive, like a concise editorial description of a job, with the added attractiveness of a make-up not always possible in the editorial pages.

This method of presenting the possibilities of a machine or method is not only of great interest to the reader, but carries a forceful argument to the buyer of mechanical products. It brings him a definite message, one likely to leave an impression. Advertisements of this kind start people thinking, talking and acting. The mechanical reader who is not directly a buyer and who gets Machinery mainly for the mechanical information it brings him, misses some of the most useful information on production methods that it contains, if he does not faithfully examine the advertising as well as the editorial section. It will be interesting to watch the development of this trend in advertising. It should grow in every field. It extends and amplifies the editorial work, and greatly increases the educational value of technical journalism.

The Machine Tool Industry

THERE has been no change in the situation in the machine tool field during the past month. Business is very quiet, and machine tool plants are working with greatly reduced forces or are practically shut down for the time being. Manufacturers and dealers are well stocked up on machine tools, and should one judge the outlook by present conditions in this field alone, it would be distinctly discouraging. Fortunately it is neither wise nor necessary to judge entirely by the conditions in a single industry; and the reports of business as a whole throughout the country indicate that we have passed the lowest point of the depression. Secretary Hoover says: "Business has made the turn."

General Industrial Review

The textile industries, for example, present quite an accurate index to general business conditions and prospects. These industries were the first to feel the depression, over a year ago, and now they are the first to return to conditions showing a satisfactory degree of activity. In the woolen industry particularly, business is being carried on at a high rate. The American Woolen Co. is operating at 95 per cent of capacity, which is practically as high a rate as it has ever attained, and most, if not all, the New England woolen and worsted industries are operating at 75 per cent capacity or better.

Reports from retail stores handling all lines throughout the country, as published by the Federal Reserve Banks, show that net sales in dollars are very nearly equal to the sales for the corresponding month last year; and as retail prices have been considerably reduced in the past twelve months, this means that in actual goods the volume of sales is larger now than a year ago.

Another indication of improved industrial conditions is the freight car movement. During January and February the loaded freight car movement was only 85 per cent of the average freight car movement during the first six months of 1920; in March and April this rose to 87 per cent; and in May—the last month on record—to 93 per cent; so that the actual business done in the country is only a small percentage below that done during the first six months of 1920, which was regarded as very satisfactory.

One of the electric furnace companies reports more orders in the month of June than for any other single month during the past two years. Most of the sales were made to concerns not particularly busy at the present time, but who purchased equipment in the firm belief that by the time the furnaces were installed and ready for operation, business would be such as to justify the present expenditure. Early returns for the month of July indicated equally good business.

The rapid restoration to normal business in several industries has been greatly facilitated by the readjustment in prices of raw materials. It is interesting to note that the raw materials in the cotton, leather, and rubber industries (as well as basic necessities in the food production industries, such as cattle and corn) now sell at wholesale below their average 1913 prices; while the basic raw material in the iron and steel field (pig iron, as well as structural steel and bars) still sells at about 35 per cent above the average 1913 price. There has been recent outspoken criticism of the high prices of raw materials in the iron and steel field, as compared with some of the other industrial fields, and it has been charged that the slow resumption of business in the metal-working industries is partly due to the reluctance of the iron and steel interests to reduce prices on the raw materials used in those industries. Whatever basis there may be for this, it is a fact that the readjustment of prices of the raw materials in some other fields has been much more rapid.

It has been predicted with reasonable certainty that there will be some railroad business in the early fall, because the condition of the rolling stock, and even of tracks in some cases, will force action. One middle-western railroad is asking for bids for over 100 locomotives, which is considered a sign of revival of buying by the railroads.

Automobile Industry

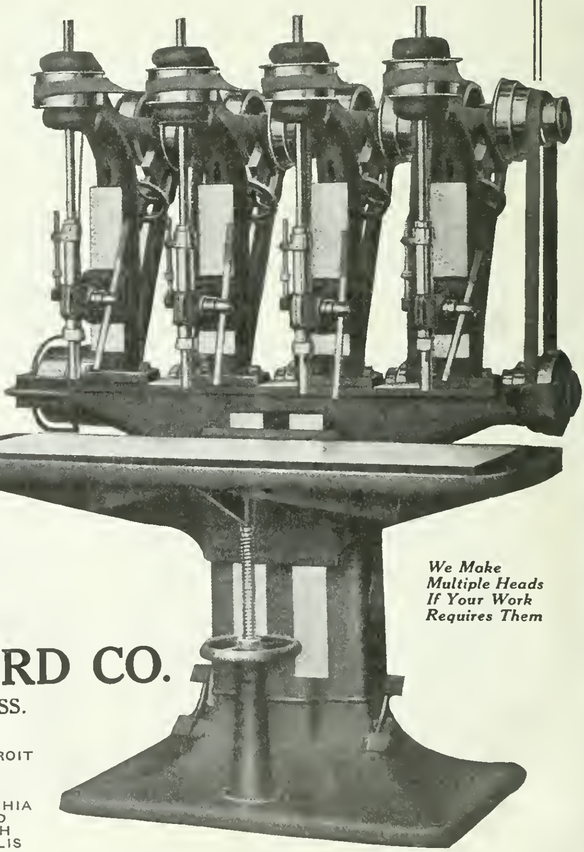
The reduction in the prices of many well-known automobiles, ranging from 5 to 35 per cent, is expected to have a favorable effect upon the market for cars. The schedules for the Ford plants for July call for over 100,000 cars. The output during June set a new record in the history of the company, the total, including Canadian and foreign branches, reaching 116,000 cars, as against 111,000 in May. A new record for a single day was set when 4300 cars were turned out. News from other automobile companies varies considerably, some reporting good business, while others find prospects less encouraging. Buick is said to be planning to increase production for the rest of the year. The same report is made by the Willys-Overland Co. Studebaker has been running practically at full capacity for months. Signs of better tire business are appearing. Goodyear has re-employed 3000 men, and Fiske has added a night shift and is increasing the day force. A survey of the Akron rubber companies indicates that they are running from 50 to 60 per cent capacity, which is remarkable under the circumstances, as their total capacity is enormous.

The healthy, if painful, process of deflation and readjustment is steadily working out the economic problem. That way lies the road to business recovery and prosperity.

Production Machines for Your Drilling and Tapping Jobs

Some one of the LELAND-GIFFORD machines is adapted to your drilling from the smallest hole up to ¾″ diameter, and one of our tapping attachments will do your tapping from the smallest up to ⅝″ diameter.

Our service department is ready to help you with your drilling and tapping problems and to advise regarding jigs and fixtures.



We Make Multiple Heads If Your Work Requires Them

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WORCESTER, MASS.

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NEW YORK
CHICAGO
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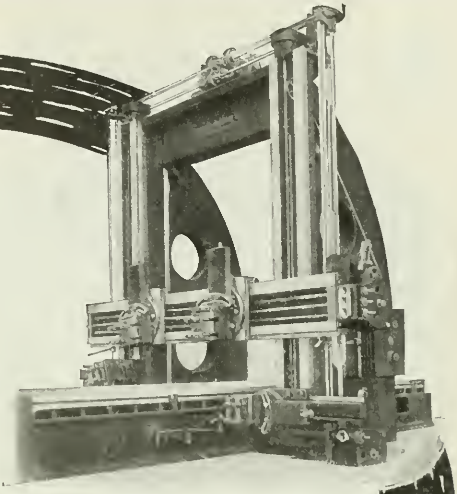
DOMESTIC AGENTS

Swind Machinery Co.	PHILADELPHIA
The W. M. Pattison Supply Co.	CLEVELAND
Somers, Fitler & Todd	PITTSBURGH
F. E. Satterlee Co.	MINNEAPOLIS

HEAVY
BETTS
DUTY



BETTS PLANERS

Box Form Table
Closed Top Bed

The tables on all Betts Planers are of our improved double plate box construction so that no chips can reach the driving gears or vees. These tables are extra heavy and of unusual depth.

The openings at the side of tables are extra wide and have square corners. This allows the chip rake clear passage without any obstructing flanges—a feature of all Betts Planers.

The bed is full box type, strongly reinforced which completely encloses the top except where the bull wheel engages the rack.

Send us
your inquiry

- Planers
- Boring and Turning Mills
- Engine Lathes
- Axle Lathes
- Journal Truing Lathes

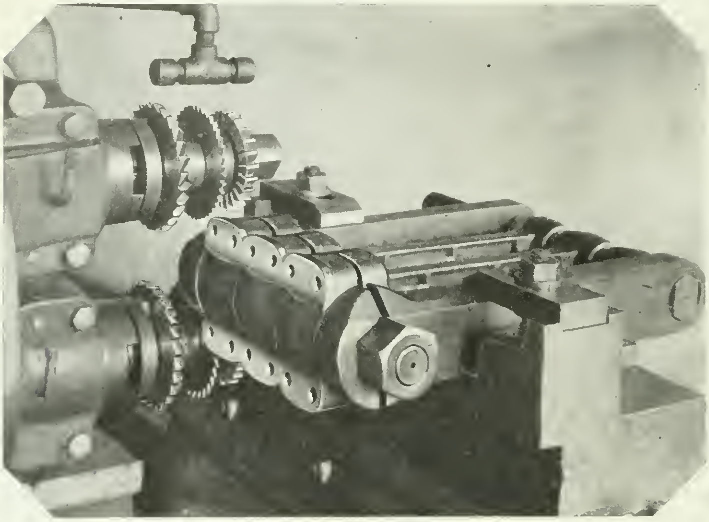
We can save you money.

Betts Machine Company
400 Blossom Road, Rochester, N.Y.

- Horizontal Boring, Drilling and Milling Machines
- Tire Turning Mills
- Car Wheel Borers
- Slotters, etc.

BETTS
MACHINE TOOLS

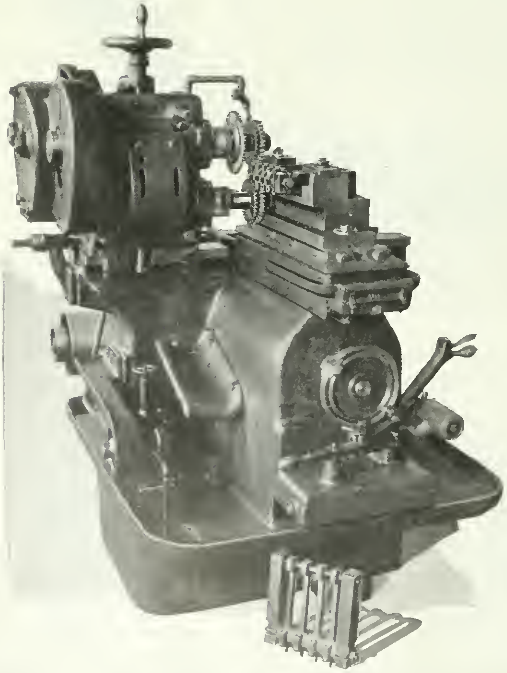
A New Development in



Pratt &
Auto
Milling

As an aid to the more efficient milling of connecting rods, we have designed and

Double Spindles for Big Production



FOR big production we have added an extra spindle so that it is possible to mill over and under the screw bosses and *at the same time* split the caps ready for fitting.

The machine with its wide range of spindle speeds and table feeds is especially adapted to work of this nature.

The rapid advance to the cutting position, dropping to cutting feed and on completing the cut, the quick return to the loading position is all automatically controlled by the cam and dogs on the front of the machine —a special feature.

A production of 50 large or 120 small rods can be expected with the double spindle machine.

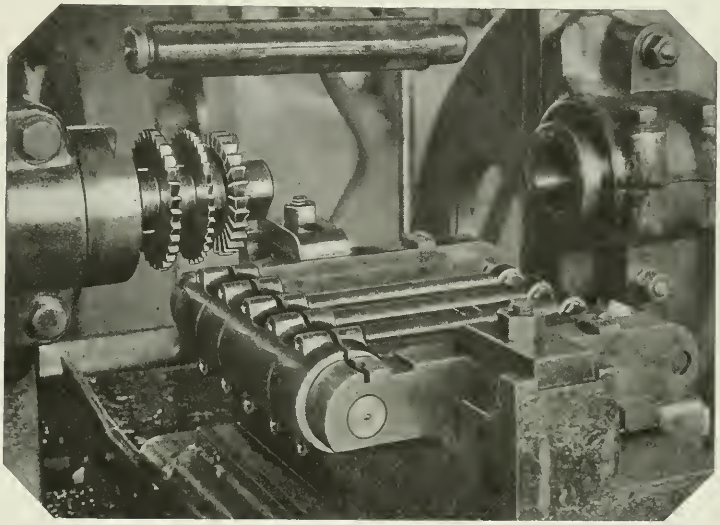
Send in *your* rods or blueprints for a demonstration, suggested equipment and estimate.

PRATT &

WORKS: Hartford, Conn.

ROCHESTER, 116 South St.
BOSTON, 93-95 Oliver St.
PHILADELPHIA, 405 N. 21st St.
CLEVELAND, 730 Superior Ave
PITTSBURGH, 425 Seventh Ave
DETROIT, Kerr Mchy. Bldg.

Milling Connecting Rods



Whitney matic Machine

perfected complete equipment and adapted it to the NEW STYLE Automatic Miller.

Single Spindle for Ordinary Work

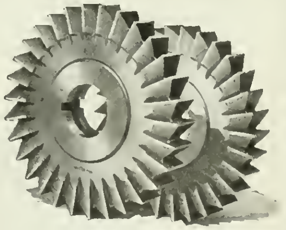
WHERE rods are milled in small lots, the machine can be released for other milling operations.

For this purpose we suggest the use of the single spindle machine. The fixture equipment is the same as that used with the double spindle and the rods are turned over for a second cut.

A production of 25 per hour on large and 60 on small rods has been secured.

We have patterns, drawings, etc., for building this equipment at a nominal cost. The arrangement includes a work holding fixture complete with two loading frames, arbors, etc.

Why not investigate the possibilities of our Thread and Spline Millers, Engine and Tool-room Lathes, Vertical Shapers and Vertical Surface Grinders. For years they have helped make possible big production at low cost in the automotive and allied industries.



You'll Get Better Production If You Use P. & W. Milling Cutters

Our Small Tool Works is prepared to supply a full line of milling cutters to go with these machines.

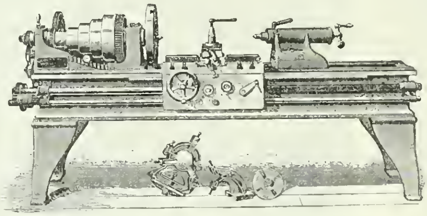
Where a form is to be milled, we suggest the use of our new "Curvex Cutters"—spiral fluted and eccentrically relieved—which allow the use of a maximum feed to increase production on form milling from 50 to 100 per cent.

WHITNEY COMPANY

GENERAL OFFICES: 111 Broadway, New York

CHICAGO, 33 South Jefferson St.
ST. LOUIS, 516 North Third St.
CINCINNATI, 336 W. Fourth St.
BIRMINGHAM, ALA., 2015 First Ave.
LOS ANGELES, 454 E. Third St.
ST. PAUL, MINN., 334 St. Peter St.
SAN FRANCISCO, 16 to 18 Fremont St.

Look at it!



Twenty-six years ago we recommended this lathe for manufacturing purposes! At that time, however, very little, if any, attention was paid to such a thing as the *cost per piece*, but even then we were advocating the use of a lathe that would ACCURATELY do the work.

And we had one to offer!

From the very beginning Lodge & Shipley paid particular attention to accuracy and it is to this fact that we owe our position today in the lathe world.

Put it up to the operator—ask him about the accuracy of Lodge & Shipley Lathes! He can give you the facts right off! He will tell you that, besides being accurate, the convenience and ease of operation play a big part in maintaining its popularity.

It has always been our aim to make lathes that not only will satisfy the most exacting operator, but which will please him so well that he will insist on running no other. We feel confident that in our Manufacturing Lathe we have succeeded.

The Lodge & Shipley

CINCINNATI,

The Lodge & Shipley Manufacturing Lathe

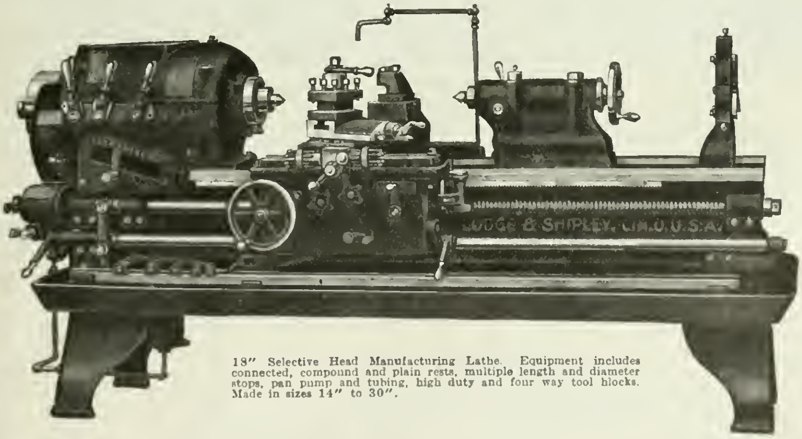
is our standard engine lathe fitted with attachments which enable duplicate pieces of work to be turned with a time saving of 25 to 50 per cent. Think of that!

Think of being able to save almost one-half the usual time taken to turn parts on the ordinary engine lathe. Not only is this possible but a high standard of accuracy, better even than hand measurement, is continuously maintained.

The live, wideawake manufacturer fully realizes the necessity of keeping down the *cost per piece* and this lathe surely fills the bill. Think of the time it can save, with the subsequent reduction in the *cost per piece!*

Taking it from the standpoint of the operator, he has the utmost confidence in the accuracy of the stops. The convenience of four cutting tools on the compound rest and another on the rear rest ready for instant use, forms a combination hard to do without.

Let us explain in detail. Bulletin "Examples of Turning on the Manufacturing Lathe" covers this thoroughly. Shall we send you a copy?



18" Selective Head Manufacturing Lathe. Equipment includes connected, compound and plain rests, multiple length and diameter stops, pan pump and tubing, high duty and four way tool blocks. Made in sizes 14" to 30".

Machine Tool Co.

OHIO

DURALUMIN

Duralumin is an alloy produced after years of systematic endeavor to meet the demand for a metal which shall be as light as Aluminum and as strong as mild steel, yet without the many disadvantages of Aluminum in its pure state.

Duralumin is the only light metal that can replace steel in forgings. With a two-thirds saving in weight, heat-treated Duralumin Forgings approximate mild steel forgings in strength.

Wherever weight is a deciding factor Duralumin is the most satisfactory metal for most articles made by hot working or forging. Naturally, Duralumin Forgings are especially desirable for reciprocating or moving parts where inertia, due to their own weight, forms a large part of the total stress.

Minimum Physical Properties of Rolled or Sheet Metal (heat treated) and of Forging Metal are:

Tensile, - - -	55,000 lbs. per sq. inch.
Elastic Limit, - - -	30,000 lbs. per sq. inch.
Elongation, - - -	18%

BAUSH MACHINE TOOL COMPANY

Metals Division
SPRINGFIELD, MASS., U. S. A.

MANUFACTURERS OF

BAUSH
DURALUMIN

BLOOMS—SLABS—BILLETS—SHEETS—FORGINGS

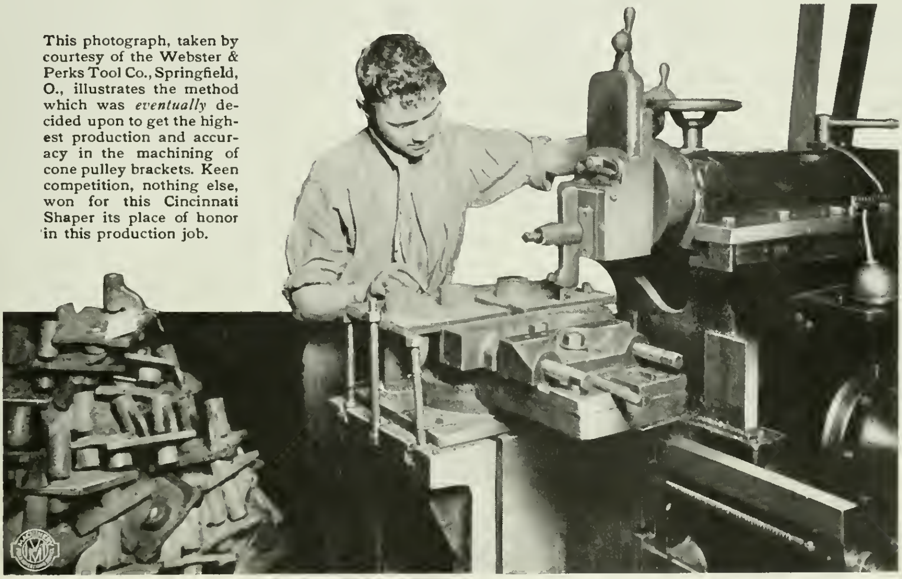
BAUSH CASTING METAL INGOTS
Aluminum Alloy of High Tensile Strength.

Rolling Mill and Drop Forge Works
SPRINGFIELD, MASS.

Detroit Office:
1825 Dime Savings Bank Bldg.

This Cincinnati Shaper

Won its Position by Beating Both Lathe and Milling Machine in Production and Accuracy



This photograph, taken by courtesy of the Webster & Perks Tool Co., Springfield, O., illustrates the method which was *eventually* decided upon to get the highest production and accuracy in the machining of cone pulley brackets. Keen competition, nothing else, won for this Cincinnati Shaper its place of honor in this production job.

This Cincinnati Shaper is machining cone pulley brackets—two at a time—for the Webster & Perks Universal Grinder. Amount of stock removed from the two 9" x 8" surfaces is 1/8". The boy operator in charge has no difficulty in making five set-ups per hour; turning out ten pieces in that time.

First came the lathe; then the milling machine, on which production was bettered; but last came the Cincinnati Shaper, on which both production and accuracy were *best*.

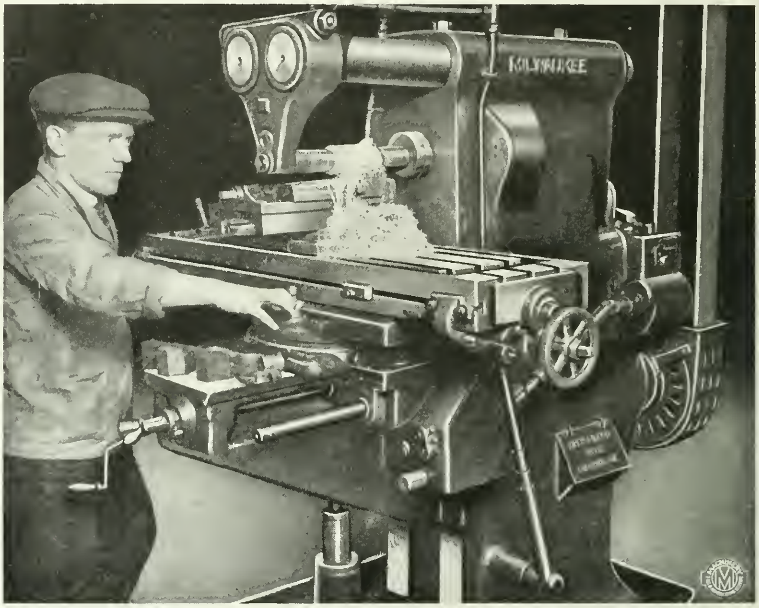
THE CINCINNATI SHAPER COMPANY

Manufacturers of standard machine tools for a quarter of a century

CINCINNATI **OHIO, U. S. A.**

MILWAUKEE MILLING MACHINES

KEARNEY & TRECKER
CORPORATION
MILWAUKEE
MILLING
MACHINES



Big British Motor Builders Find them Just Right for Precision Work

Milwaukee Milling Machines are just as popular at the Manchester, England works of Crossley Motors as they are in big plants on this side of the ocean—and for the same reasons—accuracy, convenience and all-round satisfactory service.

The machine shown is milling the sides and back of a cast-iron drill jig for a motor crankshaft.

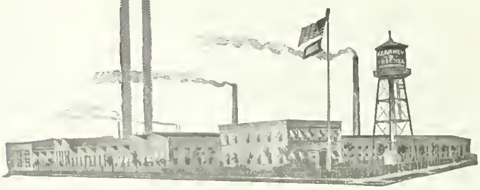
If you're interested we'll be glad to send you details of Milwaukee Milling Machines and operations. Write us.

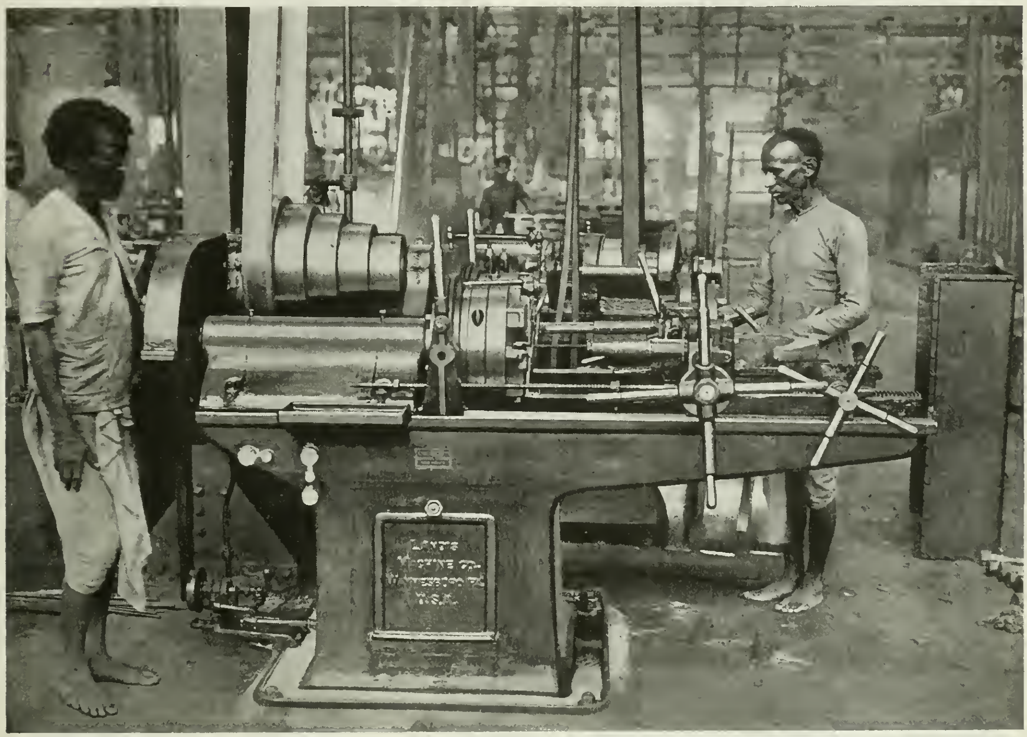
KEARNEY & TRECKER
CORPORATION
MILWAUKEE, WIS., U.S.A.

CHICAGO OFFICE
631 WASHINGTON BLVD.

CLEVELAND OFFICE
738 SUPERIOR AVE., N.W.

NEW YORK OFFICE
1801 SINGER BLDG





Landis Threading Machines

They call this man a "Landis Walla" in Indian Railway Shops

It's a far cry from Waynesboro, Pa., to the shops of the Eastern Bengal Railway at Kanchrapara, British India; but it didn't take long for this Landis Threading Machine to pay its freight bill.

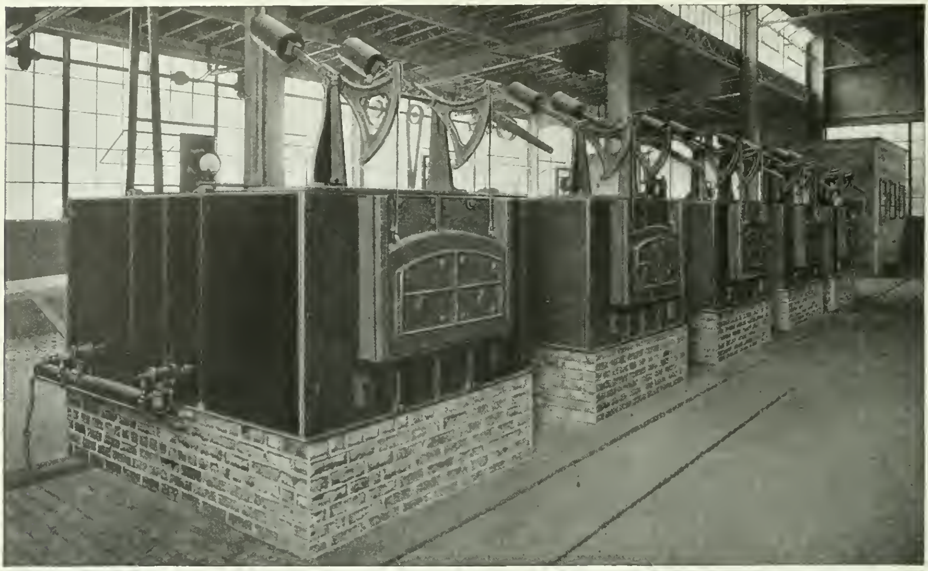
Used for threading bolts, locomotive set screws, and many other parts, it has not only set a new standard for quality, but left former production far behind.

Landis Threading Machines serve the mechanical industries throughout India. The Bengal Bridge & Bolt Company, for instance, whose plant is at Shalimar, Howrah, is equipped exclusively with Landis Die Heads and Machines in its Bolt Shop.

The introduction of Landis Machines into India created the new title of "Landis Walla" for its operators—"walla," as every Anglo-Indian knows, meaning a worker. Native labor in all countries quickly learns the few simple movements necessary to Landis operation, and the fact that the machine cuts both right- and left-hand threads from the same chasers adds largely to its utility.

Glad to send you a copy of the latest Landis Catalog.

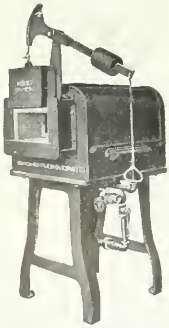
Landis Machine Company, Incorporated
WAYNESBORO, PENNSYLVANIA



Stewart strength, solidity and enduring qualities are shown in this lineup of Stewart "Inbuilt" Oven Furnaces. Used for carbonizing in the Milwaukee plant of the Nash Motors Company. Stewart Furnaces are efficiently serving many nationally known automobile manufacturers.

Stewart No. 10 Cyanide Furnace

For Lead or Cyanide Hardening



Stewart No. 27 Oven Furnace

For Annealing, Carbonizing, Hardening High-Speed Steel or Pre-Heating for High Speed Steel Hardening

Furnace Men Like Them

STEWART FURNACES are such efficient equipment that they go a long way toward cultivating friendly feelings between furnace men and their employers.

It is a pleasure to Stewart operators to regulate the burners, lift the doors, fill the ovens and watch the recording instruments.

They soon discover that Stewart engineers in designing and building Stewart Furnaces really apply knowledge of manufacturing conditions gained only by actual experience.

Stewart Furnaces are more than an assembly of steel plates, refractories, valves, etc. They are an effective combination of practical heat-treating experience and furnace engineering of unusual skill.

Burner placement insures proper atmospheric conditions; flexibility of control enables desired temperatures to be reached and held steadily; high quality insulation minimizes heat radiation, enabling operators to work close to the furnace without suffering from intense heat.

Stewart furnace engineers lend a helping hand with heat-treating problems. These practical men get down into the shop—they know conditions at first hand—their counsel is profitable.

Chicago Flexible Shaft Company

1154 South Central Ave., Chicago

350 Broadway,
New York

Railway Exch. Bldg.,
St. Louis

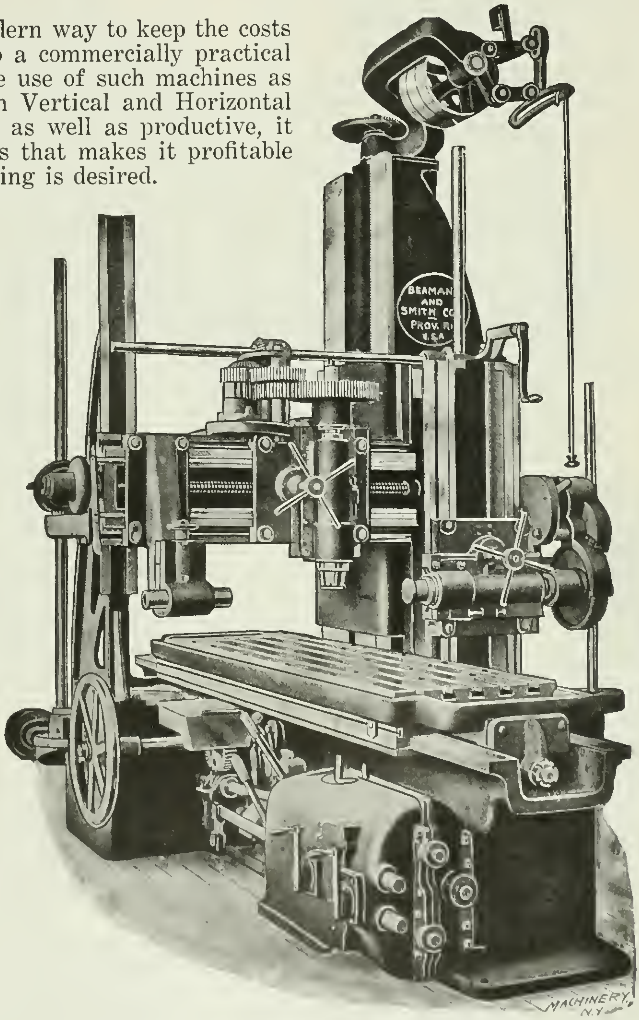
601 Kerr Bldg.,
Detroit

BEAMAN & SMITH

Production Machines for Milling, Drilling, Boring and Tapping

Quantity production—the modern way to keep the costs of high quality work down to a commercially practical level—is made possible by the use of such machines as this B.&S. No. 2 Combination Vertical and Horizontal Milling Machine. Adaptable as well as productive, it has a wide field of usefulness that makes it profitable wherever rapid, accurate milling is desired.

The table is 24″ by 8″ with 9″ movement on the bed; nine changes of automatic table speed with quick power movement of 15′ in either direction make it possible to maintain any desired rate between 7/8″ to 9½″ per minute at any spindle speed. Spindles can be driven in unison or singly, horizontal spindles can be driven in either direction. Double back gearing for each spindle attached to its respective head permits the simultaneous employment of different speeds.


BEAMAN AND SMITH CO PROV. RI U.S.A
MACHINERY, N.Y.

Send for the circular of this machine or tell us your needs in this line and we'll send you details of the B. & S. machines most calculated to meet them.

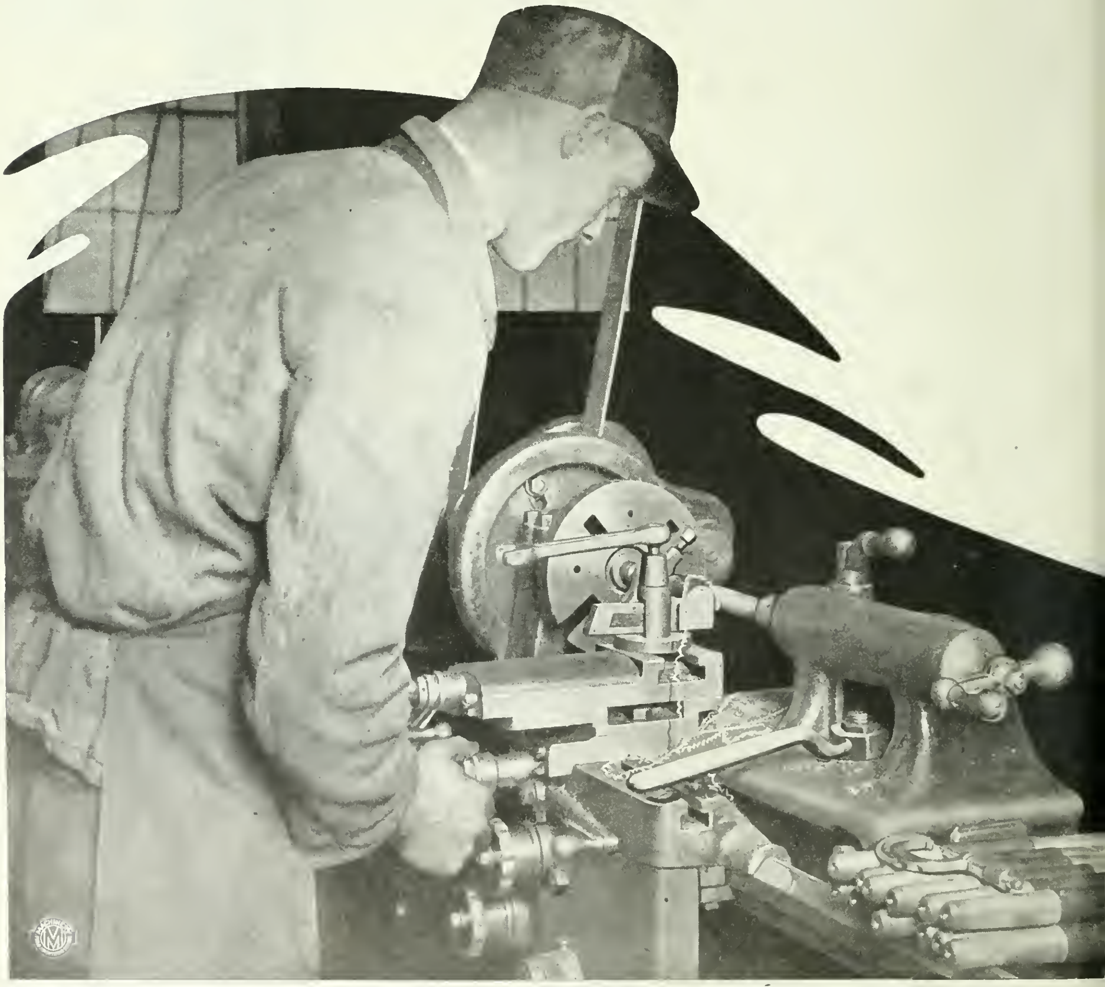
The Beaman & Smith Company

PROVIDENCE RHODE ISLAND

AMERICAN

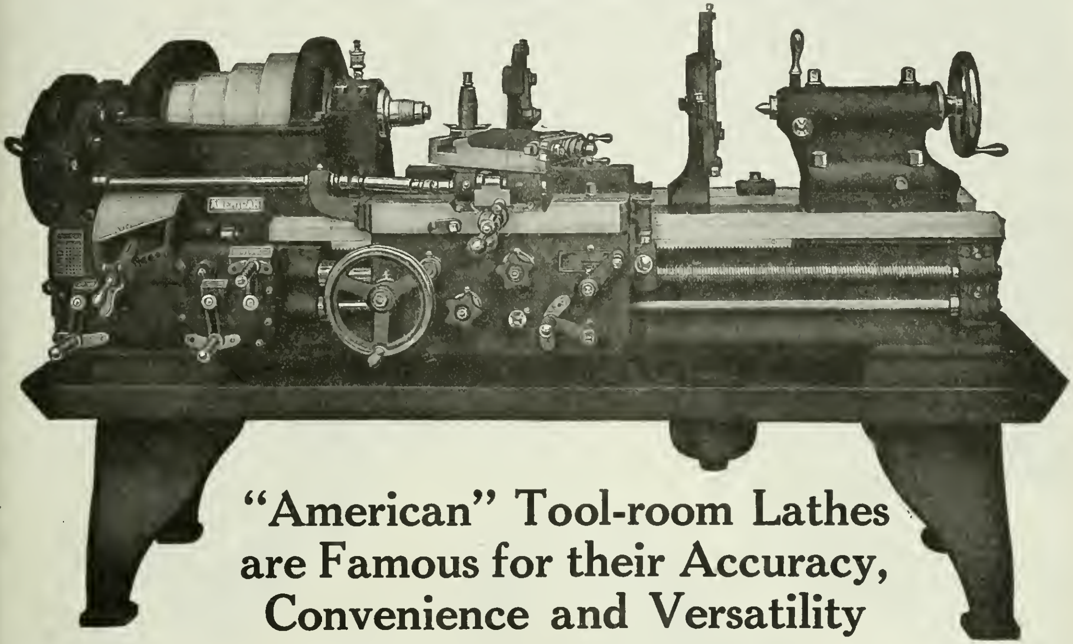
After Ten Years Hard Service this Lathe is Still Admirably Adapted for the Difficult Work Shown Below—Turning Tool Steel Centers for Dividing Heads.

There are two "American" Tool-room Lathes in the Mill City Mfg. Co.'s plant, at Minneapolis, Minn.—one ten, the other eight years old—the satisfactory performances of the first having sold the second. Both are used for general shop work as well as for fine tooling and are as uniformly accurate as when first installed. The work shown is tool steel centers for dividing heads for "Kriesel" Machines—machined in pairs and then cut apart.



SHAPERS **RADIALS**

AMERICAN

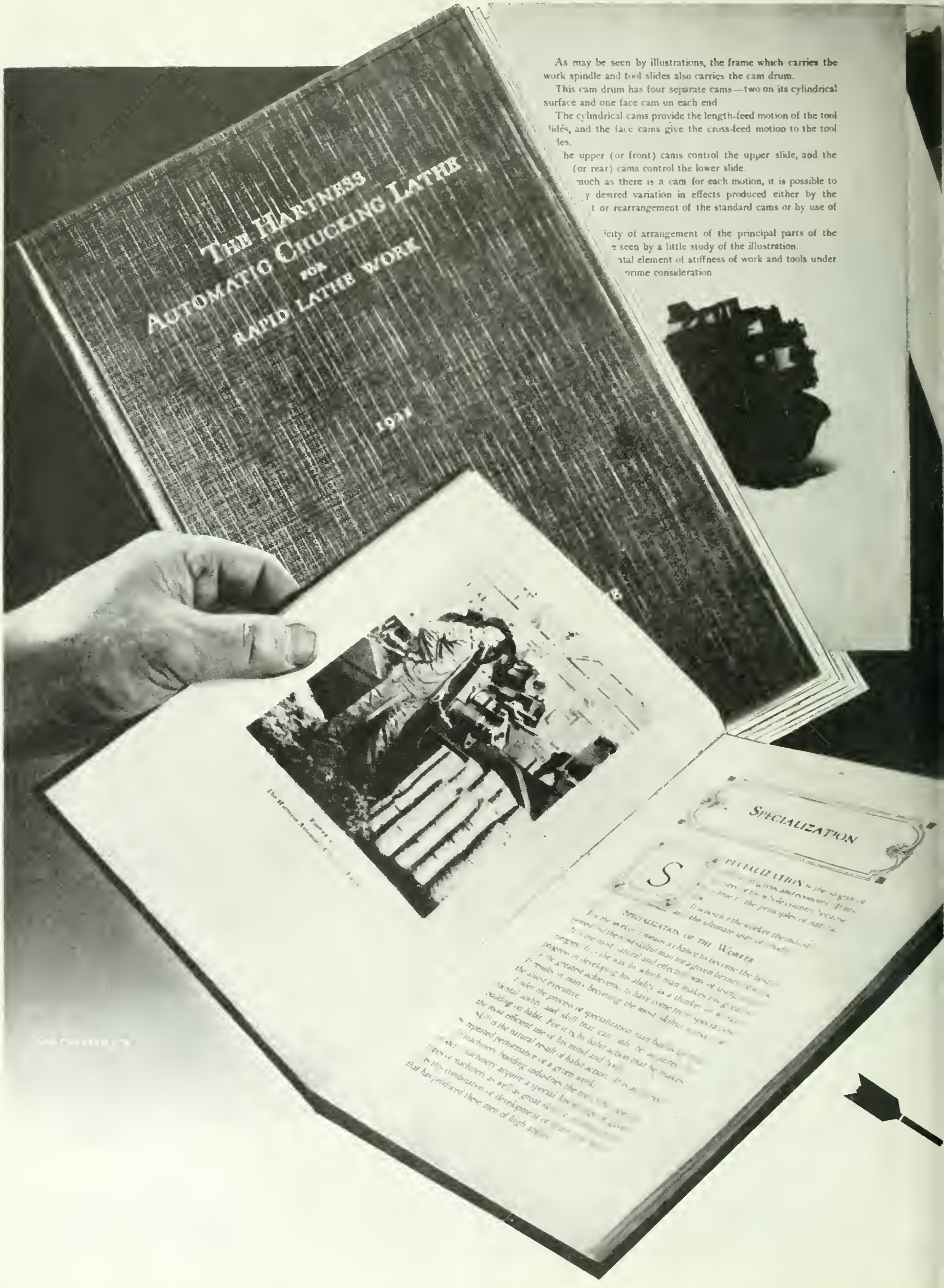


"American" Tool-room Lathes are Famous for their Accuracy, Convenience and Versatility

We expect "American" Lathes to give this class of service. We make them carefully of the very best material throughout—machining all structural parts in jigs and fixtures; employing templets and test papers in all planing operations and leveling, erecting and aligning with equal care and precision. We run the finished machines under belt at top speed from 6 to 10 hours and chase every thread on the index plate for testing—allowable error being less than .001″. Controls and attachments are designed to provide the widest possible range with least amount of adjustment and effort.

Complete description of "American" Lathes—tool-room and heavy duty—their design, construction and application, on request.

The American Tool Works Company
Cincinnati, U. S. A.



THE HARTNESS
AUTOMATIC CHUCKING LATHE
FOR
RAPID LATHE WORK

1921

As may be seen by illustrations, the frame which carries the work spindle and tool slides also carries the cam drum.

This cam drum has four separate cams—two on its cylindrical surface and one face cam un each end

The cylindrical cams provide the length-feed motion of the tool lidés, and the face cams give the cross-feed motion to the tool les.

he upper (or front) cams control the upper slide, and the (or rear) cams control the lower slide.

nuch as there is a cam for each motion, it is possible to y desired variation in effects produced either by the t or rearrangement of the standard cams or by use of

icity of arrangement of the principal parts of the e seen by a little study of the illustration.

ntal element of stiffness of work and tools under prime consideration

SPECIALIZATION

SPECIALIZATION OF THE WORKER

A New Hartness Catalogue

Fill in the coupon to make sure a copy of our latest catalogue is in your file. The book describes the New Lathe, illustrates its application to every day manufacturing needs—and points the way to economical production.

The new machine is designed to accommodate work up to 6" long and 12" diameter —the ultimate in simplicity, power and speed.

The New Hartness Automatic Chucking Lathe Stands for the "Limit" in Rapid Lathe Work—The New Book Illustrates and Describes It.

Jones & Lamson Machine Company
SPRINGFIELD VERMONT, U. S. A.

9-10 Water Lane, Queen Victoria Street, London, E. C.

503 Market St., San Francisco, Cal. F. Auberty & Co., 182 Rue Lafayette, Paris, France, Spain and Belgium Holland: Spliethoff, Beeuwkes & Co., Leuvehaven Wz. 159, Rotterdam. Japan, Korea, etc., Mitsui & Co., Ltd., Tokyo. Australasia: McPherson's Pty. Ltd., 554 Collins St., Melbourne.
Sweden: A. Bol. Oscar Lindbom, Stockholm.

Jones & Lamson Machine Co.
Springfield, Vt., U.S.A.

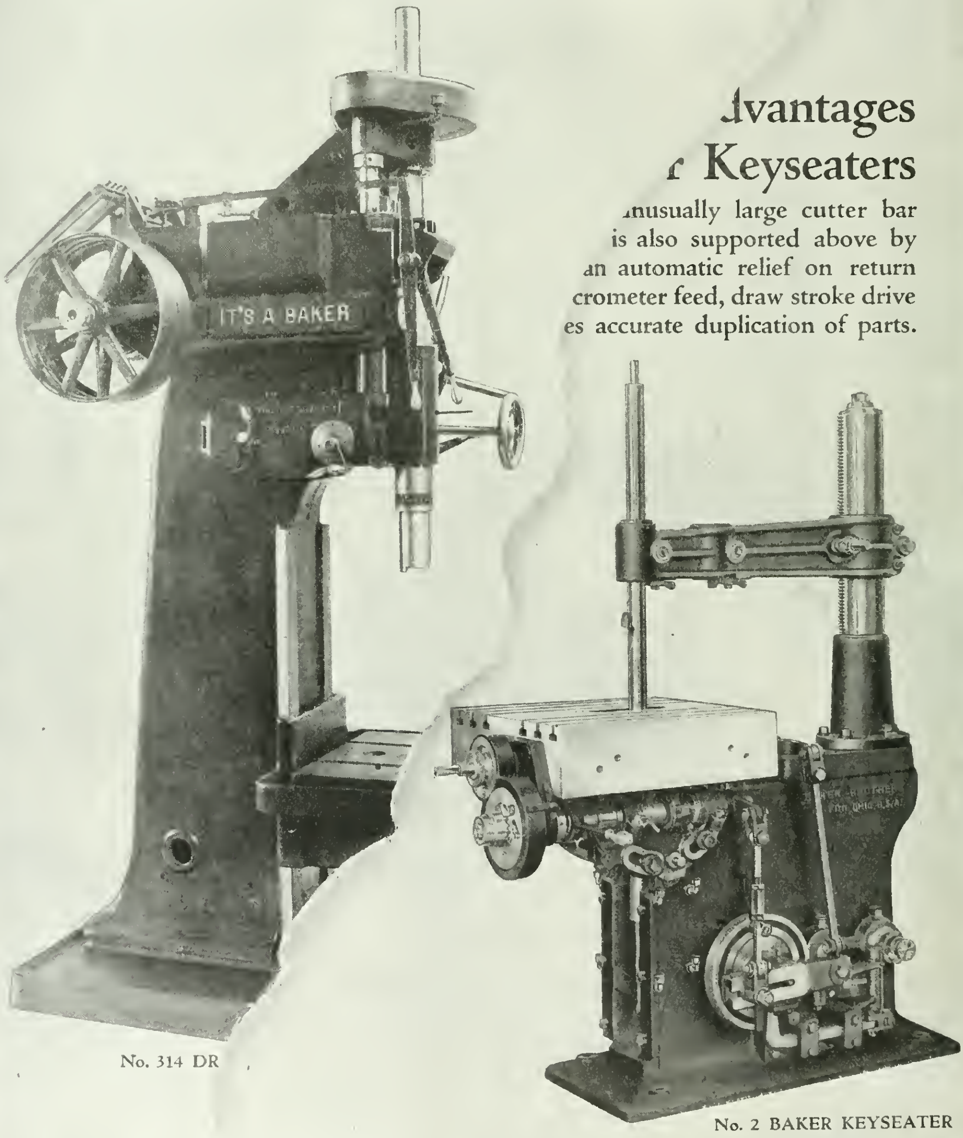
Please send me your 1921 Catalogue of the Hartness Automatic Chucking Lathe.

Name .... Position ....
Address .... Company ....
....

MAIL THIS COUPON TODAY

Both Are Leaders in Their Field

Baker Brothers machines are all kept up to the minut
the last word in efficient keyseating and drilling mach



dvantages
r Keyseaters

nusually large cutter bar
is also supported above by
an automatic relief on return
crometer feed, draw stroke drive
es accurate duplication of parts.

No. 314 DR

No. 2 BAKER KEYSEATER

r Keyseaters are unexcelled for efficient and *accurate* cutting of misc-
keyseats, in addition being adapted for many slotting operations.

BAKER BROTHERS Toledo, Ohio, U. S. A.

What's Your Guarantee that these Hubs Will be Threaded *Right?*

The manufacturer of these outside wheel hubs knew that every inaccurate or damaged thread made a big difference in the cost per piece of the good ones. He wanted a guarantee that the hubs would be threaded *right*—and he got it.

For many months this 2 13/16″—16 U. S. F. NAMCO Self-Opening Die has been threading these hubs accurately, speedily and at low cost per piece.

Performance is our guarantee behind this tool and others in a long list of satisfied NAMCO Die and Tap owners. NAMCO Thread-Cutting Dies have solved more than one problem of this nature, in fact, hundreds. How about yours?

THE NATIONAL ACME COMPANY
CLEVELAND, OHIO
NEW ENGLAND PLANT, WINDSOR, VT.
CANADIAN SCREW PLANT, MONTREAL, P. Q.
BRANCH OFFICES:
NEW YORK BOSTON CHICAGO DETROIT BUFFALO

"GIANT" KEYSEATERS

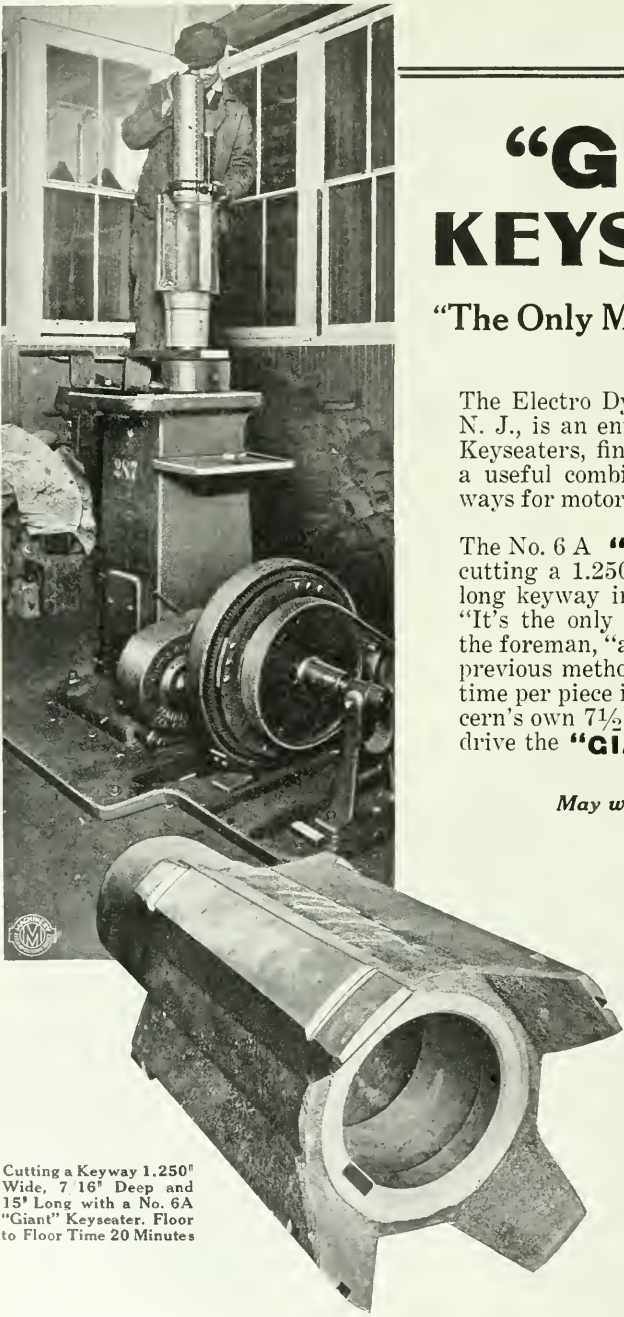
"The Only Machine for this Work"

Says the Foreman

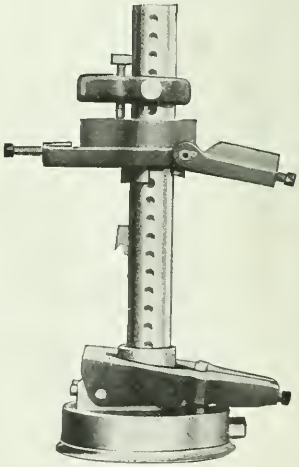
The Electro Dynamic Company, of Bayonne, N. J., is an enthusiastic user of **"GIANT"** Keyseaters, finding their speed and accuracy a useful combination in the cutting of keyways for motor parts.

The No. 6 A **"GIANT"** Keyseater shown is cutting a 1.250″ wide by 7/16″ deep by 15″ long keyway in a cast-iron armature barrel. "It's the only machine for this work," says the foreman, "and a big improvement over our previous method of doing it." Floor to floor time per piece is 20 minutes. One of this concern's own 7½ H.P. electric motors is used to drive the **"GIANT"** Keyseater.

May we send you the catalog?



Cutting a Keyway 1.250″ Wide, 7/16″ Deep and 15″ Long with a No. 6A "Giant" Keyseater. Floor to Floor Time 20 Minutes



MITTS & MERRILL, 843 Water Street
SAGINAW, MICH.

FOREIGN AGENTS. Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Christiania, Norway and Stockholm, Sweden.

The Resources Of Our Modern Organization

Are available for the building of special equipment; or the manufacture of standard machines or mechanical devices in quantities.

Our equipment, the most modern that has come under our observation, embraces all of the best known types and entirely covers the field of boring, turning, grinding, hobbing, broaching, gear cutting, milling and planing in addition to our facilities for heat-treating and automatic screw machines and our adequate cost, record and production systems.

We will be pleased to consult with you on your engineering problems and quote fixed prices upon receipt of data. Our equipment and facilities are so widely diversified that we can build efficiently practically any mechanical device or machine tool now in use.

Can we be of service to you?

The R.K.Le Blond Machine Tool Co.
Cincinnati, Ohio.

For Drilling in Tough Heat Treated Material

After thirty years development, this sensational hot rolled drill has conclusively demonstrated the superiority of its work in hard drop forgings, cored steel castings and alloyed steels equally difficult to drill.

Special advantages of design and construction bring about the special superiorities that enabled it to win practically every competitive test in which it took part.

Its wide flute and 32° helix angle affords more than ample chip clearance for deep drilling. The uniform increase in the web thickness gives unusual strength and torsional resistance which eliminates all "chatter." The increased helix angle toward the point provides a sharp shearing action on the stock being drilled.

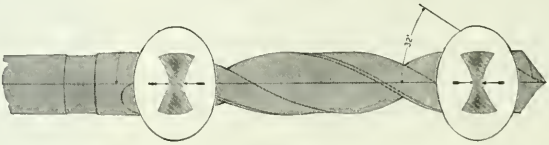
Made Exclusively By D. T. D.

No other concern has ever produced a twist drill by this special hot rolled process which has been patented by the Detroit Twist Drill Company and used by them exclusively. Blanks of high tungsten, high speed steel are fluted by being passed heated through specially built and patented rolls. This operation gives a refined and uniform grain and a desirable compactness to the steel structure at the vital parts—the center and outer edges. Then the fluted blank is twisted in specially designed automatic machines which insure absolute accuracy.

Increased Production

Exhaustive tests show that D D hot rolled drills increase production at least twenty-five per cent. Manufacturers and shop owners called upon to do deep drilling in tough metals are urged to write for complete reports and data which substantiate this claim. They will be sent without cost.

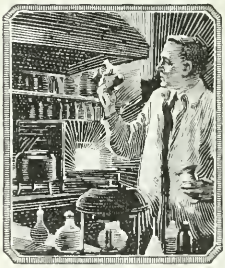
The wide flute insures ample chip clearance for deep drilling.



Double-D hot rolled drills now available in sizes from ½" to 1⅝"

Detroit Twist Drill Company, Detroit, Michigan
45 Warren Street, New York **Hurt Building, Atlanta**
Canadian Detroit Twist Drill Co., Limited, Walkerville, Ontario

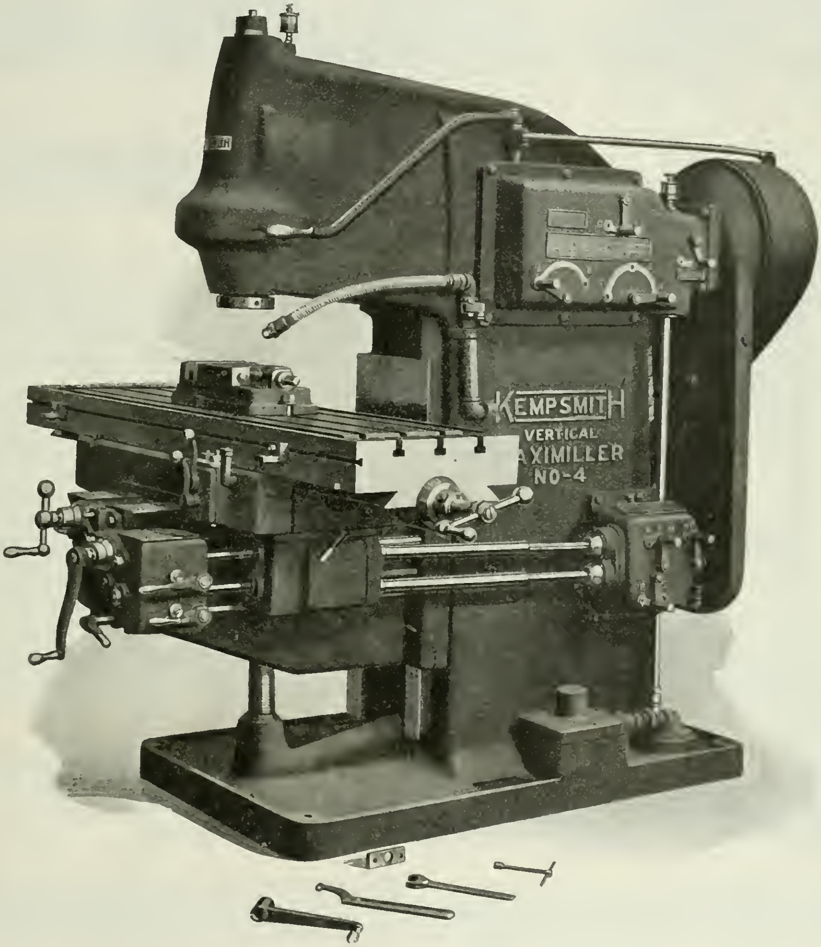
(15)



DETROIT DOUBLE-D ROLLED DRILLS

KEMPSMITH MAXIMILLER

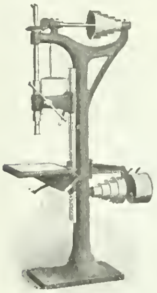
The No. 4 Vertical—A Machine of Unusual Merit

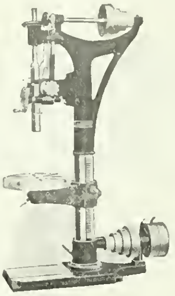


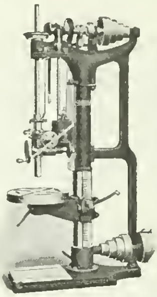
Ask Us For Circular No. 84 Which Gives Full Details.

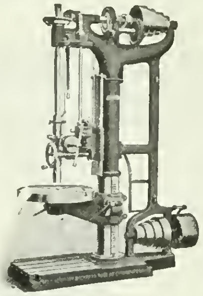
KEMPSMITH MILWAUKEE, U.S.A.

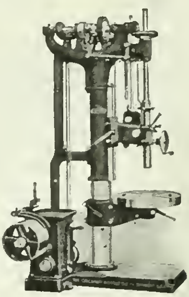
FOREIGN AGENTS American Trading Company, Tokyo, Japan. Barandiaran & Company, 3-Alameda, San Sebastian, Spain. Bevan & Edwards Pty. Ltd., 117 King Street, Melbourne, Australia. Blair, Reed & Company, Nathan's Building, Box No. 941 Wellington, New Zealand. Edgar Bloxham, 12 Rue Du Delta, Paris, France. Societe Anonyme Belge Alfred Herbert, 34 Rue Melsens, Brussels, Belgium. Nielsen & Winther, Blegdamsvej 60, Copenhagen, Denmark. Parks & Lacy Company, 60 Clarence Street, Sydney, N. S. W. Australia. Rene Berndes, Calle de Cuba, No. 61, Havana, Cuba. Selson Engr. Company, 85 Queen Victoria St., London, E. C., England. Selson Engr Company, Corso Vittorio Emanuele, No. 11, No. 9, Turin, Italy. Selson Engr. Company, 5 Piazzo Castella, Milan, Italy. Forum Smidt & Cia., Peru Esquina, San Juan, U. T. 2794, Buen Orden, Buenos Aires, Argentina. Mr. Armando Bussetl, Rua 7 de Setembro No. 183, 1° Rio de Janeiro, Brazil. Pascual Teja, La Capuchinas, No. 32, Mexico, D. F. Spiethoff, Beeuwkes & Co., Leuvehaven, W. Z. 159 Rotterdam, Holland. Turner, Hoare & Company, Ltd., Gateway Bldg., Lansdowne Road, Apollo Bunder, Bombay, India. Charter & Gardiner, P. O Box 1201, 55 Calle Echaque, Santa Cruz, Manila, Philippine Islands.

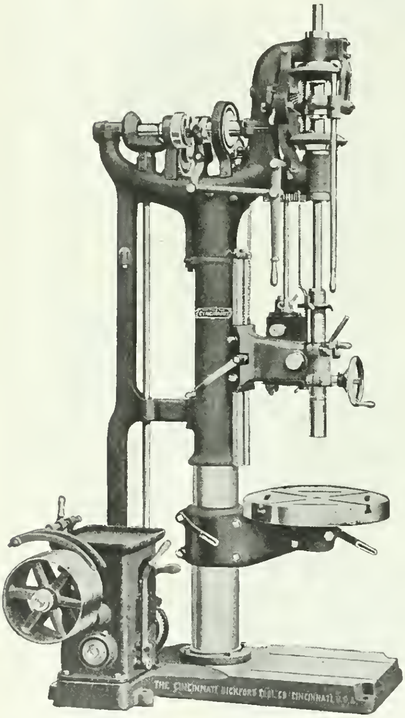












THE
CINCINNATI

The 24-in. to 42-in. High-Speed Upright Drilling Machine

Quality and convenience are developed far beyond the average in these high-speed, wide range machines. Back gears and tapping attachment operate through friction clutches which eliminate shock and noise and save time, power and upkeep. Any of 16 spindle speeds are instantly available and automatic trip and depth gage protect both tools and work and insure exact duplication on production jobs. A choice of three different tables and three styles of drive is available and the tapping attachment is optional. Details of whole line on request.

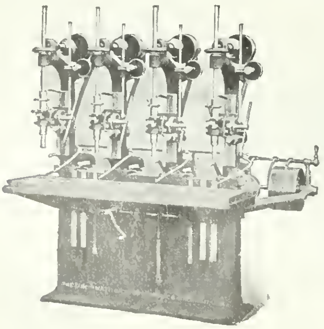
The Cincinnati Bickford Tool Co.

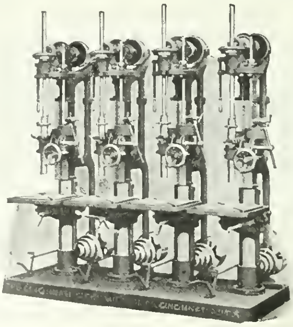
Oakley, Cincinnati, Ohio, U. S. A.

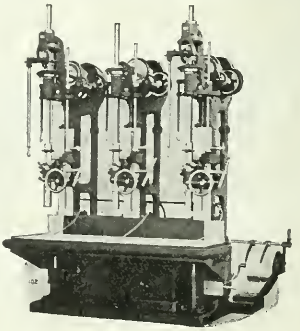
Founded 1874

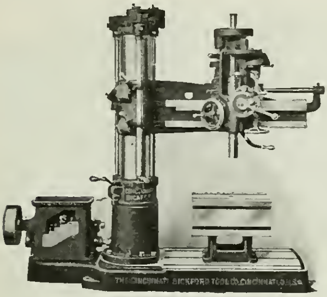
U581

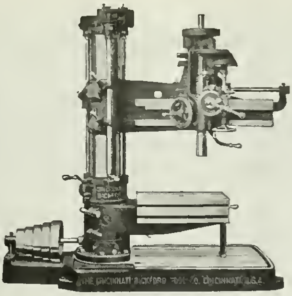
DOMESTIC AGENTS: Henry Prentiss & Co., Inc., New York, Hartford, Conn., Boston, Mass.; Buffalo, Rochester, and Syracuse, N. Y. **Motch & Merryweather Machinery Co.,** Cleveland, Ohio; Detroit, Mich.; Cincinnati, Ohio, and Columbus, Ohio. **Marshall & Huschart Machinery Co.,** Chicago, Ill. **Brown & Zortman Machinery Co.,** Pittsburgh, Pa. **W. E. Shipley Machinery Co,** Philadelphia, Pa **Marshall & Huschart Machinery Co. of Indiana,** Indianapolis, Ind. **Elliott & Stephens Machinery Co.,** St. Louis, Mo. **Harron, Rickard & McCone,** San Francisco, Calif., and Los Angeles, Calif. **C. T. Patterson Co., Ltd.,** New Orleans, La. **Robinson, Cary & Sands Co.,** St. Paul, Minn. and Duluth, Minn. **Kemp Machinery Co.,** Baltimore, Md. **Dewstoe Machine Tool Co.,** Birmingham. Ale. **Seeger Machine Tool Co.,** Atlanta, Ga. **Hallidie Machinery Co.,** Seattle, Wash. **Zimmerman-Wells-Brown Co.** Portland, Ore. **Charlotte Supply Co.,** Charlotte.

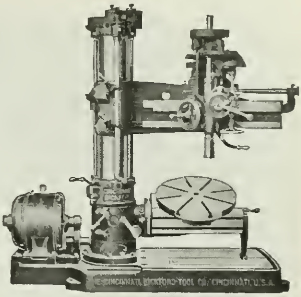












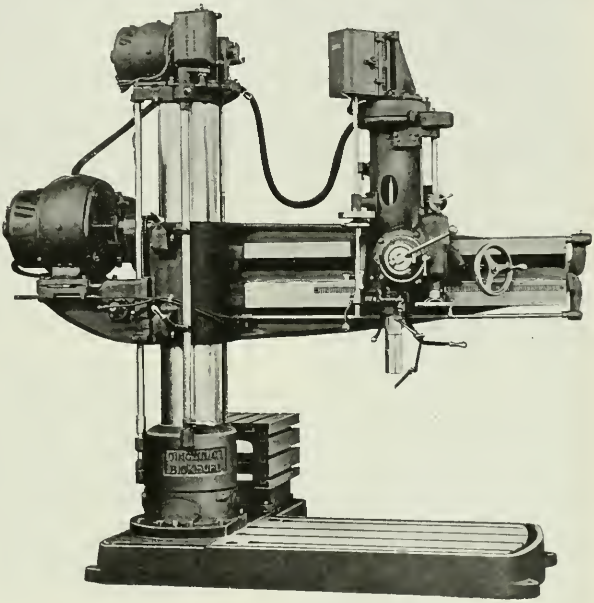
THE
CINCINNATI BICKFORD

Electrically Driven Throughout—As Usual Cincinnati Bickford Leads

Operating this completely motorized C-B Radial is almost a case of "you push the button; we do the rest," and construction is appreciably simplified.

Four shafts and seven gears are eliminated by gearing a 3 to 1 variable speed motor direct to the arm shaft and mounting a constant speed reversing compound wound motor on the column.

As shown, the machine is further equipped with our compressed air column-binder and cutting lubricant outfit—their superior advantages fully described in our latest bulletin.

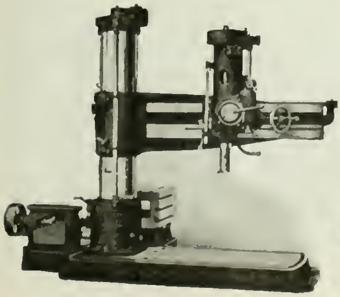


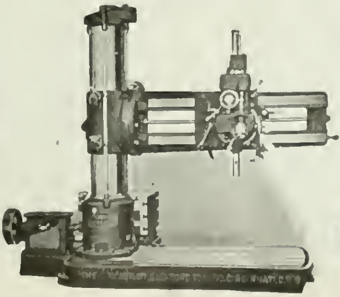
The Cincinnati Bickford Tool Co.

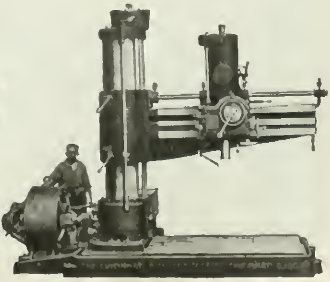
Oakley, Cincinnati, Ohio, U. S. A.

Founded 1874 R581

N. C. **Mills & Lupton Supply Co.**, Chattanooga, Tenn. **The Salt Lake Hardware Co.**, Salt Lake City, Utah. **CANADIAN AGENTS: H. W. Petrie, Ltd.**, Toronto, Ont. **Williams & Wilson, Ltd.**, Montreal, Quebec. **FOREIGN AGENTS: Charles Churchill & Co. Ltd.**, London, Manchester, Birmingham, Newcastle-on-Tyne, England, and Glascow, Scotland. **Aux Forges de Vulcain**, Paris, France. **Hijo de Miguel Mateu**, Barcelona, Spain. **Ateliers Demoor Ste Ame.**, Brussels, Belgium. **Chr. A. Hersted**, Copenhagen, Denmark and Stockholm, Sweden. **Andrews & George Co.**, Tokyo, Japan. **McPherson's Pty., Ltd.**, Melbourne, Australia. **Bartle & Co.**, Johannesburg, South Africa. **H. S. Gray Co.**, Honolulu, Hawaii. **Gustav Nielsen**, Christiania, Norway. **Maskin-Aktiebolaget E. Gronblom**, Abo, Finland. **J. Lambercier & Co.**, Geneva and Zurich, Switzerland. **Lovell Tool & Machine Co.**, Havana, Cuba. **Naamlooze Vennootschap Higeta**, Rotterdam, Holland. **Edward J. Nell & Co.**, Manila, P. I. **Phillip G. Roeder**, Mexico City, Mexico.



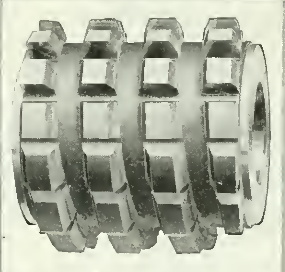




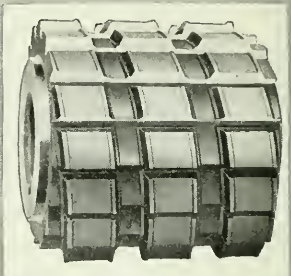
BARBER-COLMAN

HOBS -FORMED AND GROUND

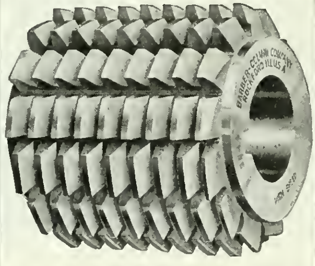
ACCURATE *DEPENDABLE*



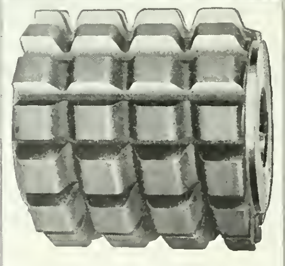
SPLINE SHAFT HOB



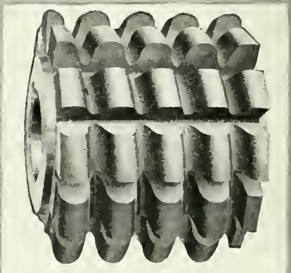
SPLINE SHAFT HOB



GEAR HOB



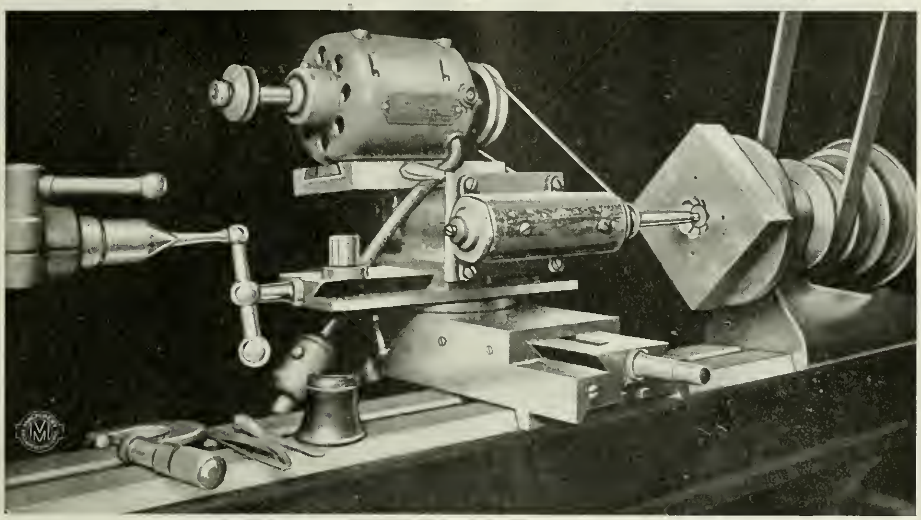
BLOCK CHAIN SPROCKET HOB



ROLLER CHAIN SPROCKET HOB

BARBER-COLMAN COMPANY
HOME OFFICE & PLANT
ROCKFORD, ILL., U.S.A.

1920-54



Remarkable Adaptability Proved by this Unique Set-Up

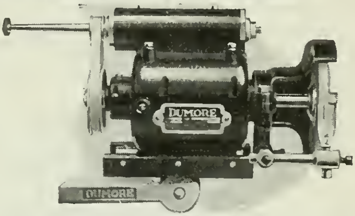
This photograph, taken at A. Nacke & Sons, Philadelphia, Pa., shows a Dumore Grinder set-up for an internal grinding operation on a Rivett Bench Lathe. The internal grinding arm is removed from the grinder proper and screwed to a plate which is fastened to a shaft 1⅞" in diameter held in the tool holder; the driving mechanism is bolted to the other end of this shaft.

This unique set-up, necessary because of the construction of the Rivett Tool Holder, is made easily possible by the adaptability of this Dumore Grinder. A versatile machine, used in its original form on a large variety of work, it has saved the cost of a special grinding attachment for this machine and has done some exceedingly close work here in the past few years.

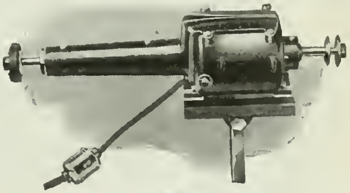
Although the set-up in this instance is unusual it is but another instance of the adaptability of Dumore Grinders. A part of their job is doing the unusual.

Send for a catalog of Dumore High-Speed Grinders and Drills
There is a model particularly suited to your work

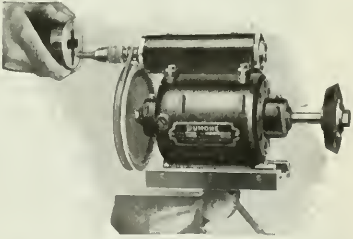
Wisconsin Electric Company
2538 Sixteenth Street Racine, Wis., U.S.A.



EQUIPMENT A
For general tool-room use. Includes High-Speed Internal Spindle A with reach of 3 inches. 30,000 R.P.M. Comes fully equipped. Weighs 171 pounds.



EQUIPMENT B
For deep internal work. Extension arm has 10-inch reach. 10,000 R.P.M. Arm interchangeable with internal spindle on Equipment A.

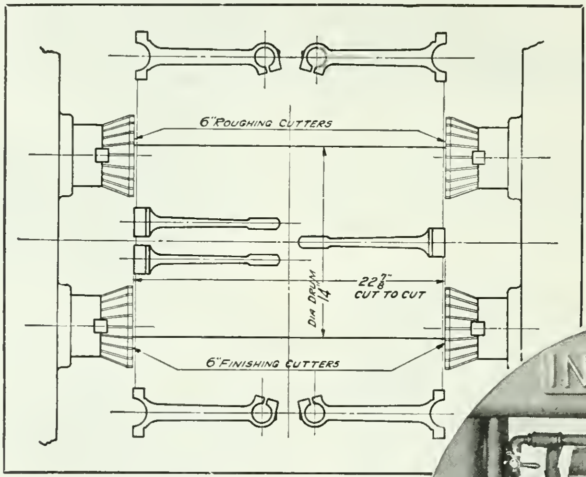


EQUIPMENT C
For button discs. Will grind 20 an hour. Interchangeable with A and B.

DUMORE HIGH SPEED GRINDERS

• INGER

Milling the Ends of 376 Connecting Rods per hour

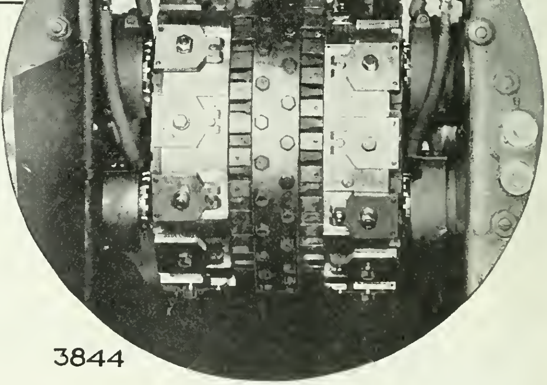


The diagram shows the continuity of machining that is made possible through Ingersoll Drum Type Milling Machines. Two circles of 28 forgings, each set so close together that they nearly touch, are continually revolving past the cutters. Both roughing and finishing cuts are taken on each rod at one setting. The forgings are held in a fixture quickly and easily operated by the operator. Each clamp holds a pair of forgings. The production is 376 pieces per hour.

Diagram Showing Arrangement of Forgings on the Drum. The Fixture Holds 56 Forgings.

On receipt of blueprints, we will gladly submit an estimate of guaranteed production.

We design and build machinery for special work, and furnish fixtures and cutters complete for immediate operation when installed.



3844

Front View Showing Roughing and Finishing Cutters of Machine Illustrated on Opposite Page

The Ingersoll Milling Machine Company

Milling Machines and Their Equipment

ROCKFORD, ILLINOIS

SALES OFFICES: 50 Church St., New York City. David Whitney Bldg., Detroit

SOLL ·

The Ingersoll Drum Type Continuous Milling Machine

is exceptionally well adapted to milling small forgings and castings. A 30-inch machine is shown here milling the bearing cap contact surfaces of connecting rods.

This photograph shows the operator's side of the machine just after he has replaced two finished rods with two rough ones. The drum revolves upward and another pair of finished rods is nearly ready to be taken out of the fixture.

The diagram on the opposite page shows the arrangement of rods in the fixture. Both roughing and finishing cuts are taken and a production of 376 rods per hour is obtained.

This machine occupies but 29 square feet of floor space.

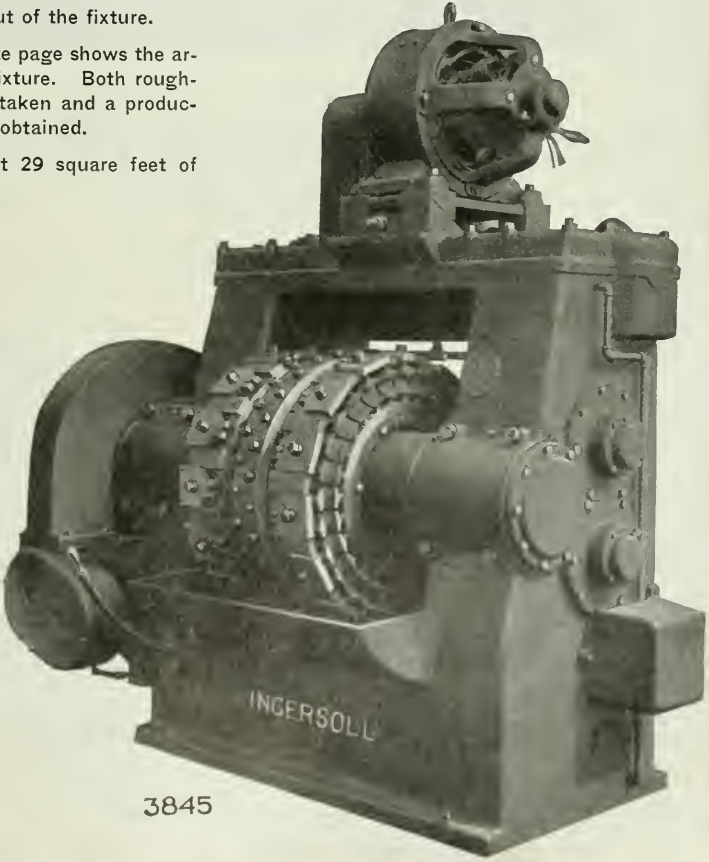
Any of the following Bulletins will be sent on request:

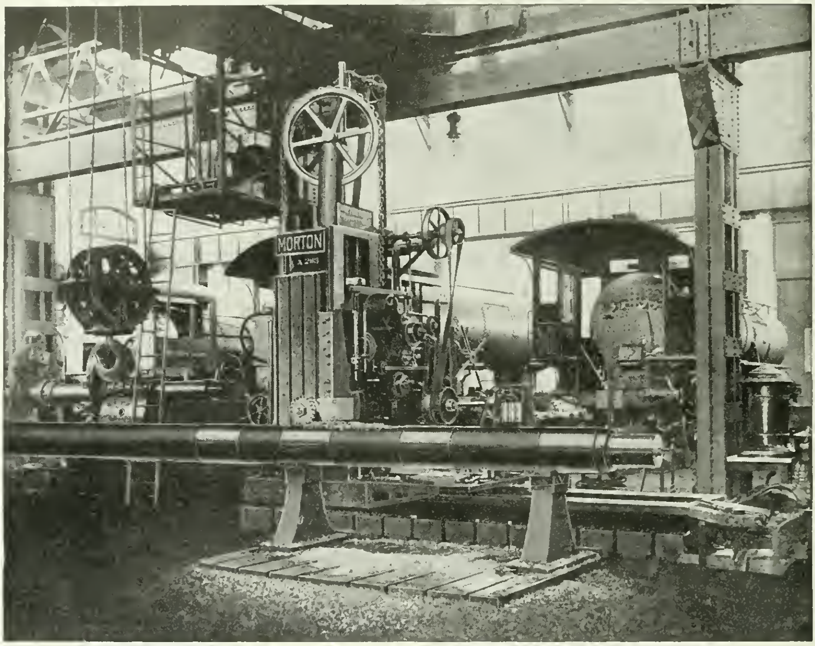
BULLETIN NO. 37
"Ingersoll Cutter Grinders"

BULLETIN NO. 38
"Ingersoll Milling Cutters"

BULLETIN NO. 39
"Ingersoll Continuous Milling Machines"

BULLETIN NO. 40
"Ingersoll Installations"





Morton Traveling Head Planers

For the Contract Shop That Gives Service on All Kinds of Work

This is a big job—but they could handle a small one just as conveniently and economically on the same machine. The size of the piece makes little difference in the result—the work is held stationary and an almost unlimited number of operations can be performed without resetting.

Morton Traveling Head Planers take less space than housed planers and use less power. Adaptable for either draw or push cut and equipped with a wide range of milling and boring feeds and adjustments, these machines are "ready for anything" and greatly increase the capacity of the general contract shop to handle a wide variety of work efficiently and profitably.

The machine shown has a 60″ stroke; the operation is milling keyseats in a 29″ x 1″ shaft; eight keyseats 22″ long, 2″ wide and $\frac{5}{8}$″ deep are cut in nine hours. If it is desired, the vertical attachment may be used and the ends of keyseats routed for round end feather keys.

Morton Traveling Head Planers are made in several sizes—each with capacity for a wide range of work. Send for Circular 8-D, it's full of interesting facts about these machines and their possibilities.

Morton Manufacturing Company
MUSKEGON HEIGHTS MICHIGAN, U. S. A.

Big Work—Small Work—Morton Handles Both with Equal Ease

THE GENUINE MORSE DRILLS ENCIRCLE THE GLOBE

MTD

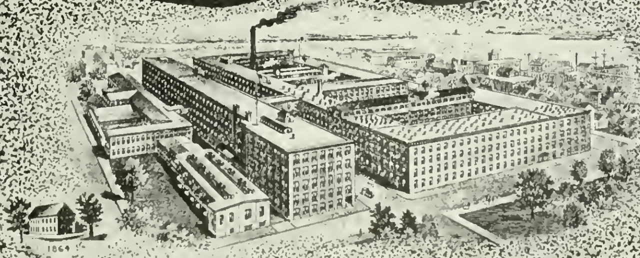
The Call is still on for Increased Production and we can furnish the

DRILLS

which will help a whole lot. It is no time for experimenting. Use the Reliable

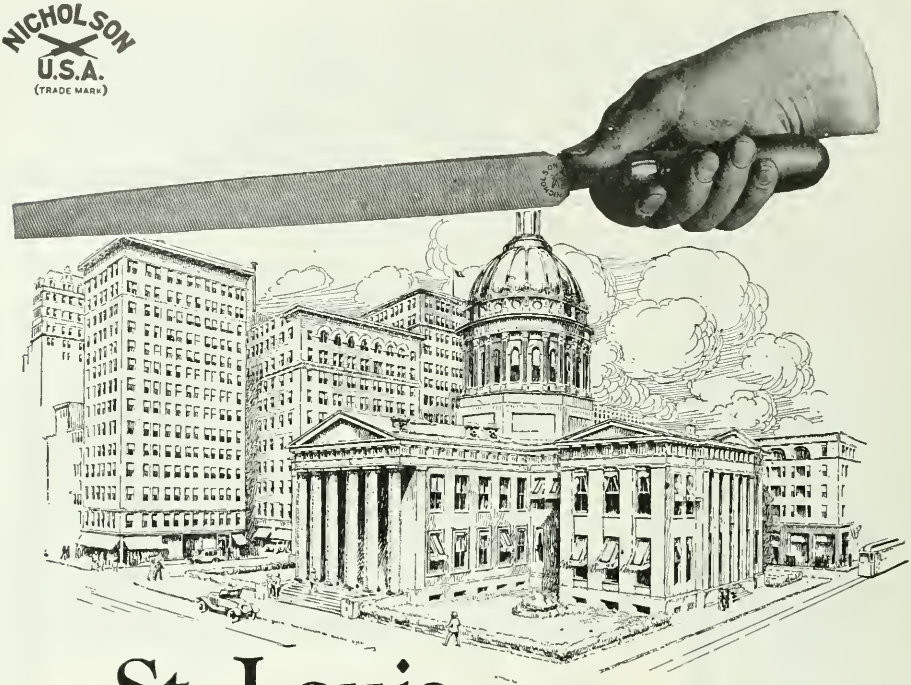
"MORSE" DRILLS

AND BE SURE



Morse Twist Drill & Mch. Co.
New Bedford, Mass. U.S.A.

NICHOLSON
U.S.A.
(TRADE MARK)



St. Louis

The commercial queen among cities of the Mississippi valley—great in industry—the home of 2,500 factories, but even greater in distribution of manufactured goods—annual sales approaching one billion dollars. An export city of considerable importance via Mississippi River and the high seas.

NICHOLSON FILES

dominate in the esteem of St. Louis file users and file distributors. This is a plain statement of fact, yet in fact a tame statement. To supply the file users of the territory served by St. Louis takes no small part of the 100% UNIFORM product of the World's largest File Factory.

NICHOLSON FILE CO.
PROVIDENCE, R.I., U.S.A.

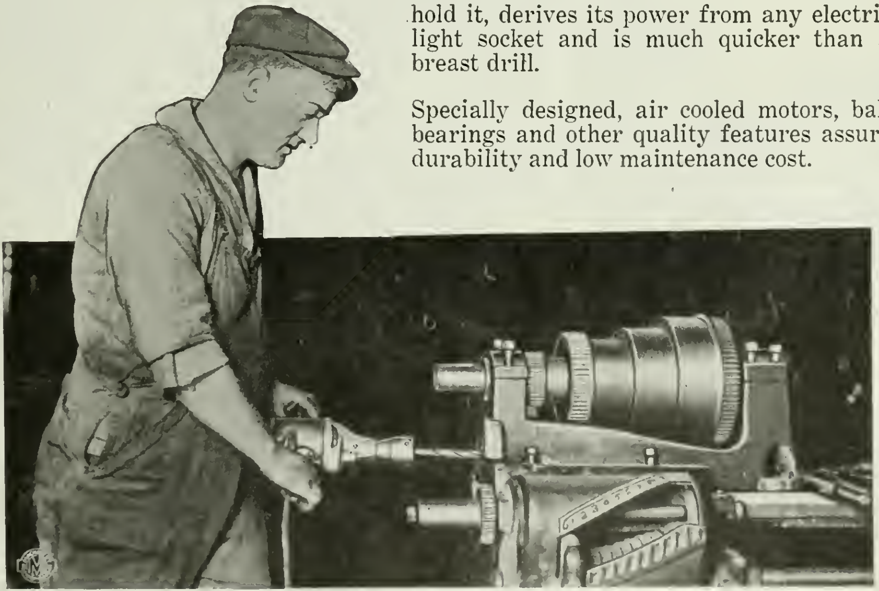
U. S. Portable Electrically Driven Drills

Catalog lists the whole U. S. Line

Indispensable for Assembling and Repair Work

Below is shown an every-day occurrence in most any lathe builder's assembling department—drilling a hole for a transmission guard. The lathe is of a well-known "brand" and the drilling machine, an U. S. Portable Electrically driven machine which is in constant use—now in one part of the shop, now in another—wherever small holes must be drilled for name plates, guards, covers, spot holes, etc. On this class of work it saves all the time, trouble and expense of moving heavy castings to the stationary drill press; in the repair shop the time it takes to dismantle and reassemble the machine is often saved in addition. For it can be used wherever a man's arm can reach to hold it, derives its power from any electric light socket and is much quicker than a breast drill.

Specially designed, air cooled motors, ball bearings and other quality features assure durability and low maintenance cost.



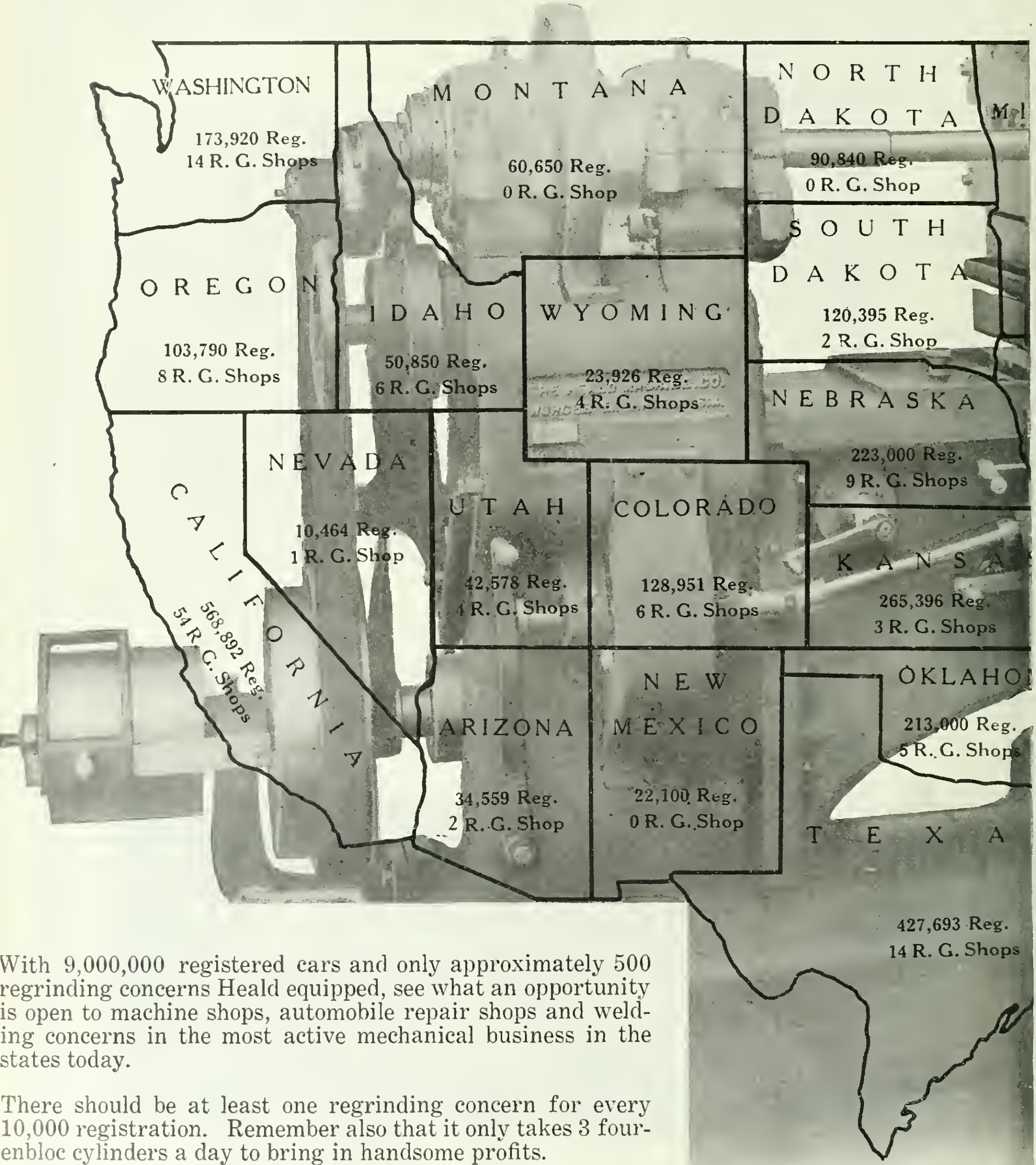
The United States Electrical Tool Company

6th Avenue and Mt. Hope Street **Cincinnati, Ohio**

STOCK CARRIED IN BRANCHES

New York Office: 50 Church Street. St. Louis Office: 1956 W. Broadway. Detroit Office. Marquette Building. Chicago Office: 549 West Washington Boulevard. Boston Office: 12 Pearl Street. Philadelphia Office. The Bourse. Pittsburgh Office: Oliver Bldg. Cleveland Office: 512 Bangor Bldg. Kansas City Office: 3007 Holmes St.

THE MAP OF



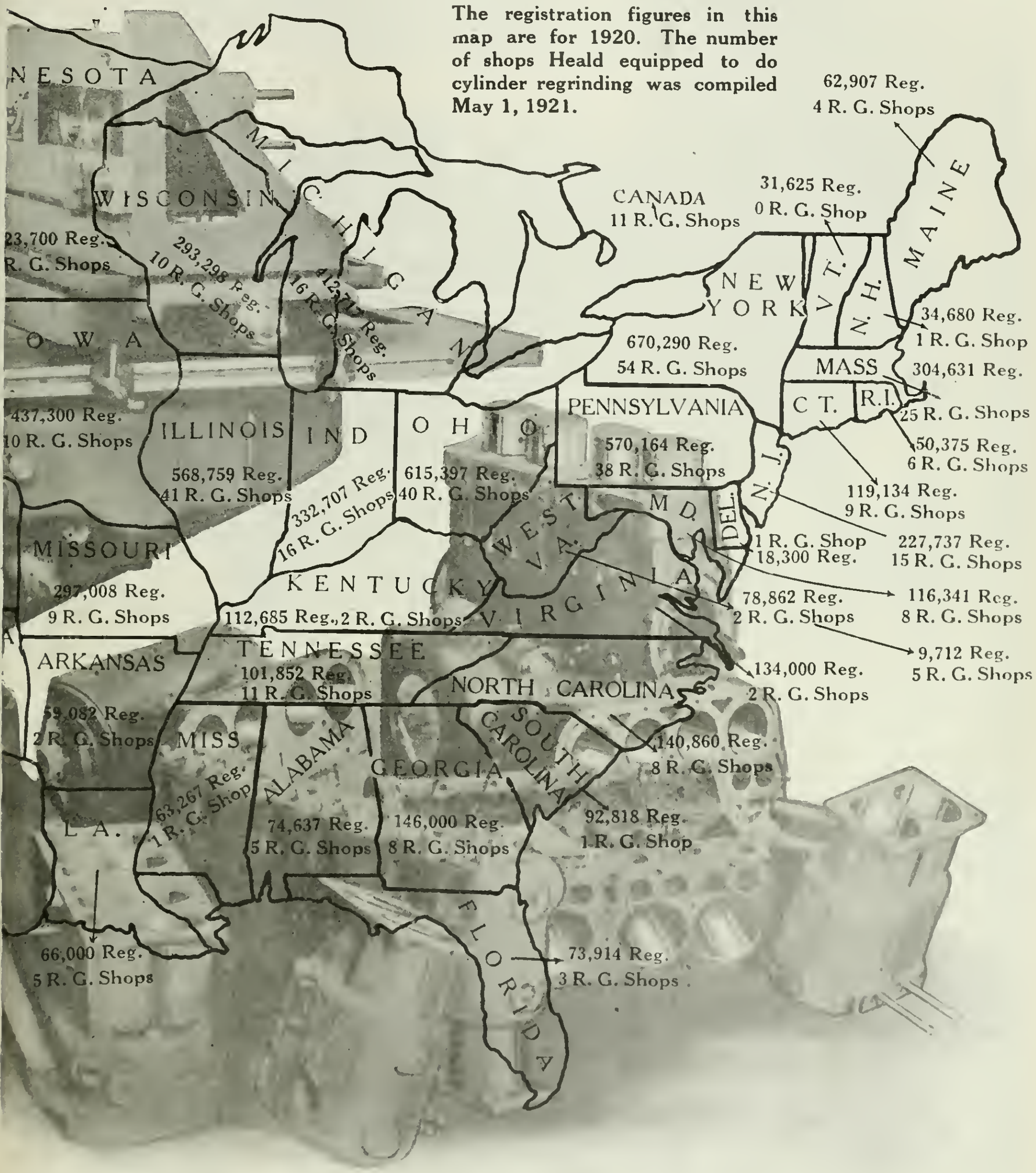
With 9,000,000 registered cars and only approximately 500 regrinding concerns Heald equipped, see what an opportunity is open to machine shops, automobile repair shops and welding concerns in the most active mechanical business in the states today.

There should be at least one regrinding concern for every 10,000 registration. Remember also that it only takes 3 four-enbloc cylinders a day to bring in handsome profits.

Don't think you must be located in a city or among high class cars. 75% of the registrations are in towns and cities of less than 50,000 population and the largest profits are made on Fords and low-priced cars.

Write us in regard to your particular locality. We will give you facts and figures on the possibilities and profits Remember, the first to start gets the cream. Better 'phone or wire. It will be a paying investment.

OPPORTUNITY

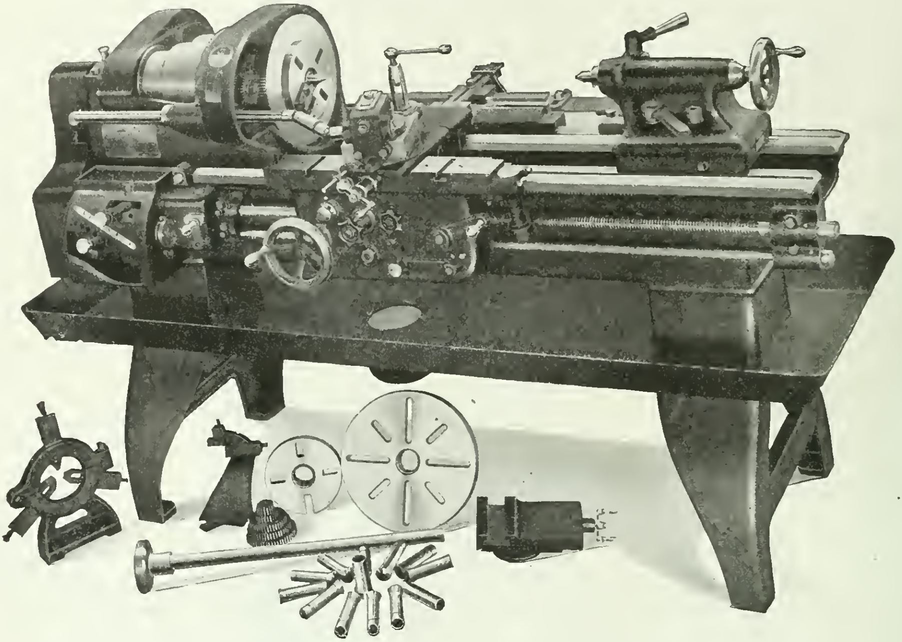

The registration figures in this map are for 1920. The number of shops Heald equipped to do cylinder regrinding was compiled May 1, 1921.

THE HEALD MACHINE COMPANY

16 New Bond Street, Worcester, Mass.

Monarch Tool-room Lathes

14"x6' Monarch Tool-room Lathe with full equipment, including *UNIVERSAL Relieving Attachment, Taper Attachment, Draw-in Attachment, Chasing Dial* and *Chasing Stop.*



Many other sizes of Monarch lathes can be furnished with complete tool-room equipment. Complete range of sizes 10-inch to 30-inch swing.

Special features of Monarch tool-room lathes include the following:

Full double plate apron with all drop-forged steel gears and central oiling system for back plate.

Efficient full Universal Relieving Attachment which is quickly attached and removed from the lathe.

Has all the features required for the rapid accurate making of tools and gauges.

Is constructed of the very finest materials and in sufficient quantity to justify the most modern methods of duplicate quantity production in their manufacture.

Monarch lathes are *manufactured* in quantity, not *built* singly or in small lots. As a consequence Monarch lathes are always attractively priced. Inspection records which are guarantees of accuracy accompany each lathe showing the accuracy of the lead screw for chasing and of the alignment of the lathe for accuracy in turning, facing and boring.

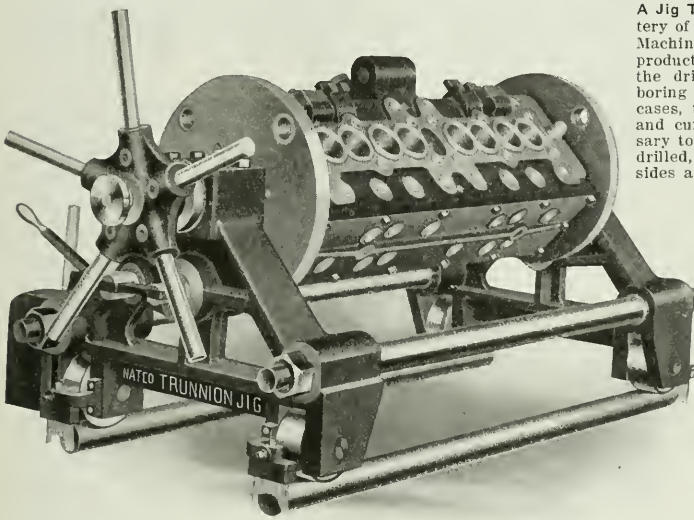
Few lathes equal and none rival the Monarch lathe for accuracy and efficiency.

The Monarch Machine Tool Co.

109 Oak St., Sidney, Ohio, U. S. A.

Lynd-Farquhar Co., Boston, Mass.; Brownell Machinery Co., Providence, R. I.; Purinton & Smith, Hartford, Conn.; Vandyck Churchill Co., New York, N. Y.; Syracuse Supply Co., Syracuse, N. Y.; Syracuse Supply Co., Buffalo, N. Y.; Syracuse Supply Co., Rochester, N. Y.; Simmons Machine Co., Albany, N. Y.; Morris Machinery Co., Newark, N. J.; Monarch Machinery Co., Philadelphia, Pa.; J. S. Miller Machinery Co., Pittsburgh, Pa.; Banks Supply Co., Huntington, W. Va., Greenboro Supply Co., Greensboro, N. C.; John P. Dale Machinery Co., Nashville, Tenn.; Oliver H. Van Horn Co., New Orleans, La.; Cameron & Barkley Co., Jacksonville, Fla., and Charleston, S. C.; Walraven Co., Atlanta, Ga.; Hartfelder-Garbutt Co., Savannah, Ga.; W. M. Pattison Supply Co., Cleveland, Ohio. The National Supply Co., Toledo, Ohio; Hallidie Machinery Co., Seattle, Wash.; Herberts Machinery & Supply Co., Los Angeles, Calif.; Herberts Machinery & Supply Co., San Francisco, Calif.; Reed & Duecker, Memphis, Tenn.; Peden Iron & Steel Co., Houston, Texas; Osborne & Sexton Machinery Co., Columbus, O.; Vonnegut Machinery Co., Indianapolis, Ind.; Charles A. Strelinger Co., Detroit, Mich.; McMullen Machinery Co., Grand Rapids, Mich.; Badger-Packard Machinery Co., Milwaukee, Wis.; Northern Machinery Co., Minneapolis, Minn.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; English Tool & Supply Co., Kansas City, Mo.; Sunderland Machinery & Supply Co., Omaha, Nebr.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; General Machinery Co., Spokane, Wash.; Portland Machinery Co., Portland, Oregon; Smith-Courtney Co., Richmond, Va.; E. L. Essley Machinery Co., Chicago, Ill.; The Murray Co., Dallas, Texas; Charles A. Strelinger Co., Windsor, Ont., Canada; V. Lowener, Denmark, Finland, Norway and Sweden.

Increase your production by use of NATCO Jigs and Fixtures in connection with NATCO Multi-Drillers and Multi-Tappers



Trunnion Jig made by NATCO, *used in plant of Midwest Engine Co., Indianapolis, Ind.*

A Jig Track System in connection with a battery of NATCO Multiple-Drilling and Tapping Machines enables the user to get the maximum production with the minimum man-power on the drilling, reaming, tapping and counterboring operations on cylinder heads, crankcases, tractor frames and all kinds of large and cumbersome parts in which it is necessary to place a number of accurately located drilled, reamed or tapped holes on various sides and angles.

An Indexing Trunnion Fixture is constructed to contain the part to be drilled. This fixture is designed to index to the necessary drilling positions on the various sides of the part to be drilled and spring-actuated shot-bolts securely hold the fixture in the desired position.

When the fixture is to be indexed to the next position it is only necessary to pull a lever and the shot-bolts are removed and the fixture is then indexed by means of either a pilot wheel or a handwheel.

On fixtures that are of such size and design as to be easily balanced a pilot wheel is used for indexing. When the fixture is of unusual size or weight, however, a worm and worm wheel indexing device is recommended which is operated by means of a handwheel.

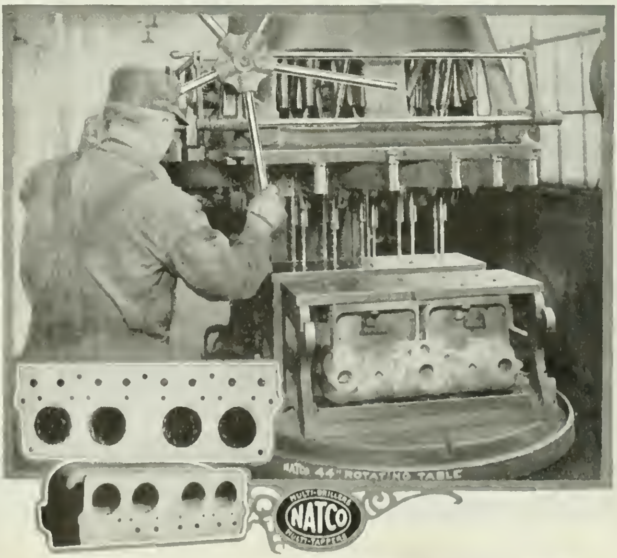
The Wheels on which the fixture is rolled along the track are of hardened steel and equipped with either roller or ball bearings. The wheels on one side of the fixture are generally made V-type for keeping the fixture in correct alignment with the machines, and the wheels on the opposite side of the fixture are flat. In some cases all four wheels are made V-type.

The use of NATCO Rotating Tables in connection with multiple spindle drilling machines is a NATCO development which offers great possibilities for increased production in drilling, reaming, tapping, spotfacing and counterboring. NATCO Jigs and Fixtures used in connection with Rotating Table makes it possible for the operator at all times to be engaged and the machine is never idle with the exception of a few seconds required to index the table.

The Rotating Table is particularly advantageous for drilling, for drilling and reaming for drilling, reaming, spotfacing, or counterboring and for obtaining close centers, which is made possible by passing the piece from one position to another without rejigging. The Rotating Tables are regularly indexed for 90°, 120°, and 180°, which permits one, two or three distinct operations to be performed at the same time.

NATCO Jigs and Fixtures are designed and built by men of years' experience in this line of work, and backed up by NATCO service should appeal to any manufacturer looking for the best possible design and construction in Jigs and Fixtures.

SEND US YOUR BLUE PRINTS, and we shall be glad to submit propositions for your approval, or write us and we will have NATCO representative call and make a study of your drilling requirements without any obligation on your part.



The National Automatic
Tool Company

Largest exclusive manufacturers of Multi-Drillers and Multi-Tappers.

Richmond, Indiana, U.S.A.

LINK-BELT Silent Chain Drives

98.2% Efficient

(on actual test)

LINK-BELT Silent Chain Drives can be applied to almost any shop condition.

For driving lineshafting, pumps, fans, machine tools and equipment of every kind, in every industry, they are rapidly superseding flat belts and gearing. Link-Belt Silent Chain is Flexible as a Belt—Positive as a Gear—More Efficient than Either.

Let one of our experienced power transmission engineers tell you what Link-Belt Silent Chain Drives can accomplish in your plant.

Send for 128-page pricelist data book No. 125.

LINK-BELT COMPANY

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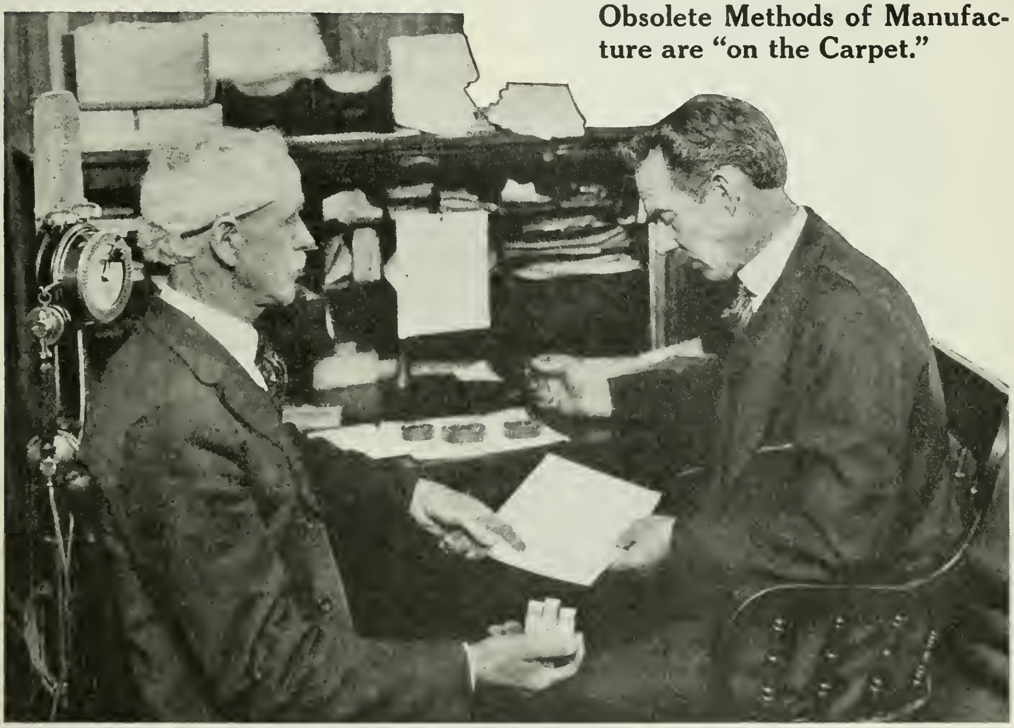
S. L. Morrow, 720 Brown-Marx Bldg.
Charlotte, N. C., J. S. Cothran, Com. Bk. Bldg.

675

F.G.S.Co. **SERVICE, ACCURACY, PRODUCTION** F.G.S.Co.

THE SURVIVAL OF THE FITTEST



Obsolete Methods of Manufacture are "on the Carpet."

HE is the production manager, and "he is on the carpet."

The cost superintendent is showing him last month's cost records on a certain type of gear. The conversation that ensues is somewhat as follows:

Cost Superintendent—"We must cut down the cost of these gears. They are mounting every month, whereas on other parts a reduction is shown or else we are breaking even."

Production Manager—"Well, what would you suggest? We have been making these gears in this way for years, and while we have had our troubles with repairs, etc., a better solution has not presented itself."

Cost Superintendent—"Well, what about making this gear in one piece, *instead of from three pieces riveted together?*"

Production Manager—***"If we do, how will we cut the teeth in the two end gears?"***

Cost Superintendent—"Why, haven't you read the Fellows Gear Shaper advertisements; they claim that the Gear Shaper will cut cluster gears when the clearance is ⅛ inch or more."

This is not the only Production Manager that is in trouble, and this is not the only type of gear on which the Gear Shaper will show a saving over any other known method. The Gear Shaper not only cuts gears more accurately, but produces them in larger quantities and at greatly reduced costs.

If you have any gear problems, why not write our engineering department? The suggestions you get may be the means of saving you considerable trouble and money. This service is yours for the asking, and has no strings tied to it.

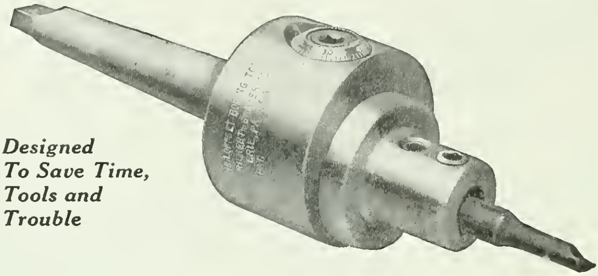
The Fellows Gear Shaper Company

Springfield, Vermont, U. S. A.

Foreign Agents: Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Societe Anonyme Alfred Herbert, Barcelona, Spain; Societe Anonyme Belge Alfred Herbert, Brussels, Belgium; Alfred Herbert (India) Ltd., Head Office, Calcutta, India.

Introducing the New

R-S Adjustable Boring Head



Designed
To Save Time,
Tools and
Trouble

Whenever speed, accuracy or both are important in enlarging diameters, the convenience and economy of the adjustable boring head is indispensable.

The new R-S Adjustable Boring Head is constructed with the same care and precision and of the same high grade materials as the famous R-S Die Heads. Once set and locked it is as rigid as a solid tool. The micrometer friction dial, graduated to thousandths, permits accurate settings within .0005" limits without measurement or delay.

A distinctive feature of the R-S Boring Head is the clamp which locks the tool holder after positioning and at the same time pulls and holds it rigidly against the head and shank.

Adapted for use on drill press, milling machine or turret lathe, the R-S Boring Head accommodates any drilling, turning or boring tool within its range and is the practical solution of many problems in both tool-room and manufacturing departments of the modern shop.

Bulletin No. 8 tells all about it.

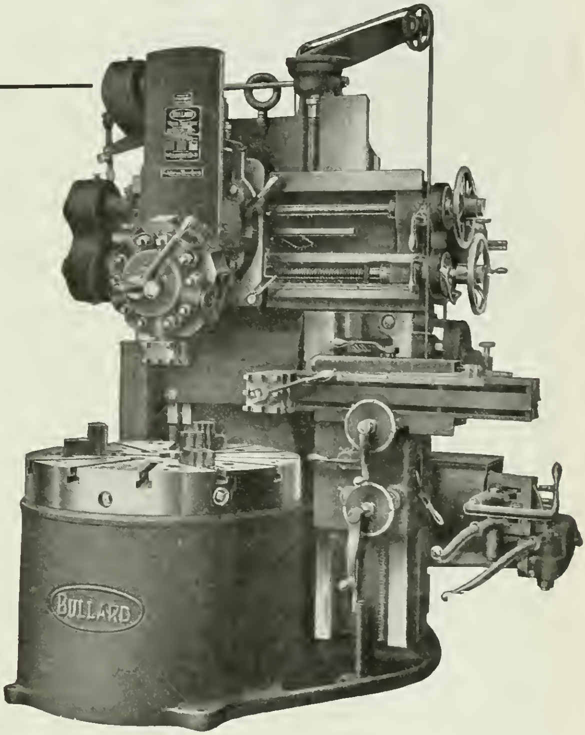
RICKERT-SHAFER COMPANY

New York Office, 50 Church Street
612 WEST 12th STREET ERIE, PA., U. S. A.

BRANCH OFFICES: 380 Rockefeller Bldg., Cleveland, Ohio; 117 N. Jefferson St., Chicago, Ill.; 50 Church St., New York, N. Y.; 222 W. Larned St., Detroit, Mich.; 414 Elm St., Cincinnati, Ohio; 807 Iroquois Bldg., Buffalo, N. Y.
AGENTS: Vonnegut Machinery Co., Indianapolis, Ind.; Stocker-Rumely-Wachs, Chicago, Ill.; Strong, Carlisle & Hammond, Cleveland, Ohio; Michigan Metal Supply Co.. Detroit, Mich.; Peter Frasse & Co., New York, N. Y.

Are You Getting 60 Productive Minutes Every Hour?

The Real Worth of the Vertical Turret Lathe is demonstrated in its Ability to Cut Continuously with Both Heads and Group Tools at Full Capacity, and furthermore, to Reduce Idle Time Between Cuts to a Minimum.



Vertical construction makes Chucking easy. Centralized Control saves Operating Waste. Simultaneous Cutting reduces Production Cost.

By whatever standard you measure the Vertical Turret Lathe your conclusions will reveal Concentrated Productive Ability.

Ask us for a copy of "Cutting Time Between Cuts." It will also help you to "cut the cutting time."

BULLARD

The Bullard Machine Tool Company

Bridgeport, Connecticut

Builders of the Maxi-Mill, Vertical Turret Lathe and Mult-Au-Matic.

ACCURACY with SPEED

Modern methods of production demand that every operation be done speedily, but with the greatest accuracy. If you do not get these results, you are not getting the proper returns from your machine tools.

In the great industries of this country, where modern productive methods have been evolved, Kelly Tools have built themselves a reputation for these two qualities. They are designed to get the best results out of each operation and they obtain accuracy with speed because they fit the job.

However, each tool, whether standard or of special design, is made up of a number of standardized units; which means, quick delivery on replacements, interchangeability and low up-keep.

These qualities make Kelly Tools a good buying proposition anytime, but especially now.

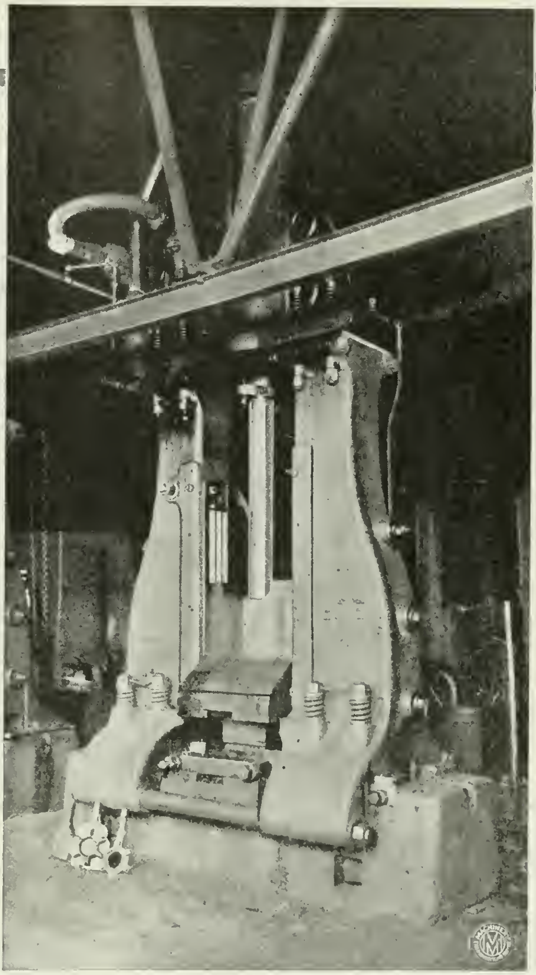
THE KELLY REAMER CO., Cleveland, O.

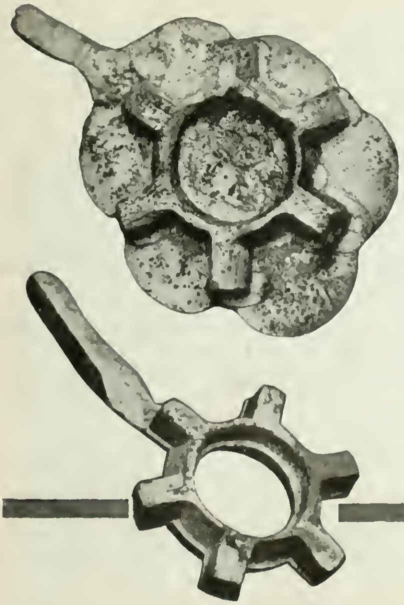
ERIE Drop Hammers

Help Make B & S Forged Tools Famous

About five years ago Billings & Spencer of Hartford, Conn., installed a pair of ERIE Steam Drop Hammers. These machines have been kept busy ever since, especially during the war, when they were in constant use, now contributing to the far-famed strength and efficiency of B & S Tools, now on outside work of which an example is shown—a drop forged main-clutch, one of a lot designed for use in a line of special machines built by another concern.

These pieces are about 2 5/16″ thick, 9″ diameter at the outer ends of the arms, which are 1⅛″ wide, and the center hole is 4⅝″ diameter. Output is 22 pieces per hour, after which the clutches are trimmed as shown.





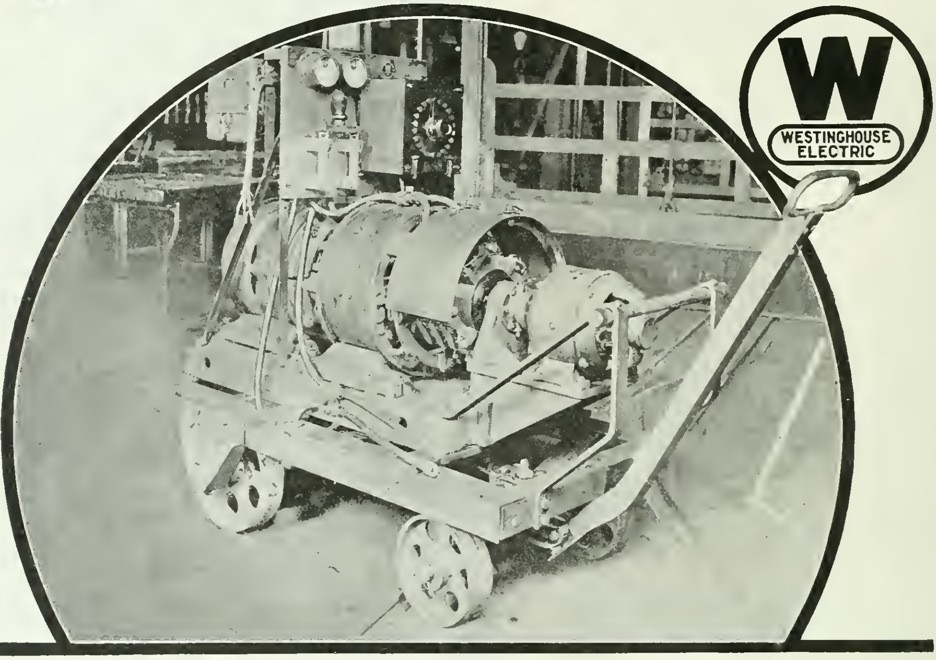
ERIE Steam Drop Hammers have been used for years in many well-known plants, where their rugged power, operating convenience and universal productiveness make them popular with all concerned and their exclusive advantages have given them a reputation well worth investigating.

Let us tell you more about them

Erie Foundry Company

ERIE, PA., U. S. A.

Westinghouse



Better Fusion—Deeper Penetration and more welds per day—

Ten points of the Westinghouse welding equipment that assure economy of operation, good penetration and the proper fusion:

1. Easy to strike and hold arc.
2. Reactor of low inductance.
3. Proper penetration of deposited metal.
4. Small current steps; less than 10 amperes.
5. Twenty one current steps obtained by adjusting only one device; namely, field rheostat. No change in rheostat setting required while changing from downward or vertical welding to overhead welding.
6. Electrode does not have a tendency to freeze to work.
7. A-C. motor provided with outside terminals for connecting for 220 or 440 volts.
8. Control panel mounted over set, making it compact and requiring minimum floor space.
9. Ammeter and voltmeter supplied on panel. Operator can readily check current and polarity.
10. Covered generator commutator and radial self-aligning ball bearings for set and exciter.

Bulletin 7149 is a valuable reference book on arc welding applications and the advantages of the Westinghouse arc welding equipment.

Write for a copy.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa. Offices in all Principal American Cities

ARC WELDERS

ACME FORGING MACHINES

Maximum Output at Minimum Cost

The work, forging auto pinion shafts; the problem, minimum output at minimum cost; the solution, Acme Forging Machines.

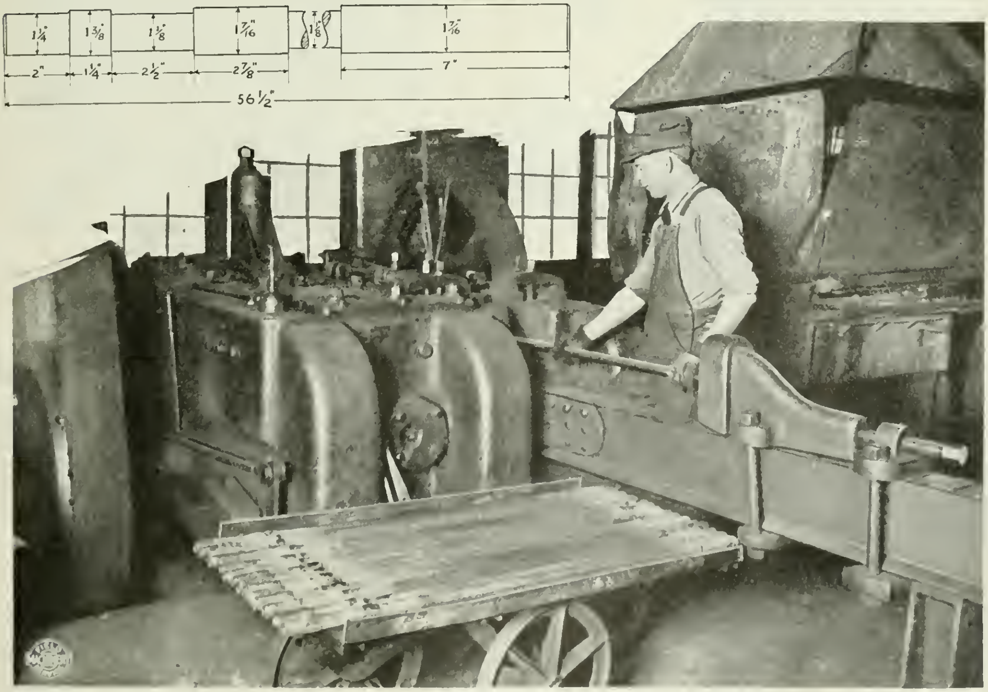
Upsetting is completed in three operations, the stock used is $1\frac{1}{8}''$ steel. The cold end of each shaft is placed against stop, then heated in die. A step on tredle completes first operation. This being a two-operation die the work is next placed in its lower section, the treadle again stepped on, and the second operation completed. After a quantity of work has piled up the dies changed and a single operation at opposite end of shaft completes the part as shown in sketch.

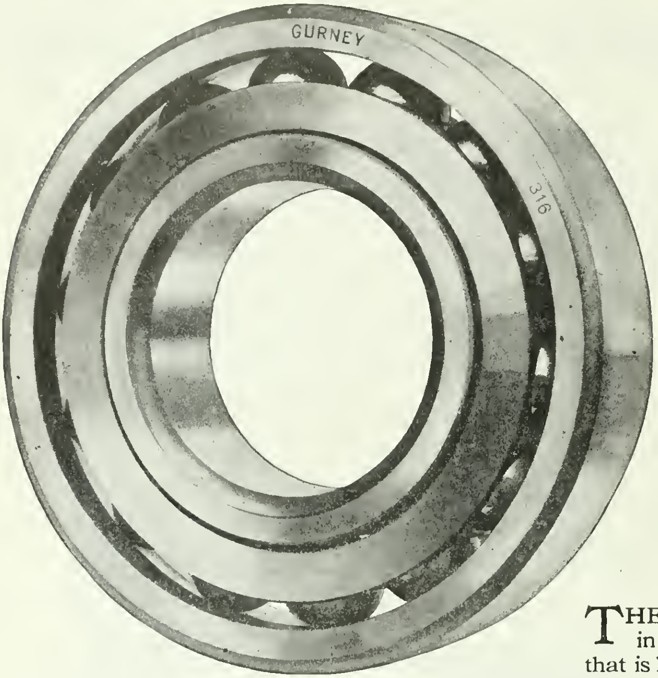
Our catalog will interest you. May we send you a copy?

THE ACME MACHINERY COMPANY
CLEVELAND OHIO, U. S. A.

Foreign Agents: Burton, Griffiths & Co., Ltd., London.

Glaenzer & Perreaud, Paris, France.





Refinement

THE refinement that is embodied in a Gurney Bearing is something that is hard to explain to one unfamiliar with mechanical subtleties. It is something that has been attained by many years of patient and painstaking work, developing and perfecting processes and equipment, experimenting, testing, rejecting. Back of this bearing which looks so simple and easy to produce is this unseen background. It is this costly preparation that has made the realization of this thing possible.

Engineering Service, based upon years of experience in the designing of bearings for all classes of machines, is at the service of any manufacturer. Write.

Gurney Ball Bearing Co.
Conrad Patent Licensee
Jamestown, N. Y.

GURNEY
BALL BEARINGS

1580

Frontier Super Drill

20-INCH SWING

"Speaking of Operations—"

(Ten good reasons why you should specify it.)

Reason No. 3

TWO MACHINES FOR THE PRICE OF ONE

Perhaps ninety per cent of the drilling operations of a twenty inch upright are such that perfect accuracy is not absolutely essential.

But that other ten per cent *MUST* be perfectly accurate.

For the ten per cent you buy a specially constructed HIGH PRICED machine which probably stands idle more than it is used.

NO WONDER

the other fellow can beat your costs for he has equipped his shop with a

Frontier Super-Drill

and does both classes of operations on the same machine.

He not only reduces production costs, cuts overhead and increases production, but he gets out BETTER WORK because the holes he drills are

100%

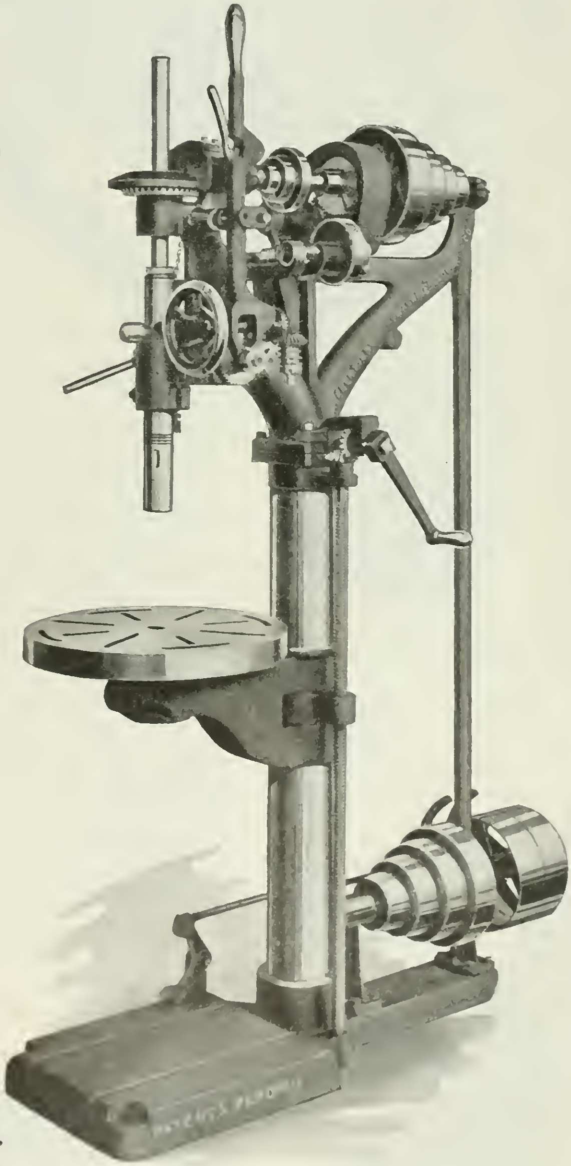
accurate instead of only

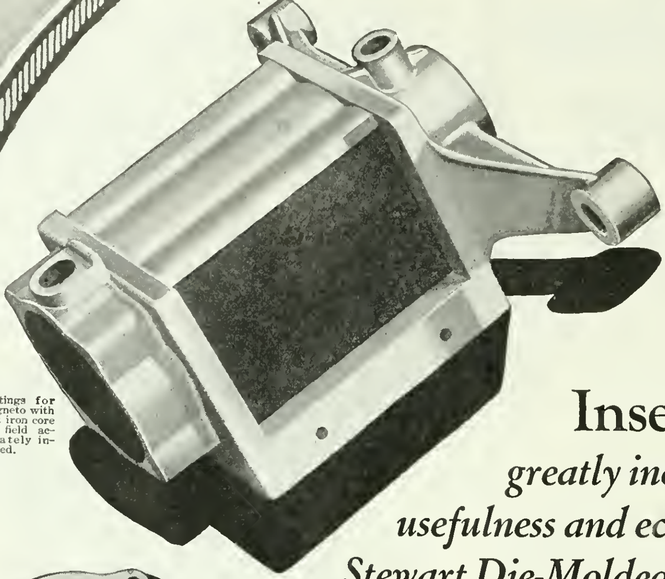
10%

That BACK COLUMN is the reason why.

Catalogue on request.

Frontier Machine Tool Co., Inc.
122 Lakeview Ave. Buffalo, N. Y., U. S. A.

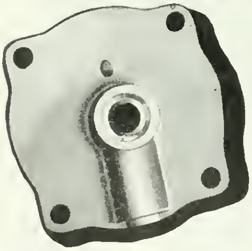




Castings for magneto with soft iron core for field accurately inserted.

Inserts—

greatly increase the usefulness and economy of Stewart Die-Molded Castings



Typical of hundreds of accurately centered inserted bronze or brass bearings.

THE use of inserts of different shapes and different metals practically removes the limitation of die-casting that otherwise would be imposed because the actual casting is confined to lower melting point metals and alloys.

Whether your parts are for electrical devices requiring soft iron for field pieces, or whether they require bearings and bushings of any type, or hardened wearing surfaces, Stewart Castings with inserts can be produced that will exactly meet your needs.

The parts illustrated here are merely representative of different uses of inserts; there are hundreds of variations of each use.

The embodying of inserts or chills in ordinary sand castings is limited to larger parts and is only feasible where great accuracy is not essential. Accurately and rigidly incorporated in the casting by the Stewart process, inserts permit lighter parts of greater effectiveness, and eliminate costly assembling and machining operations.

Place a sample part, or drawing of it, before experienced Stewart engineers, stating quantity desired. You will receive some suggestions about reducing your manufacturing costs that will surprise you!

Phonograph needle holder with stamping inserted for connecting with reproducer diaphragm. Insert must be firmly held or tone quality would be impaired.

STEWART MANUFACTURING CORP.
4500 Fullerton Avenue, Chicago

Also manufacturers of
Stewart Bronze-Back Bearings

Stewart

UMA 2

THE EXACT STEEL OF MANY USES

Produces Quality Forgings

There is no steel more "forgeable" than our UMA 2 Steel. It is not sensitive to heat variation and therefore can be forged at the temperatures which are used for "ordinary" steels.

This steel flows freely, filling all parts of the die, producing smooth forgings and giving longer life to the forgeman's tools.

Our UMA 2 Steel is a quality forging steel and is eminently suited for any forged part.

We will be pleased to present your problem to our Metallurgical Engineer and report his findings to you.

The Central Steel Company
Massillon, Ohio

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AGATHON STEELS
TRADE MARK

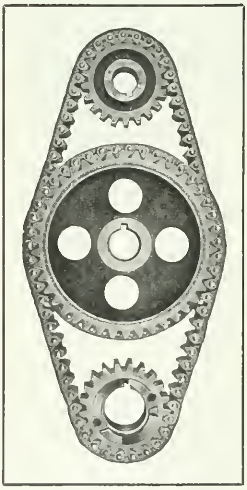
OVER 50,000 MILES NOW REPORTED ON

"WHITNEY"

HIGH EFFICIENCY

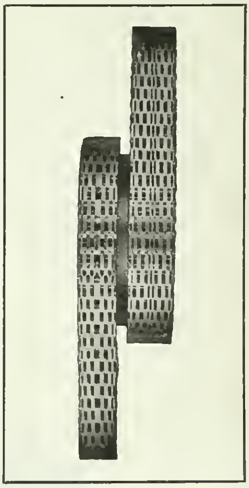
Front End Motor Chain Drives

And Still in Good Condition



NOT ONE OF THESE
CHAINS HAS BEEN
KNOWN TO SKIP A
SPROCKET TOOTH.

CHAINS HAVING A HIGH
MILEAGE
SAVE INCONVENIENCE
AND FREQUENT
REPLACEMENT EXPENSE.



THE WHITNEY MFG. CO.

HARTFORD, CONNECTICUT, U. S. A.

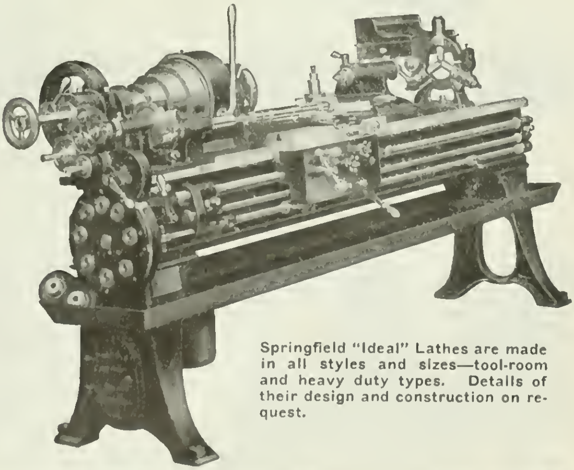
SPRINGFIELD
“Ideal” Lathes

Seven in Use in This Big Tool Shop

Six years ago the Giern & Anholtt Tool Works, Inc., of Detroit, installed a Springfield “Ideal” Lathe to be used in making dies, jigs, fixtures and similar work for the automobile trade. Pretty soon it was overworked and another was ordered, then another and so on till there were seven Springfield “Ideal” Lathes in constant use.

“Ideal” Lathes Have a Practical Range

Springfield “Ideal” Lathes have exclusive advantages which adapt them specially well to the needs of busy tool-rooms. All changes are simply and quickly effected and a specially efficient relieving attachment, automatic stops, quick reverse and other conveniences save an appreciable amount of time and effort. The machine shown was photographed while machining an index fixture for facing both ends of a tractor rear bearing cap—turning a flange .21875″ high and 6.500″ in diameter.



Springfield “Ideal” Lathes are made in all styles and sizes—tool-room and heavy duty types. Details of their design and construction on request.

The Springfield Machine Tool Company
631 Southern Ave. Springfield, Ohio

Manufacturers of Springfield Lathes and Shapers

GOOD MARKS

Good marks depend upon the *perfection* of the stamps with which the marks are to be made.

The science with which stamp forgings are treated—the degree of uniformity in temper—and the skill and accuracy with which the characters are engraved *determine* the *ability* of a stamp to make only ordinary marks or *good marks.*

Over seventy years' experience in making stamps, means that in Matthews Stamps you will find embodied the seasoned "know how" which makes possible stamps that will produce really *good marks* and give lasting service.

To whom, then, should *you* look when in the market for devices to make *good marks?* Sooner or later *you* will *insist* upon such stamps. *Consult us now.*

Jas. H. Matthews & Co.
2245 Forbes Field
PITTSBURGH, PENNA.

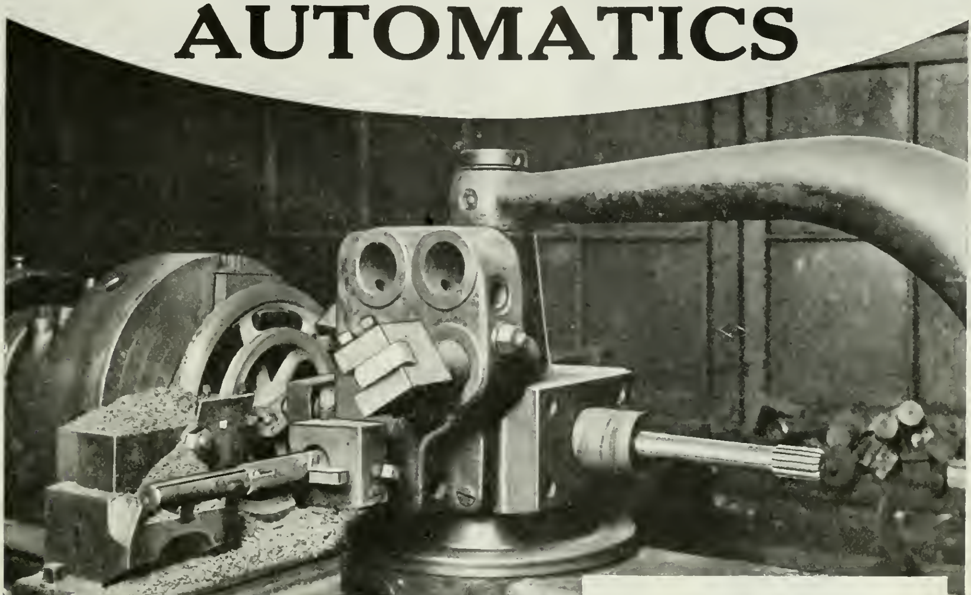
MATTHEWS
A PRODUCT WORTH MARKING IS WORTH MARKING RIGHT
MARKING DEVICES

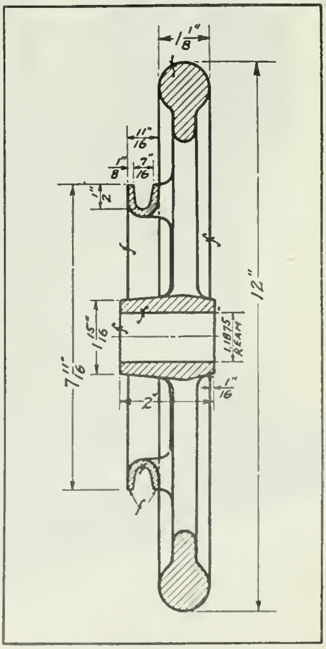
A booklet explaining how Matthews Stamps are made and showing numerous ways to use them will be mailed upon request.

MATTHEWS

MAKERS OF MARKING DEVICES SINCE 1850

POTTER & JOHNSTON AUTOMATICS





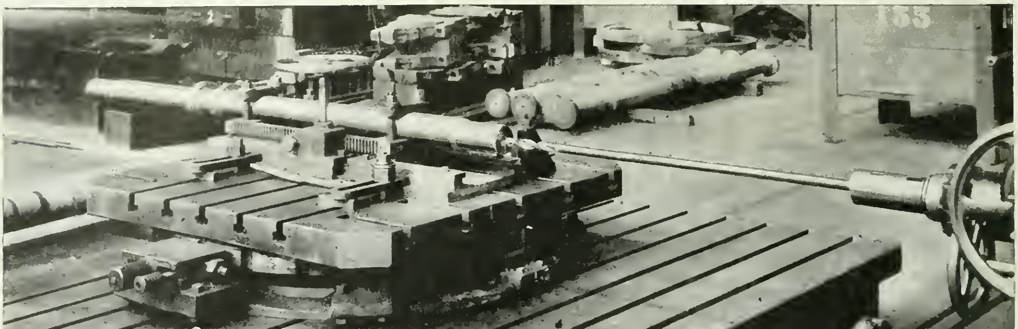
A Sewing Machine Hand Wheel Every Sixteen and a Half Minutes

Two men are sufficient to operate the battery of eight P & J Automatics which speeds production for the Landis Machine Company of St. Louis, Missouri. All that is necessary is to load and unload. An example of the type of work Potter & Johnston Automatics are doing here is shown in photograph and sketch. The part is a sewing machine hand wheel on which operations are as follows:—1st Turret Position—rough bore; rough face intermediate diameter; rough face hub; form handle, using cross slide tool; finish turn 7 11/16" diameter. 2nd Turret Position—finish face intermediate diameter, (adjacent to grooved position), using cross slide tool; bore, using piloted tool; groove, using cross slide tool; finish inside radius of handle; finish face hub. 3rd Turret Position—ream. The stop-watch reading for these operations, plus loading and unloading work, was only 16 minutes and 30 seconds.

P & J production and price figures on your work will interest you. Send prints ond specifications for same.

POTTER & JOHNSTON, Pawtucket, R. I., U. S. A.

New York Office Hudson Terminal Building, 50 Church Street, Walter H. Foster, Manager. Detroit Office The Potter & Johnston Agency Co., 533 Bates Street. Chicago Office: 1001 McCormick Building, Charles H. Shaw, Manager. Pacific Coast Offices Title Insurance Bldg., Los Angeles, 75 Fremont St.; San Francisco Louis G. Henes, Manager Toronto Office 11 Wellington Street, East, E. C. Roelofsoo, Manager. Foreign Offices and Representatives Office for Great Britain, France, Italy, Belgium, Switzerland, Spain and Portugal Potter & Johnston Machine Co., 68 Ave. de la Grande Armee, Paris, France, J. Ryan, Manager. Charles Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on Tyne, England, and Glasgow, Scotland. Ercole Vaghi Corso Porta, Nuova, 34 Milan, Italy. Rylander & Asplund Stockholm, Sweden Yamatake & Company, No 1 Yurakucho, Ichome, Kojimachiku, Tokyo, Japan.



Accuracy in Deep Drilling

Drilling one 36-inch and one 15-inch deep hole in Hyten steel is a job for only the most accurately designed Horizontal Drilling and Boring Machine.

It is another example of the service provided by P & H Machines—another indication of how the user benefits through investment in high grade machinery.

It is why P & H Horizontals are found in quantities of from 1 to 62 in such well-known plants as:

Allis-Chalmers
General Electric
Westinghouse
Lackawanna Bridge
J. I. Case
Bullard Machine
Canadian General Electric
C. M. & St. P. R. R.
Frick
Minneapolis, Steel
Ingersoll-Rand
Ingersoll Milling Machine
French Government
Hanna Engineering
American Shipbuilding
Japanese Navy
Sheffield Car
Bethlehem Steel
Atcheson, Topeka & Santa Fe R. R.
Gould & Eberhardt
Nordberg
Bucyrus
MacIntosh & Seymour
National Lamp
U. S. Navy Yard
Lodge & Shipley
Pacific Marine Iron Works
International Harvester
Jones & Laughlin
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Inland Steel
Gould
Newport News Shipbuilding
Chesapeake Iron
Watertown Arsenal
Standard Oil
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Bulletin 214 gives complete information
Send for a copy

Machine Tool Division
PAWLING & HARNISCHFEGER CO.
Milwaukee, Wis., U. S. A.

DALE MACHINERY CO., Inc.
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St. Louis: Blackman-Hill-McKee Machinery Co., 1513 No. Broadway. Birmingham: C. B. Davis Engineering Co., Brown Marx Bldg. Salt Lake City and Denver: Landes & Co.

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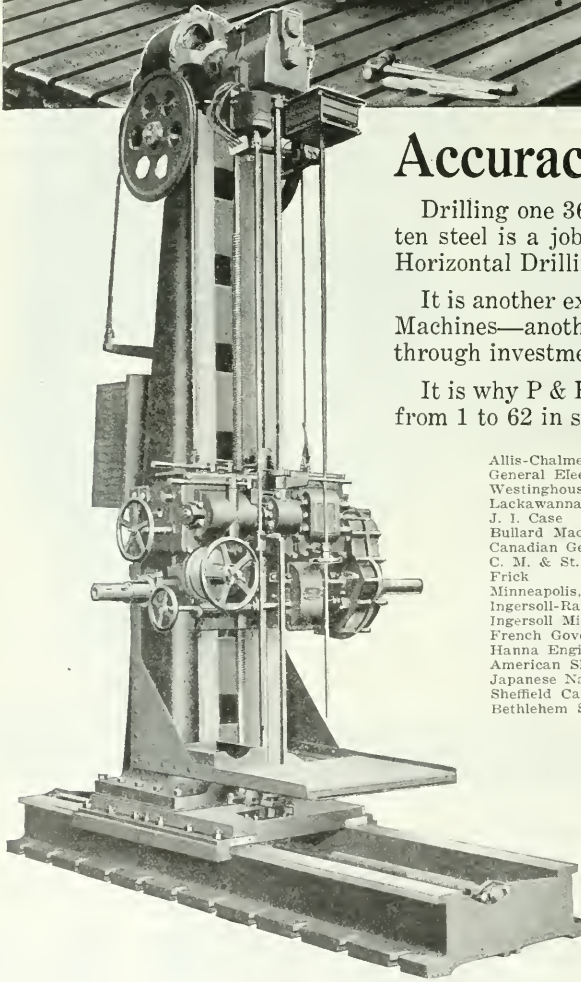


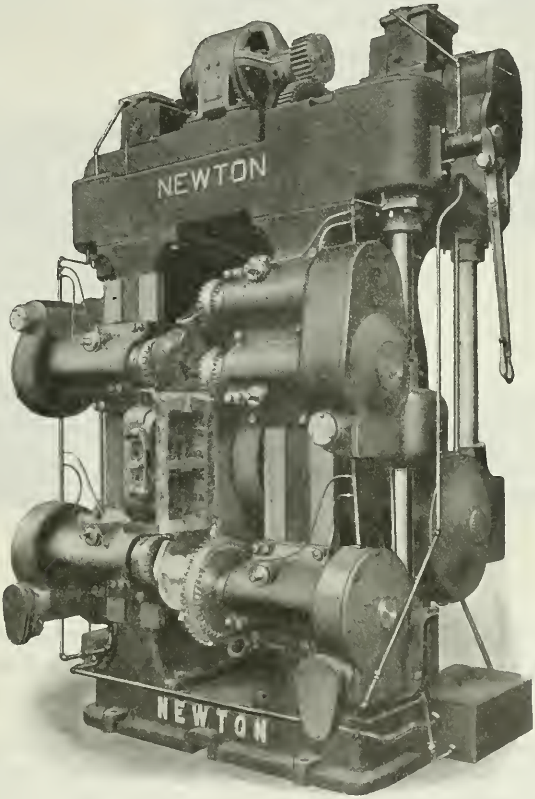
P. & H. No 10 Drilling and Boring Machine

P&H **HORIZONTAL**
DRILLING & BORING MACHINES

NEWTON

(REGISTERED TRADE MARK)

Labor Raised to the Highest Efficiency with Specialized Equipment



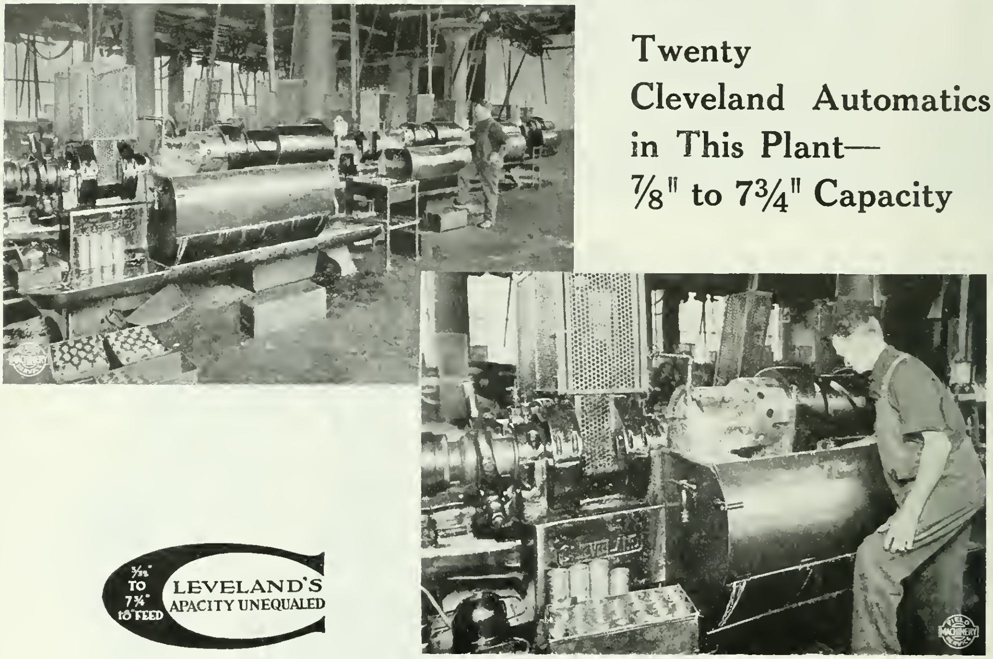
NEWTON DRUM TYPE CONTINUOUS MILLING MACHINE (MODEL 0-4)
MILLING TOPS AND BOTTOMS OF 4-CYLINDER BLOCKS SIMULTANEOUSLY

PRODUCTION—25 PER HOUR

The manufacturer whose plant is equipped with up-to-date machinery for economic manufacture will be able to maintain a safe margin of profit in a competitive market.

NEWTON MACHINE TOOL WORKS, Inc.
Twenty-Third and Vine Streets PHILADELPHIA, U. S. A.

CLEVELAND



Twenty Cleveland Automatics in This Plant—⅞" to 7¾" Capacity

3/32" TO 7¾" 18" FEED
CLEVELAND'S CAPACITY UNEQUALED

Most of this large installation of Cleveland Automatics—in the Nice Ball Bearing Company's plant, at Philadelphia, Pa.—is used in making ball-race blanks in a wide variety of sizes.

The close-up shows a 3¾" machine turning out nickel steel blanks to dimensions shown in the accompanying sketch—4 races at a time; there being four cutting-off tools on the cross slide as shown.

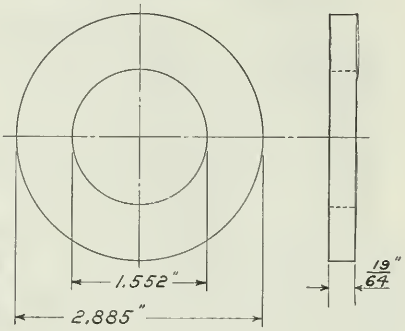
The operations involved are as follows: 1st., feed stock 1½"; 2nd., drill; 3rd., bore and turn; 4th., cut off. Production is 30 pieces per hour.

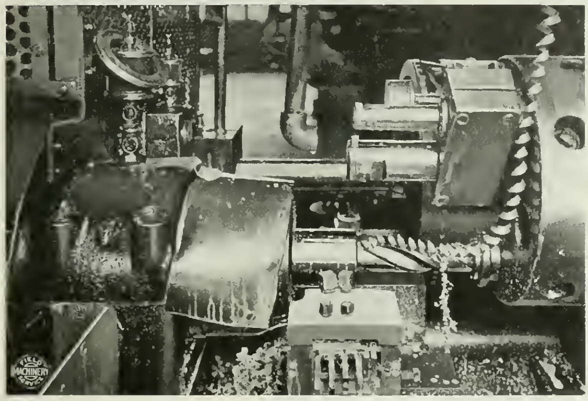
AGENTS: J. B. Anderson, 211 Gowan Avenue, Mt. Airy, Philadelphia, Pa. Herbert E. Nunn, 565 West Washington Street, Chicago, Ill. England, Charles Churchill & Co., London, England. Japan, Andrews & George Co., Tokyo, Japan. Belgium, Henri Benedictus Brussels, Belgium.

THE CLEVELAND AUTOMATIC

AUTOMATICS

Making Nickel Steel Ball-race Blanks—Thirty Per Hour





3/32"
TO
7¾"
18" FEED
LEVELAND'S
APACITY UNEQUALED

Cleveland Automatics are rapid, accurate producers on a wide range of work. They can be operated in battery by inexperienced mechanics, cost little for upkeep and give years of service without a hint of trouble.

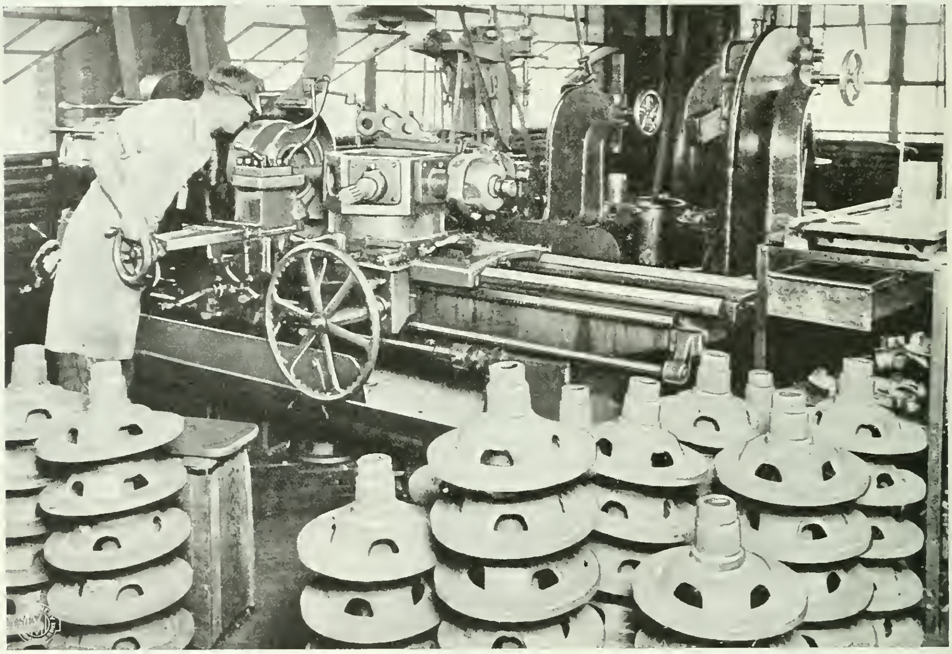
They are equally well adapted to bar and chuck work, can be equipped with magazine attachments to accommodate small forgings or castings and can be tooled to produce practically any shape within limits of 3/32" to 7⅜" diameter and 18" long.

Estimates from samples or blueprints. Details on request.

AGENTS: Denmark and Norway, Chr. A. Herstad, Copenhagen, Denmark. France, Holland and Colonies, R. S. Stokvis & Zonen, Paris, France, and Rotterdam, Holland. Switzerland, J. Lambercier & Co., Zurich and Geneva, Switzerland. Spain and Portugal, American Machinery Syndicate, 35 West 39th Street, New York, N. Y.

MACHINE CO., Cleveland, O., U.S.A.

WARNER & SWASEY



A Typical Job at Timken-Detroit

Forty-five of these malleable iron differential case sides are piled up in 10¾ hours from this Warner & Swasey turret lathe.

"Nothing special" about this job—just "typical" of the work handled by the battery of Warner & Swasey turret lathes in the Timken-Detroit Axle Company's Detroit plant.

THE WARNER & SWASEY

BRANCH SALES OFFICES: New York: Singer Building
Boston: Oliver Building
Buffalo: Iroquois Building
Chicago: 618-622 Washington Boulevard

DOMESTIC AGENTS

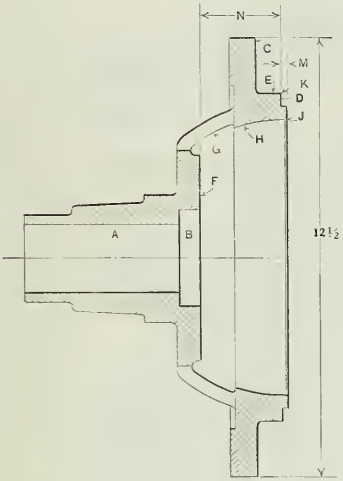
Fulton Supply Co., Atlanta, Ga.
Young & Vann Supply Company, Birmingham, Ala.
Woodward, Wight & Company, New Orleans, La.
Salt Lake Hardware Company, Salt Lake City, Utah.
Smith Booth Usher Company, Los Angeles, Calif.
Fred Ward & Son, San Francisco, Calif.
Portland Machinery Co., Portland, Oregon.
Hallidie Machinery Company, Seattle, Washington.
Hendrie & Bolthoff Mfg. & Supply Company, Denver, Col.
Peden Iron & Steel Company, Houston, Texas.
Northern Machinery Company, Minneapolis, Minn.

CANADIAN AGENTS

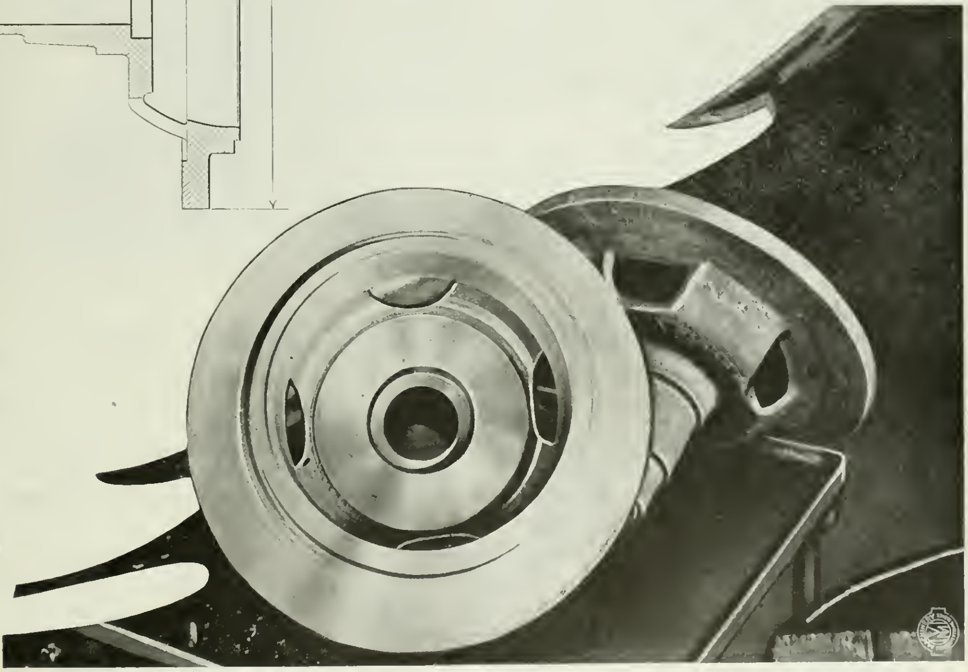
A. R. Williams Machinery Company, Ltd., Toronto, Winnipeg, Vancouver, St. John.
Williams & Wilson, Ltd., Montreal.

TURRET LATHES

One of Many in this Well-Known Plant



"Typical" work on Warner & Swasey turret lathes usually means a startling saving over previous methods. Let us send you facts and figures on work resembling yours. Or send us blue prints of your work for estimate. Send now, so you'll have the information the minute you need it, if you don't need it now.



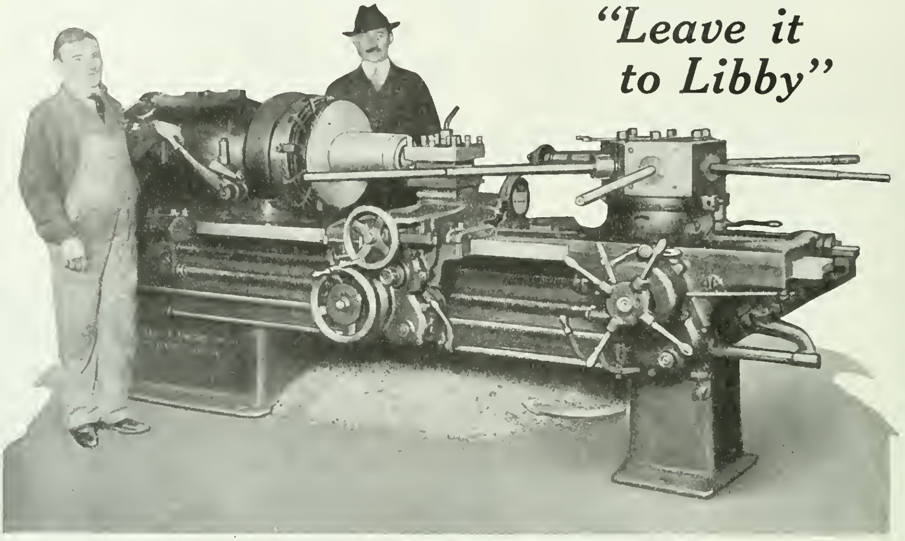
COMPANY, Cleveland, U. S. A.

Detroit: 5928 Second Boulevard
Indianapolis: 940 Lemcke Annex
Milwaukee: 209 Sycamore Building
Dayton: 518 Mutual Home Building

FOREIGN AGENTS

Charles Churchill & Company, Ltd., London, Birmingham, Manchester, Bristol, Newcastle-on-Tyne, Glasgow
Allied Machinery Company, Paris, Turin, Zurich, Barcelona, Brussels.
Wilhelm Sonesson Company, Malmo, Copenhagen, Stockholm, Gothenburg.
R. S. Stokvis en Zonen, Rotterdam.
Benson Brothers, Sydney, Melbourne, Adelaide.
Yamatake Company, Tokyo, Osaka, Nagoya, Fukuoka, Dairen.
McLeod & Company, Calcutta.
Andersen, Meyer & Co., Ltd., Shanghai.

LIBBY LATHES



The First Libby Lathe—Thirteen Years in Service— is Still Doing First-class Work

If the first Libby Lathe should have anything written off its value neither its owner nor operator will admit it. Here they are, both beside the machine, which, after thirteen years continuous work, is still to all intents and purposes as good as ever.

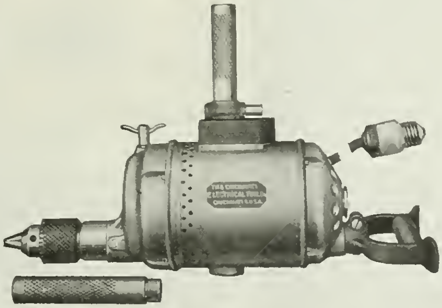
This Libby Lathe is in the plant of the Minster Machine Company, Minster, Ohio, and the concern believes it will be there for many years yet. Libby Lathes have many important features. They may, for instance, be changed from chuck to bar work in 20 minutes—a big item with varying requirements.

Get posted on Libby Lathes as they are today. Write for the catalog.

INTERNATIONAL MACHINE TOOL CO.

INDIANAPOLIS **INDIANA, U. S. A.**

DOMESTIC AGENTS: Aumen Machinery Co., Baltimore, Md.; Blackman-Hill-McKee Mchy. Co., St. Louis, Mo.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; Eccles & Smith Co., San Francisco, Calif., Los Angeles, Calif., Portland, Ore., Seattle, Wash; E. L. Essley Machinery Co., Chicago, Ill., Moline, Ill., Milwaukee, Wis.; Fairbanks Co., New Orleans, La., Birmingham, Ala.; Hill, Clarke & Co., Boston, Mass.; Northen Machinery Co., Minneapolis, Minn.; Seifreat-Woodruff Co., Cincinnati, Ohio, Dayton, Ohio; Strong, Carlisle & Hammond Co., Detroit, Mich., Cleveland, Ohio; Syracuse Supply Co., Syracuse, N. Y., Buffalo, N. Y., Rochester, N. Y.; Vandyck Churchill Co., New York, N. Y., New Haven, Conn., Philadelphia, Pa. FOREIGN AGENTS: Andersen, Meyer & Co., Shanghai, China; Coats Machine Tool Co., London, England; Ing. Ercole Vaghi, Milan, Italy; Isbecque, Todd & Co., Belgium; Iznosskoff & Co., Petrograd, Russia, Moscow, Ekaterinburg, Russia; V. Lowener, Copenhagen, Denmark, Christania, Norway, Stockholm, Sweden; Victor B. Mendoza Co., Havana, Cuba; Moerch & Roumet, Paris, France.



CINCINNATI

Portable Electric Drill and Bench Drill Press—

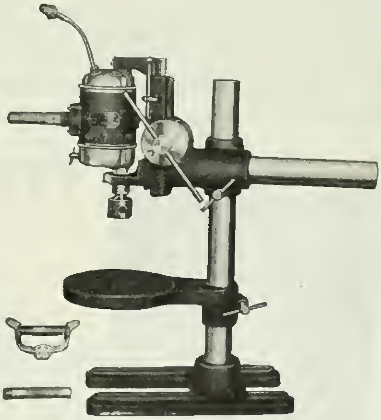
You Need Them Both

—There are many jobs around shop and factory that demand stationary drilling apparatus—and likewise a great deal of work where the use of a portable drill is essential. You need both tools—

—And the combination of Cincinnati Portable Electric Drill and Bench Drilling Stand gives them to you at much less than the cost of two entirely separate machines.

—It takes but a few seconds' time to convert your Cincinnati Drill into a drill press—and only a few seconds to change it back to a portable drill. No belts or pulleys are needed—the stand can be set up and used in any part of the shop. The high character of the workmanship employed in making them insures accurate drilling in either case—the quality materials of which they are made means long, continuous service.

If you have a Cincinnati drill, add a drilling stand to your outfit; if you have neither, investigate this combination at once. The complete Cincinnati line includes Portable Electric Drills, Grinders and Buffers—used everywhere since 1902. Our catalog tells more about them. Write for it.



The Cincinnati Electrical Tool Co.

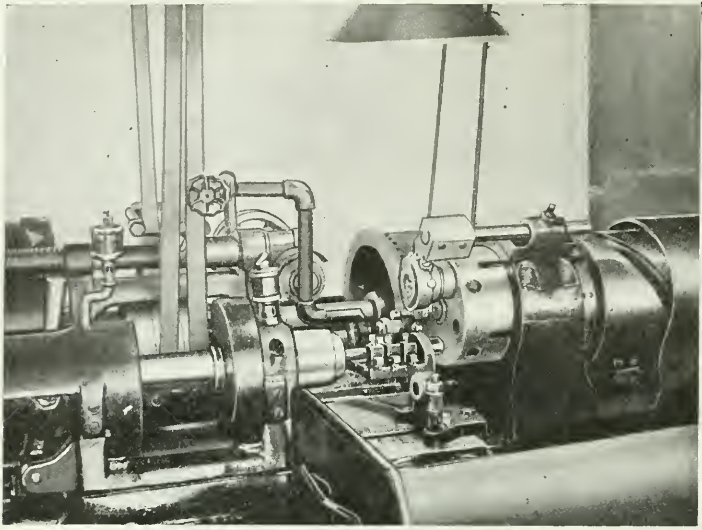
Dept. A-6

1501-1505 Freeman Ave. Cincinnati, Ohio

BOSTON	NEW YORK	DETROIT
259 Franklin St.	50 Church Street	8242 Woodward Ave

FOREIGN AGENTS:

England—S. Wolf & Co., London. Australia—Parke & Lacy Co., Ltd., Sydney. France—R. S. Stokvis & Fils, Paris. Holland—R. S. Stokvis & Zonen, Ltd., Rotterdam. Belgium—R. S. Stokvis & Fils, Brussels. Japan—Yamatake & Co., Tokyo. China—Andersen, Meyer & Co., Ltd., Shanghai. Spain—American Machinery Corp., S. A. C., Madrid. Portugal—Sindicato De Maquinaria Americana, Bilbao.



No. 1 Type "F" HARTNESS Automatic Die

The Type "F" Die Head is designed for use with automatic machines and is equipped with a floating shank to equalize the difference between the feed of the turret and the lead of the screw.

The one shown is used on a Cleveland Automatic and is provided with a positive resetting device. Capacity of this die is 3/32″ to 9/16″ 12 to 64 pitch. Standard Hartness chasers are used.

More details on request

JONES & LAMSON MACHINE COMPANY

SPRINGFIELD . DIE DIVISION **VERMONT, U. S. A.**

503 Market Street, San Francisco, Cal.

9-10 Water Lane, Queen Victoria Street, London, Eng.

AMERICAN AGENTS FOR DIES AND CHASERS: P. H. Biggs, 1235-1237 West 9th St., Cleveland, Ohio. Boyer-Campbell Co., Detroit. Carey Mchy. & Supply Co., Baltimore. E. L. Essley Mchy. Co., Chicago, Milwaukee and Moline. The E. A. Kinsey Co., Cincinnati, Indianapolis and Columbus. Machinists Supply Co., Pittsburgh. Robinson, Cary & Sands Co., St. Paul and Duluth. Coghlin-Kirkby Machinery & Supply Co., Toledo, Ohio. A. V. Wiggins & Co., Syracuse, N. Y. FOREIGN AGENTS: For France, Spain and Belgium, F Auberty & Co., 182 Rue Lafayette, Paris. For Holland, Spliethoff, Beeuwkes & Co., Rotterdam. For Sweden, A. Bol. Oscar Lindbom. Post Box 420, Stockholm. For Australia, McPherson's Pty., Melbourne. Japan, Manchuria, Korea, Formosa, Mitsui Bussan Kaisha, Ltd., Tokyo, Japan.

THIS IS THE BOOK—

"You've Got the Answer if You've Got the Handbook"

It is the standard mechanical handbook that covers thoroughly the field of machine shop practice, machine and tool design from the practical point of view. MACHINERY'S HANDBOOK contains in its 1400 pages every essential fact, figure and table needed in machine shop and drafting room. It is the working reference book of a great trade.

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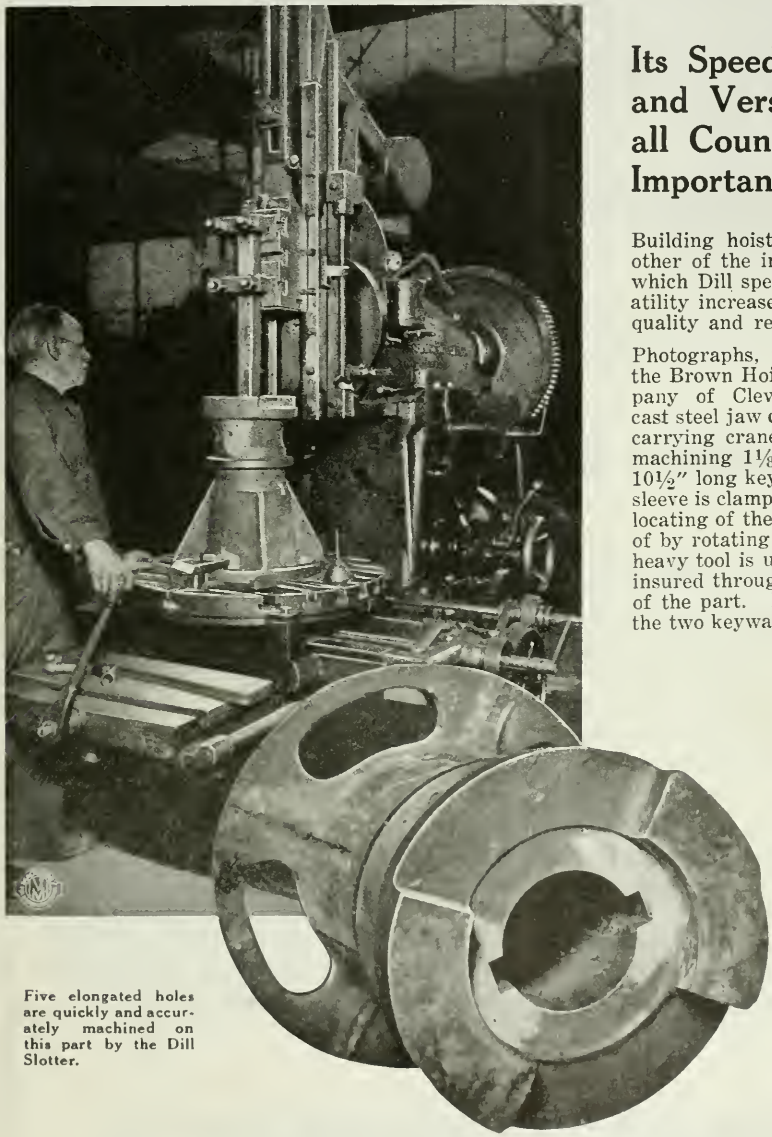
8-21

THE DILL SLOTTER

An Ideal Machine for Building Hoisting Machinery



Its Speed, Accuracy and Versatility all Count on this Important Work

Building hoisting machinery is another of the important industries in which Dill speed, accuracy and versatility increase production, improve quality and reduce factory costs.

Photographs, taken in the plant of the Brown Hoisting Machinery Company of Cleveland, Ohio, show a cast steel jaw clutch sleeve for an ore carrying crane, and the Dill Slotter machining 1⅛" wide, ½" deep and 10½" long keyways in same. After sleeve is clamped on the Dill table the locating of the keyways is taken care of by rotating the circular table. A heavy tool is used and a uniform cut insured throughout the entire length of the part. Floor to floor time for the two keyways is one hour.

Write for interesting illustrated booklet showing the Dill Slotter in actual operation.

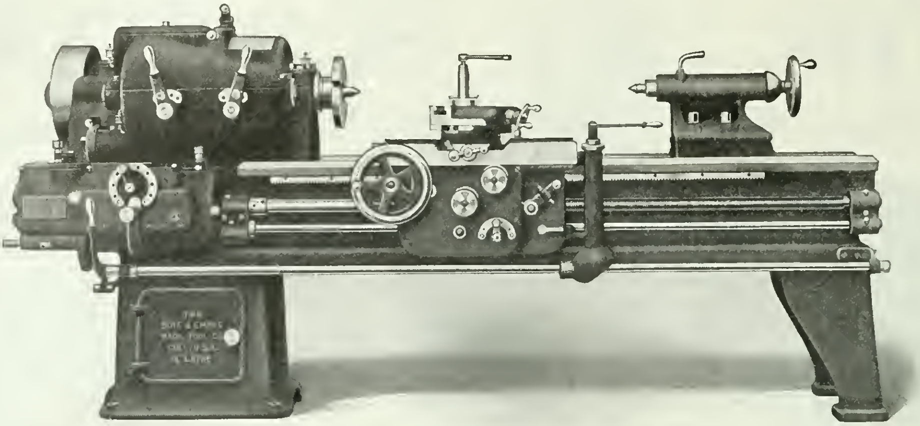
Five elongated holes are quickly and accurately machined on this part by the Dill Slotter.

These two keyways are the work of the Dill Slotter. Note that material is cast steel.

T. C. DILL MACHINE CO., Inc.

THE DILL SLOTTER PEOPLE, Philadelphia, Pa.

FOREIGN AGENTS: Alfred Herbert, Ltd., British Isles. Alfred Herbert, Ltd., Yokohama, Japan. Societe Anonyme Belge, Alfred Herbert, Brussels, Belgium. Societe Anonyme, Alfred Herbert, Ltd., Paris, France. Societa Anonima Italiana, Alfred Herbert, Ltd., Milan, Italy.



18" Engine Lathe "Coneless"

Twelve Spindle Speeds ABSOLUTELY Selective. Thirteen heat-treated gears used in headstock continually in mesh, running in a bath of oil.

Spindle speed changes made with positive clutches instantly. Shafts heat-treated. All keys and feathers milled integral with shaft.

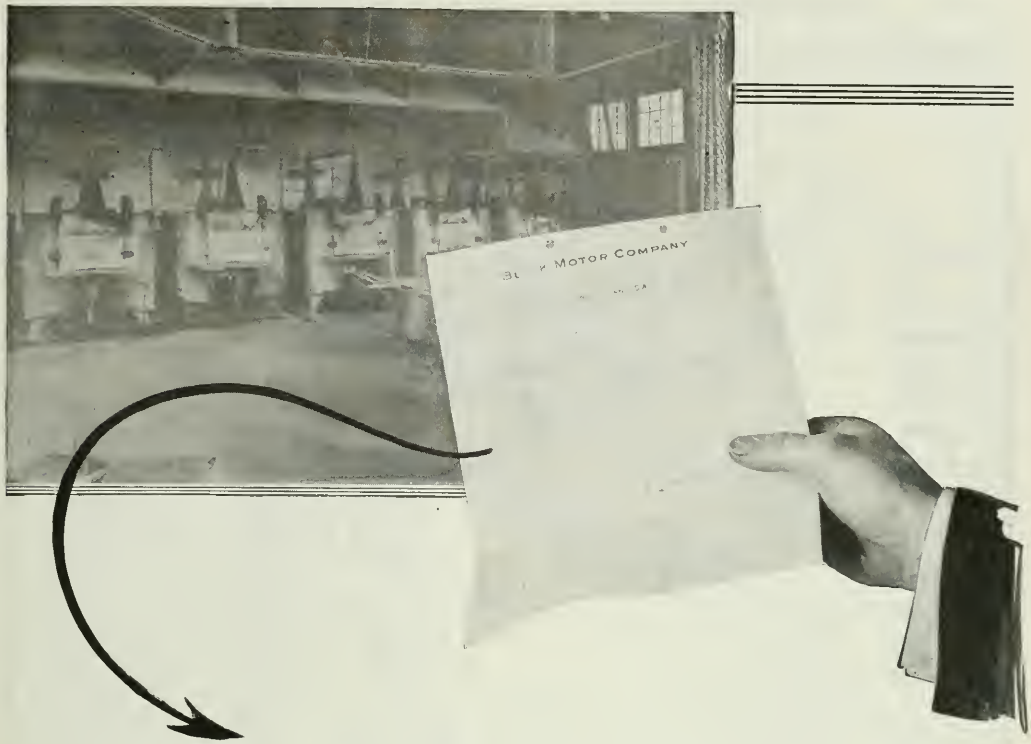
No interlocking device necessary. Impossible to engage any conflicting gear ratios. Top cover does not interfere with adjusting main spindle bearings.

Controlled to start, stop and reverse spindle speeds from lever shown on the right hand end of the apron. The only friction used is at the initial driving pulley.

The Boye & Emmes Machine Tool Co.

ENGINE LATHES

CINCINNATI **OHIO, U. S. A.**

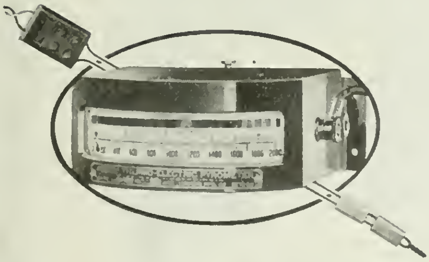


"—Never Found Anything Equal to Them"

"We have been using your CHROMEL couples for the past five years, and would state that we have never found anything on the market equal to them. We have used them in heats as high as 2400° to 2450° F."

* * * * * * *

This is Buick's opinion of Hoskins CHROMEL couples. It is just another bit of evidence of the quality of Hoskins Pyrometers and CHROMEL couples. Opinions like these are not just expressions from men who wish us well. They come also from college professors, engineering societies and technical schools. The discovery of CHROMEL probably meant more to pyrometry than any development in the past ten years. There are actually many thousand CHROMEL couples in use in the United States. Only a product that is eminently good would have such distribution as that. Send today for Catalog 31-C.



HOSKINS MANUFACTURING CO.—DETROIT

Boston New York Pittsburgh Cleveland Chicago San Francisco

Chromel
MARSH ALLOYS
THE METAL THAT MADE ELECTRIC·HEAT POSSIBLE
HOSKINS PRODUCTS

BARNES RADIAL DRILL

Spindle Travel 18 inches
No. 4 taper hole in spindle
Weight 3,300 lbs.
Table 24" x 65"

WE illustrate herewith a No. 3 Horizontal Radial Drill or End Drilling and Tapping Machine. The machine is back-geared, strong and well built, and all parts are within easy reach of the operator. The table is slotted for holding the work; the arm is of heavy box pattern, and the sliding head is gibbed strongly on the square ways of the arm. For operating the spindle, the operator has choice of three feeds; namely, the lever feed or the hand wheel feed or power feed. Power feed has positive drive.

Dimensions No. 3 Horizontal Drill:

Distance from top of table to center of bearing, 8¾ inches.

Center of bearing to maximum height of spindle, 38¼ inches.

Bearing, 9 by 12 inches long.

Spindle arm moves through circle of 180 degrees.

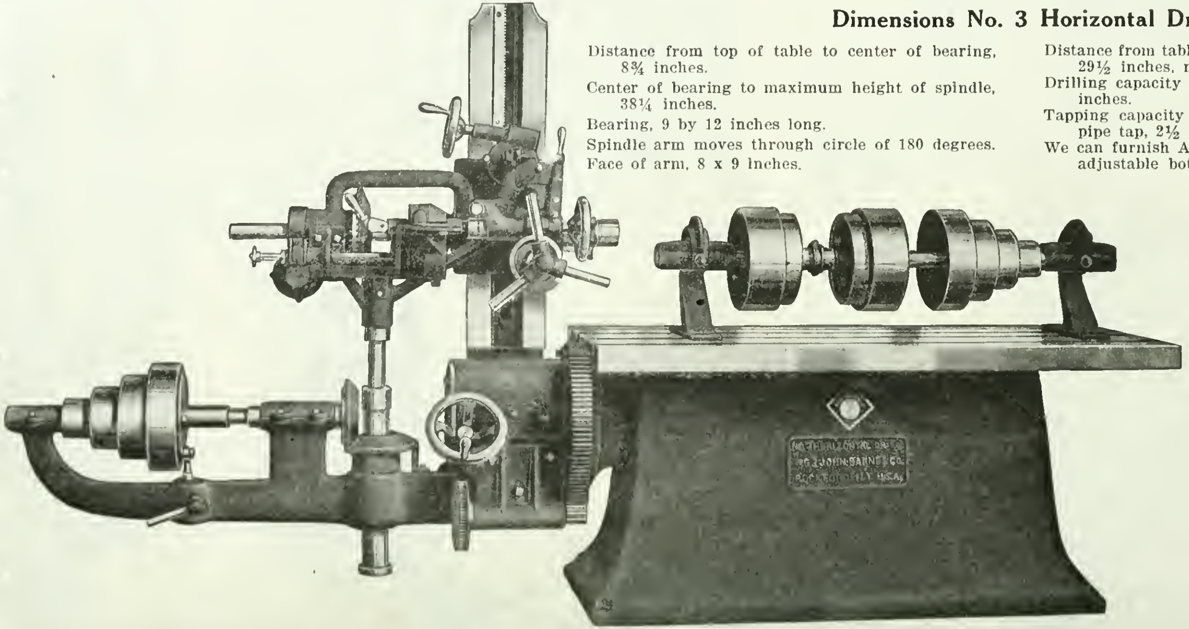
Face of arm, 8 x 9 inches.

Distance from table to center of spindle, maximum, 29½ inches, minimum, 2⅜ inches.

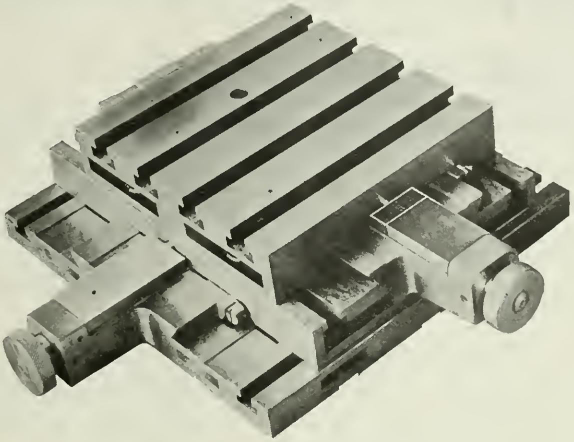
Drilling capacity in solid C. I., 3 inches; Steel, 2 inches.

Tapping capacity in C. I., 3 inches; capacity of pipe tap, 2½ inches.

We can furnish Arbor Rest (extra cost) which is adjustable both vertically and horizontally.



**W. F. and
John
Barnes
Co.**
**231 Ruby Street
Rockford
Illinois**



Johansson
ACCURACY

Paid for itself in one month

SO claims a Chicago tool manufacturer who recently put a JOHANSSON COMPOUND SLIDE to work in his shop. Very few modern inventions in tool-making have been received so enthusiastically alike by Manufacturers and Toolmakers. Assured accuracy in laying out holes has meant in the past many tedious hours of the most exacting work. With this new tool, a series of holes, in a die or fixture, can be located and drilled in a third of the time formerly required by the old button method.

AFTER determining the first position on a piece of tool work, it is only necessary to move the two slides in the proper directions and insert the correct Johansson Gage Blocks in order to obtain the other locations as desired. (See illustration above). There is no chance to go wrong, if the distances have been figured correctly. As the slides are clamped tight against the Blocks for each new position, unquestionable accuracy is assured. The Slides are 7½ in. x 7½ in. and the tool measures 3½ in. from the top surface to the base. The weight is fifty-five pounds.

THE JOHANSSON COMPOUND SLIDE operates on a vertical machine or can be clamped to the faceplate of a lathe. The fewer chances for mistakes, through its use, make it a popular tool with the workman. Its great economy appeals immediately to the manufacturer, who is confronted with the present high cost of tool making.

THE booklet shown here describes more in detail how the JOHANSSON COMPOUND SLIDE is used to advantage. It will be a pleasure to send a copy to anyone interested.

C.E. JOHANSSON · INC.
POUGHKEEPSIE, N.Y.

THE GARVIN PAGE

Issued by

THE GARVIN MACHINE CO.

Builders of Machine Tools since 1865

The Growth of the House of Garvin

based solely on the merits of its products—has been phenomenal.

Established in 1865—it occupies today a large modern fireproof building equipped with every facility for expediting the handling of its products and the convenience of its operations.

Our show room carries practically every machine listed in our comprehensive catalog—and gives the visitor an opportunity of seeing Garvin Machines in actual operation.

A corps of experts is ready to advise you regarding practically any metal product.

The time to get ready for the rush is now.

Why not drop in and look us over?

H R Garvin.

Speaking of getting down to rock bottom prices—

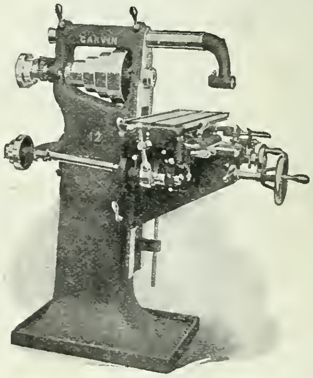
Has it occurred to you that to produce more economically and thereby reduce the selling price is the most logical means of stopping the present industrial slump?

—and has it occurred to you that Garvin Machines, on account of their many improvements for rapid production, are the logical means for helping you to this end?

Now when you have time for it, we can give you the very best engineering advice and consultation —free of charge— and you may rest assured that our engineers will recommend Garvin machines only when they serve your purpose best.

Write and tell us what you have in mind today

The Garvin Machine Co.
Spring and Varick Streets
New York City



Garvin No. 12 Plain Milling Machine

G-92

GARVIN

BUILDER OF BETTER MACHINE TOOLS

COLBURN BORING AND TURNING MILLS

"A Very Durable and Accurate Machine"

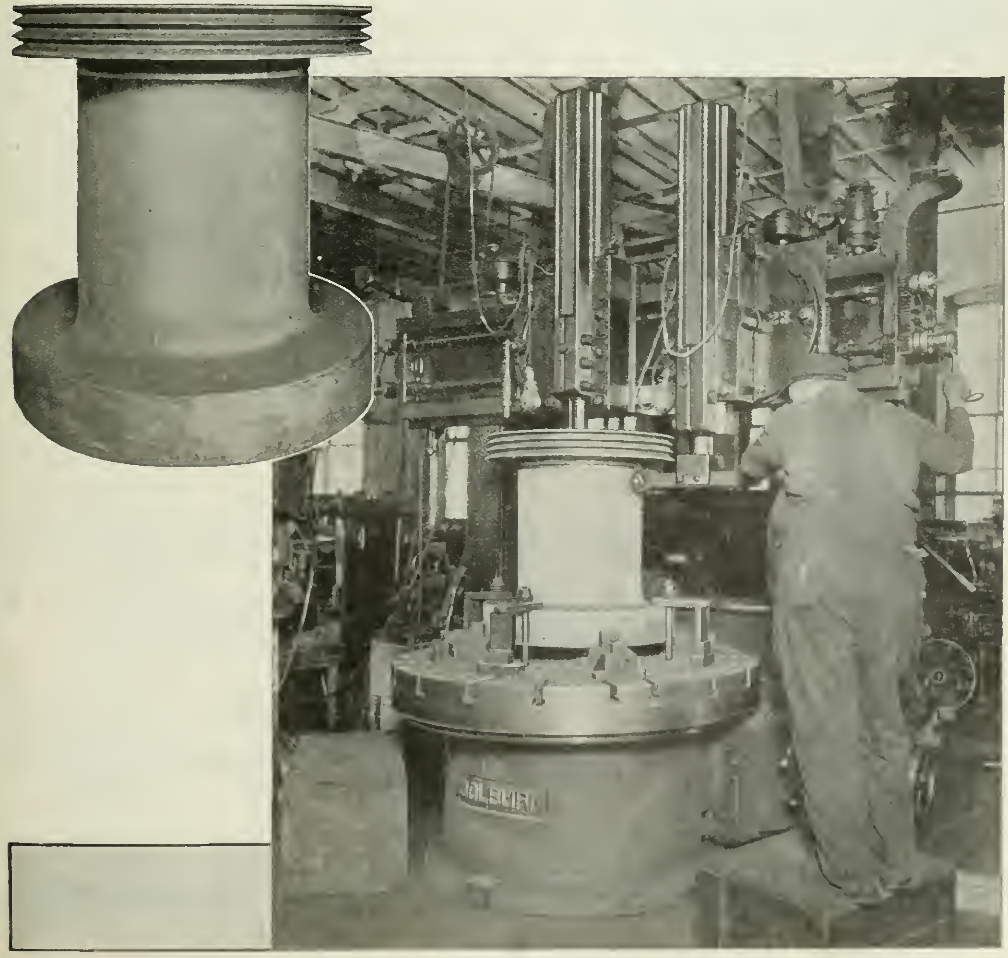
The above expression from the Thomas Elevator Company means much when you consider eight years of constant service from the Colburn Boring and Turning mill illustrated.

The piece shown is a cast iron Electric Hoist Drum and this Colburn Mill bores the 5-inch diameter hub and turns the 20-inch diameter barrel at the rate of one piece every 12 hours.

The accuracy and durability of the Colburn is the result of correct design, quality of materials built in, and careful workmanship. These same principles will work to advantage on your work. Let us show you how.

Simply send blueprints for estimates

THE COLBURN MACHINE TOOL COMPANY
1038 IVANHOE ROAD CLEVELAND, OHIO
Builders Also of Colburn Heavy Duty Drill Presses



SIMPLICITY is often deceptive. This is probably the reason why so little authentic data is available concerning the plain bearing. Yet this form of bearing is universally used and plays a far larger part in engineering practice than any other type.

This very general lack of knowledge has led us to establish an Engineering Bureau, devoted to the study of all types of bearings and their relation to machine design.

Manufacturers and engineers are invited to submit their bearing problems to us for solution. In doing so they will assume no obligation and will receive the benefit of impartial advice from an engineering organization devoted entirely to the investigation of bearing problems.

AMERICAN BRONZE CORPORATION

PLAIN BEARING ENGINEERS
AND MANUFACTURERS OF
NON-GRAN BEARING BRONZE

THE UNIVERSAL NON-GRAN BEARING BRONZE

MAIN OFFICE, BERWYN, PA.
DISTRICT OFFICES, BOSTON, MASS.
CHICAGO, ILL., CLEVELAND, O.

The wear-resisting qualities of Non-Gran result from its *Physical* properties rather than its chemical composition.

These physical properties are obtained by exclusive methods of foundry practice and the use of purest virgin metals. No machine shop scrap of any kind enters into the composition of Non-Gran.

The chemical composition of Non-Gran approximates that of ordinary bronze. But microscopic examination shows it to have a more dense, homogeneous structure than ordinary bronzes.

That is what gives Non-Gran its remarkable resistance to wear—as its particles are not torn away by frictional drag.

THE JOHNSON FRICTION CLUTCH

Photographs by courtesy of the Northwestern Cooperage & Lumber Co., Gladstone, Mich.

Friction Control on a Hardwood Planer

A Johnson Clutch driving the feed works on an American Hardwood Flooring Machine.

Speed 850 R.P.M.—8 H.P.—Clutch operates twenty times a day. It was put on to replace a belt tightener, "so that the feed would stop at once and stay stopped," and it certainly did the work.

. . . . "Your clutch is now installed and working very successfully. We wish you would kindly enter our order for four additional clutches to be shipped at your earliest convenience." . . . .

The Northwestern Cooperage & Lumber Co.

Friction Control Means Better Machinery

And Johnson Clutches cover all requirements in friction control. We specialize in applying clutches to meet any conditions.

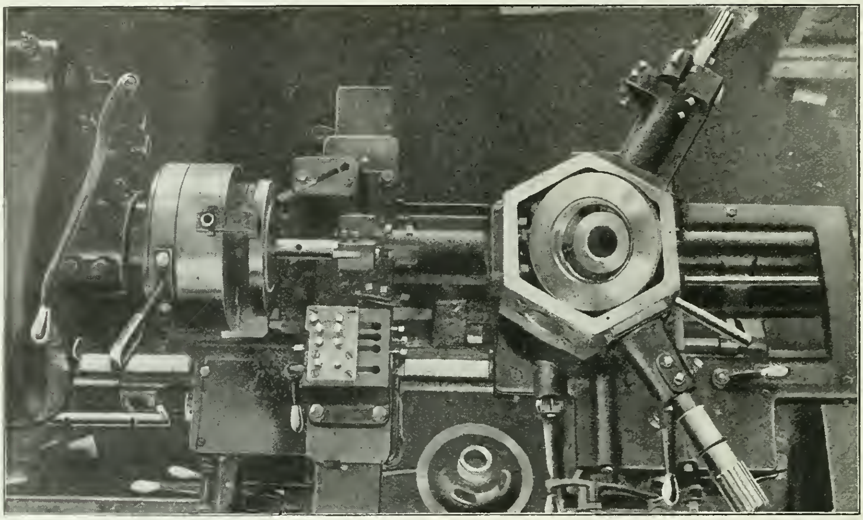
Write for our Booklet "Clutches As Applied to Machine Building" and our Catalog "A"

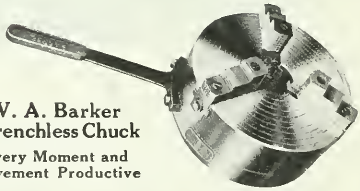
The Johnson Lineshaft Drive

Is an application of friction control that solves the power transmission problem in any manufacturing plant.

Eliminate your inefficient countershafts and expensive individual motors by installing clutch drives direct from lineshaft.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.





W. A. Barker
Wrenchless Chuck
Every Moment and
Movement Productive

What Foster Engineering Service Means to You

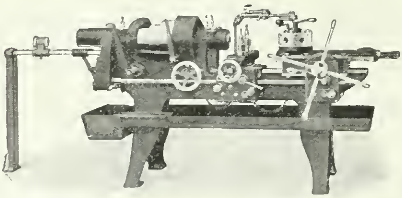
You want production, not merely a machine.

The real value of a machine to you is measured by its ability to produce.

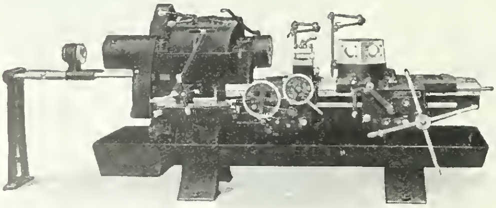
To be able to produce maximum, a machine must be tooled right and operated right.

We will gladly solve your tooling problems for you.

Send us your blue prints.



Foster Screw Machines 5 Sizes



Foster Universal Turret Lathe—3 Sizes

FOSTER MACHINE CO., Elkhart, Ind.

THE DANIELS AUTOMATIC

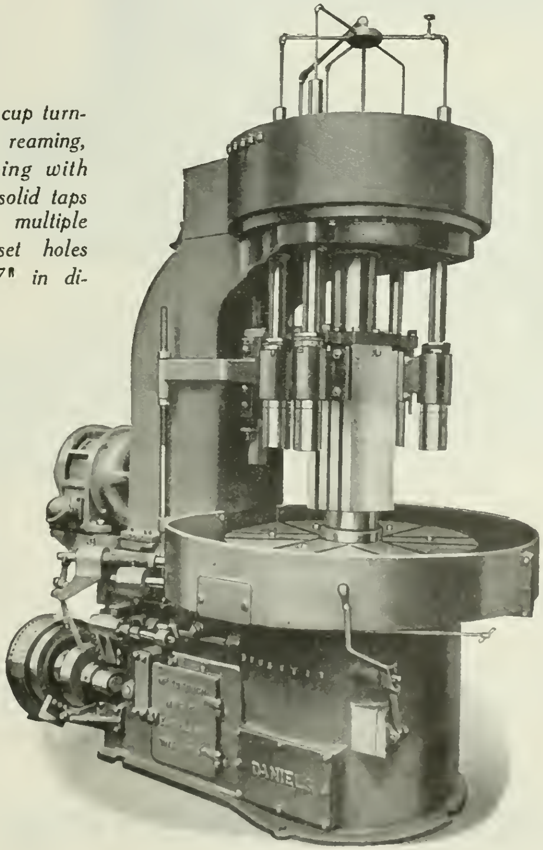
One Machine—One Operator Do the Work of Five

Figure the saving—the economies effected by the use of a Daniels Automatic touch every phase of operating expenses—labor, upkeep, overhead, power, there's an actual saving of cold cash at every point.

The possibility of performing five operations at a single chucking makes a cut in the non-productive setting-up time that is alone an important factor in quantity production. The table can also be double indexed for work with two operations and triple indexed for single operation work, either way, it's always busy, with no unproductive time.

Capacity for cup turning, boring, reaming, facing, tapping with collapsible or solid taps or drilling multiple spindle off set holes from 3" to 7" in diameter.

"The Machine That Does Everything But Think"

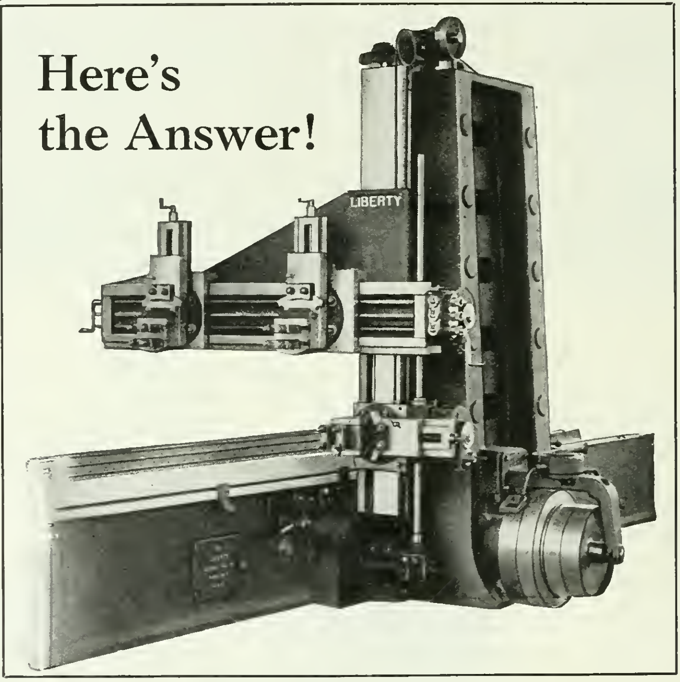


Send us blue prints or samples of your work, let us give you guaranteed production estimates and tell you the savings made possible to other users by the Daniels Automatic. Send for circular. The detailed description of the machine and operating principles, etc., will interest you.

McDonough
Mfg. Company
Eau Claire.
WISCONSIN

LIBERTY MACHINE TOOLS

Here's the Answer!



Question! What planing equipment must I install to successfully handle all work which enters my plant? Answer! The Quality Open-side Planer —that's all! It will give you adequate clearance on large and awkward shaped work; has power to cut to tool capacity, and, if you want it for ordinary work attach the left-hand housing, and you'll have a first-class four-head planer.

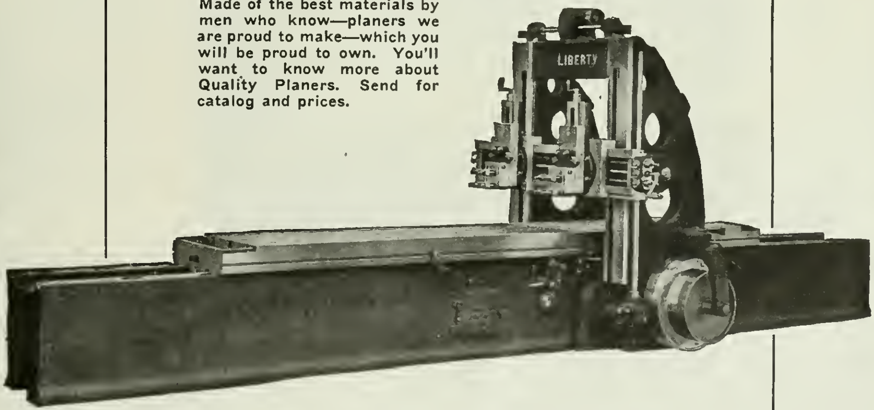
Of course, in a busy shop—and folks with first-class equipment are generally busy—you'll need more planers than this. We have just what you want—the Quality Standard Type Planer!

Quality Planers are powerful and easily operated—are guarded in every way from the possibility of operating errors. The patent feed, the care given to bearings and lubrication, the scientifically correct proportioning and the accuracy and fine finish of each part are points well worth your attention.

THE LIBERTY MACHINE TOOL

Quality Planers

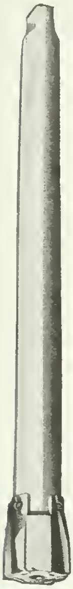
Made of the best materials by men who know—planers we are proud to make—which you will be proud to own. You'll want to know more about Quality Planers. Send for catalog and prices.



Quality Standard Type Planers are made in sizes from 22" to 60", inclusive; Quality Open-side Planers from 24" to 60".

COMPANY, Hamilton, Ohio

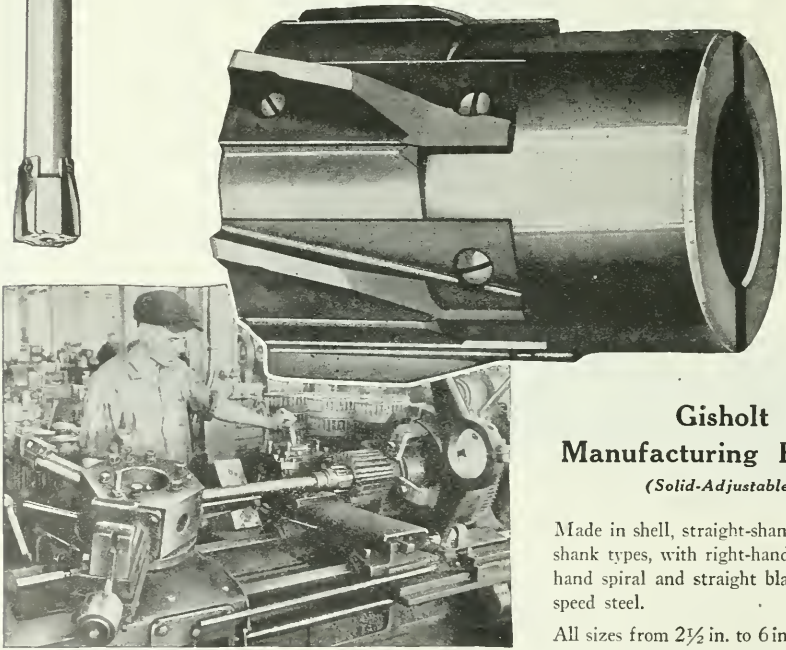
LIBERTY MACHINE TOOLS



REAM MORE HOLES— REAM THEM TRUER

If a hole requires reaming, use a reamer that is adjustable. Accurate holes are what you really want. The real value of a reamer lies in its ability to ream holes accurately, for the longest possible time. This is what you will get in the *Gisholt Manufacturing Reamer.*

It is a solid-adjustable reamer and may be repeatedly restored to original size by a wide range of adjustment. When the blades are finally worn out, they can be replaced with new ones.



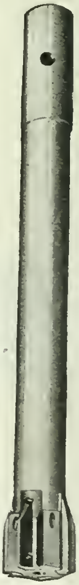
Reaming a gas engine cylinder with a Gisholt Manufacturing Reamer

Gisholt Manufacturing Reamer

(Solid-Adjustable)

Made in shell, straight-shank and taper-shank types, with right-hand spiral, left-hand spiral and straight blades of high-speed steel.

All sizes from 2½ in. to 6 in. for prompt shipment. Send for the folder giving complete information.



GISHOLT MACHINE CO., 9 So Baldwin Street, MADISON, WIS., U. S. A.

Builders of Standard and Automatic Turret Lathes, Vertical and Horizontal Boring Mills, Tool Grinders, Small Tools, Special Machinery, etc.

Eastern Sales Office: 30 Church St., New York. *Works:* Madison, Wis.; Warren, Pa.

MUELLER RADIAL DRILLS

Repeat Orders the Only Comeback

The Wilmarth & Morman Co., of Grand Rapids, Mich., found its first Mueller Radial so dependable and productive that subsequent orders for equipment of this class have been marked "Mueller" as a matter of course. Three times, so far, we've filled repeat orders from the W. & M. shop—three of the total installation being shown below.

Nineteen years of practical experience are back of "Mueller" efficiency. During this time we have designed many exclusive features which make these machines unusually powerful, convenient and productive—notably, the one-piece patented column, reinforced with 4 internal webs joined both top and bottom, the unusually long bearing of the arm on the column and the convenient location of all control levers (even the arm-locking lever) within easy reach of the operator as he sits or stands at his work.

Let us describe them in detail

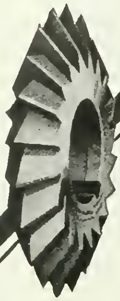
THE MUELLER MACHINE TOOL COMPANY

Established 1902

CINCINNATI, OHIO, U. S. A.

Radial Drills and Lathes

National-Cleveland



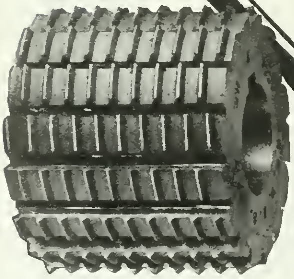
Made in Cleveland for Nation-Wide Service

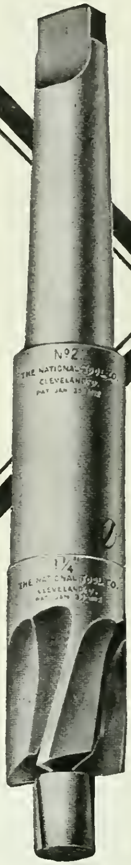
Keen cutting tools, produced by modern methods in a modern plant, to completely fill the needs of modern metal working practice.

The National-Cleveland factory in the heart of the machine tool district and offices and stock rooms in easy reach of the large industrial centers insure quick service and enable you to get the tool you want when you need it.

National-Cleveland Cutting Tools cover an exceptionally wide range of work; their field of use covers the continent.

Our monthly bulletin lists the tools in stock with their prices, if your name is not on our list, a card from you will put it there. Also, send for our catalog for your files.





CUTTING TOOLS

NATIONAL TOOL COMPANY

CLEVELAND, OHIO

Chicago Sales Room:
26 S. Jefferson Street

Philadelphia Office and Stock:
1215 Filbert Street

New York Office: 50 Church Street, stock carried at 36 Murray Street

Pacific Coast Office:
1125 Gasco Bldg., Portland, Oregon

Detroit Office and Stock:
610-611 Sun Bldg.

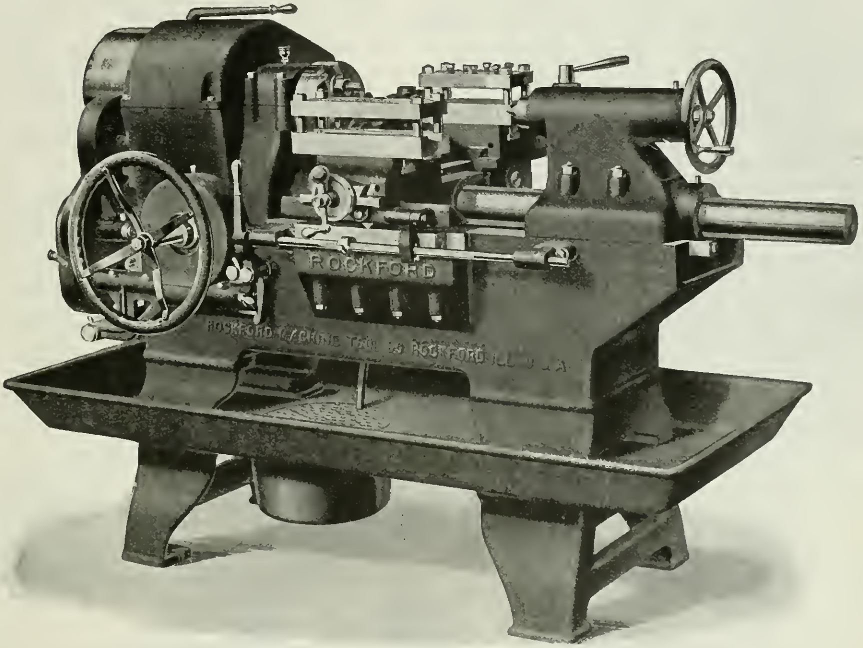
Pittsburgh Office:
988 Union Arcade Bldg.

Atlanta, Georgia:
34 So. Forsythe St.

European Office: THE NATIONAL TOOL CO., 139 Queen Victoria St., London, E. C. 4

ROCKFORD

AUTOMATIC LATHE



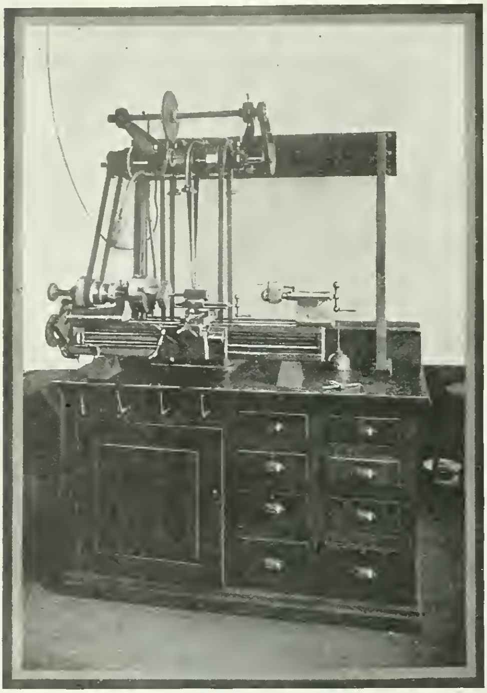
A Production Unit of Exceptional Efficiency

The Rockford Automatic Lathe is a heavy, rigid and powerful machine built to stand the severest service. It has three changes of speed, positive geared feed and automatic stop. Front and rear heads are both controlled by the same feed lever, but the amount of feed of each head may be adjusted independent of the other. All cuts are taken simultaneously by both front and rear tools. Drive is through single clutch pulley with controlling lever in convenient position for operator. Arranged for motor drive if desired. Will swing work 14-in. in diameter and take 18-in. between centers. Let us show you the saving this machine will give you.

Manufactured by

ROCKFORD MACHINE TOOL COMPANY

2400 Kishwaukee St., ROCKFORD, ILL.



Rivett Equipment

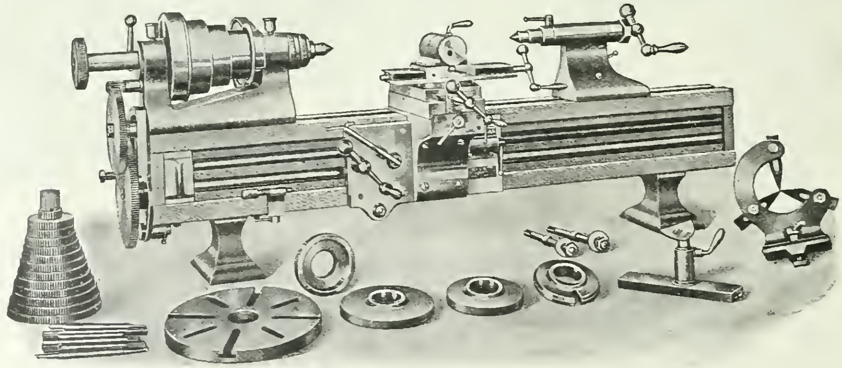
Second only to the brain of the inventor is its servant, his mechanical equipment. With this, in his own private workshop, his ideas become actualities with the assurance that his unprotected secrets are safe.

The Rivett No. 608 Precision Bench Lathe is a type of equipment much favored by such men. It is mounted on an oak cabinet and driven by an individual motor.

With this lathe and its many handy attachments the research engineer or inventor has a tool on which practically every operation known to lathe practice may be satisfactorily performed.

The Nearest Rivett Agent
is at Your Service

Rivett No. 608 Back Geared Precision Lathe



RIVETT LATHE AND GRINDER COMPANY

Builders of High Grade Precision Tools

Brighton District of Boston, Massachusetts

DOMESTIC AGENTS: The Fairbanks Company, Boston, Mass., Providence, R. I., New Orleans, La., Birmingham, Ala.; Purinton & Smith, Hartford, Conn.; Peter A. Frasse & Co., Inc., New York City; Homer Strong & Co., Inc., Rochester, Buffalo, Syracuse and Albany, N. Y.; D. Nast Machinery Co., Philadelphia, Pa.; Somers, Fitler & Todd Co., Pittsburgh, Pa.; Cleveland Tool & Supply Co., Cleveland, Ohio; J. R. Stone Tool & Supply Co., Detroit, Michigan; E. A. Kinsey Company, Cincinnati, Ohio, Indianapolis, Ind.; National Supply Co., Toledo, Ohio; Dale Mchy. Co., Inc., Chicago, Ill.; Blackman-Hill-McKee Machinery Co., St. Louis, Mo.; Portland Machinery Company, Portland, Ore.; Hallidie Machinery Co., Seattle, Wash.; F. O. Stallman Supply Co., San Francisco, Los Angeles, Cal.; F. E. Satterlee Co., Minneapolis, Minn.; Peden Iron & Steel Co., Houston, Texas; Smith-Courtney Co., Richmond, Va.; Walraven Company, Atlanta, Ga. FOREIGN AGENTS: H. W. Petrie, Ltd., Toronto, Ont., Can.; Williams & Wilson, Ltd., Montreal, Can.; Fenwick Freres, Paris, France, Belgium, Switzerland, Italy, Spain, Portugal; Buck & Hickman, Ltd., London, Glasgow, Manchester, Sheffield, Birmingham; Benson Brothers, Sydney, Australia; Yamatake Co., Tokyo, Japan.

VAN NORMAN

No. 34 BORE GRINDER

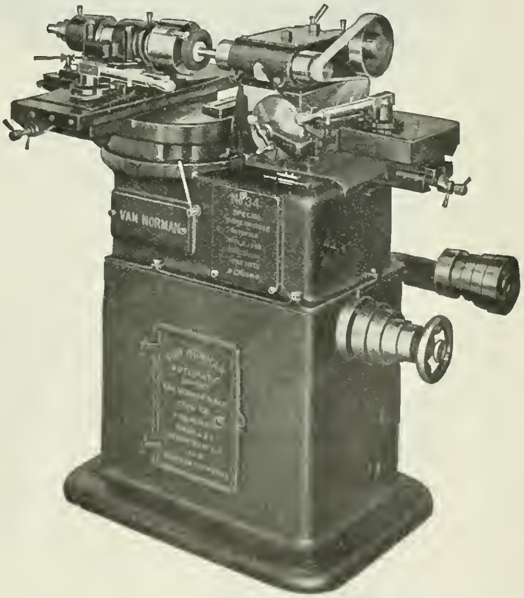
UNUSUALLY SPEEDY—EXCEPTIONALLY ACCURATE

Grinds Short, Straight or Taper Holes from Smallest up to 4 or 5 inches

The need for precision hole grinding at commercially profitable speeds has long existed, and the trend toward more refined methods of manufacture has made a production unit to achieve these ends a practical necessity.

The No. 34 Van Norman Special Automatic Bore Grinder, designed and built for grinding short, straight or taper holes with unusual speed and exceptional accuracy, is therefore a welcome addition to the equipment of ball bearing manufacturers and other concerns who handle this class of work.

The handy, quick-shift features are particularly appreciated—the ability to disconnect the table feed mechanism and withdraw the cutting wheel by a single movement of one hand against a latch and lever—to release and carry the work head out on cross-slide ways at right angles to wheel spindle, giving clear-way for test and inspection of work, with a single movement of the other hand.



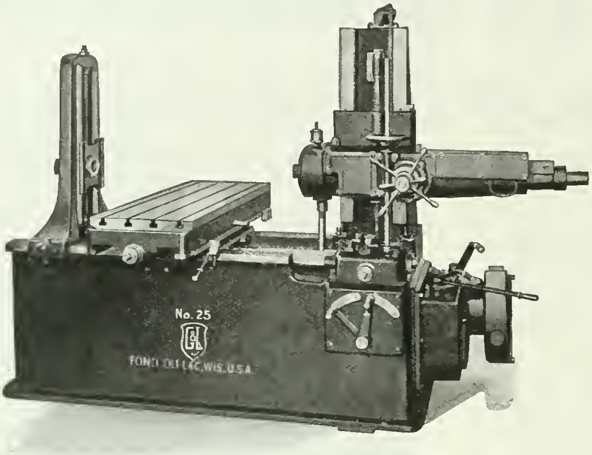
Tell us your problems and we'll advise you frankly as to the ability of this machine to solve them.

VAN NORMAN MACHINE TOOL COMPANY

Office and Factory, 160 Wilbraham Ave., Springfield, Mass., U. S. A.

Branch Sales Offices: 601 Kerr Bldg., Detroit, Mich., 50 Church Street, New York, N. Y.

Giddings & Lewis Horizontal Boring, Drilling and Milling Machines



Five Factors Which Make for Efficiency

**Unusual Accuracy,
High Production,
Stability,
Endurance
and Simplicity**

In this new machine every part is brought within extraordinarily close limits before it can pass our rigid inspection. Each machine is tested under actual working conditions when completed.

Maximum production is assured by the convenient location of the adjustable platen which carries the work, and by placing all manipulating levers within easy reach of operator's right hand.

Rugged construction and unusual factors of safety give the stability required to withstand the driving of high-speed steel to the limit.

A careful selection of material, scientific lubrication and the elimination of frictional bearings guarantee endurance. Simplicity of construction facilitates operation and precludes the machine getting out of order.

The Standard size No. 25 Machine has a 2½″ spindle with a longitudinal travel of 27″ (2 x 13½″). The vertical adjustment of head on column is 20″ and size of table 18″ x 48″.

Full particulars upon application

Giddings & Lewis Machine Tool Company

FOND DU LAC (Designers and Builders of Special Boring Fixtures.) **WISCONSIN**

AT HOME: Henry Prentiss & Co., New York City, Syracuse, Rochester, Buffalo, Boston, Hartford; Marshall & Huschart Machinery Co., Chicago, Milwaukee; Swind Machinery Co., Philadelphia, Baltimore; Motch & Merryweather Machinery Company, Cleveland, Pittsburgh, Detroit; E. A. Kinsey Company, Cincinnati, Indianapolis; Smith Courtney Company, Richmond, Va.; Young & Vann Supply Co., Birmingham, Ala.; Blackman-Hill-McKee Machinery Co., St. Louis; Eccles & Smith Co., San Francisco, Los Angeles, Portland; English Tool & Supply Co., Kansas City; Fairbanks Co., New Orleans; McMullen Machinery Co., Grand Rapids, Mich.; Manning, Maxwell & Moore, Inc., Seattle; Northern Machinery Co., Minneapolis; Salt Lake Hardware Co., Salt Lake City; Sunderland Machinery & Supply Co., Omaha. ABROAD: Canadian Fairbanks-Morse Co., Ltd., Toronto, Montreal, Winnipeg, Vancouver, Hamilton; Fenwick, Freres & Co., Paris, Lyons, Liege, Brussels, Zurich, Spain, Portugal; Burton, Griffiths & Co., England, R. L. Scrutton & Co., Ltd., Sydney, Australia; Gustan Nielson, Christiania. Aktiebolaget Rylander & Asplund, Stockholm, Sweden; Sale & Frazer, Ltd., Tokyo, Japan; Maskinbolaget, Groenblom, Abo, Finland; Gaston, Williams & Wigmore, Shanghai, Hongkong, Hankow, Tientsin, China. Export Representative, L. S. Devos, Manager, Grand Central Palace, New York City.

Jacobs Super Chuck

Patented 1909-1915. Other patents pending.

A Look Inside

Here are the several parts —carefully designed, exactly fitted, perfectly made —that guarantee the Jacobs Super Chuck to hold a drill tight, to hold it right, and to keep on doing its work indefinitely.

FIRST THE BODY—scientifically casehardened; size limits within .0005″, arbor hole ground on a special fixture with six gages to position it accurately in relation to the hole for the jaw.

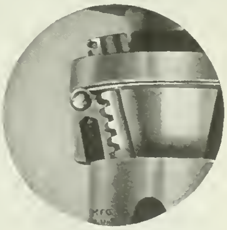
THE SLOT FOR THE NUT, correctly located in relation to the jaw holes by means of micrometer gages, insures a properly fitting thread on the nut and jaws.

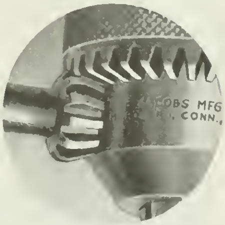
NO WEAR ON KEY HOLES because of the deeply casehardened body, result—a well fitting Gear on Sleeve and Key.

THE JAW, OF TOOL STEEL, has glass hard gripping surface; threads are tough, and all surfaces are ground on centers to within *a quarter of a thousandth* of an inch.

THE NUT, of special analysis steel, is ground after heat-treatment, in correct alignment with thread; tolerance .0005″.

THE BALL RACE comes within limits of .0001″; finest grade balls are used. An important point is the pitch of thread on nut—angle is 90 degrees to center line of jaw, so part cannot run over thread of latter.

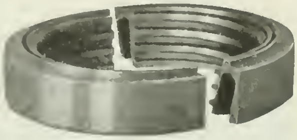




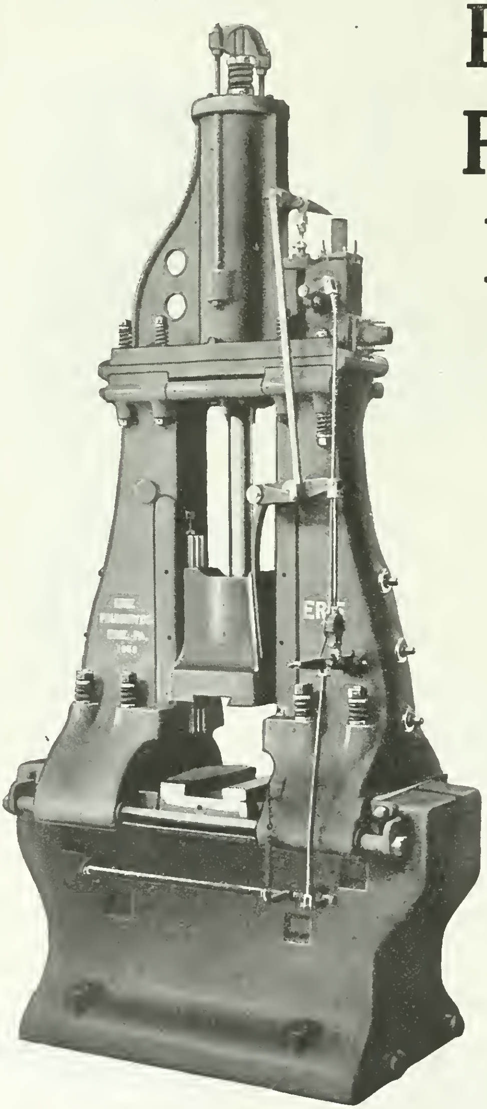
The Jacobs Super Chuck centers a drill, *accurately*, and will continue to do so after years of use. It saves its cost time and again by preventing drill breakage. Its correct balance preserves bearings of your drilling machine—order a Super Chuck from your dealer.

The Jacobs Manufacturing Company

Hartford, Connecticut, U. S. A.



VANADIUM STEEL HAMMER PISTON RODS



"We have found from experience and every form of laboratory test that vanadium steel is the best possible material for piston rod purposes."

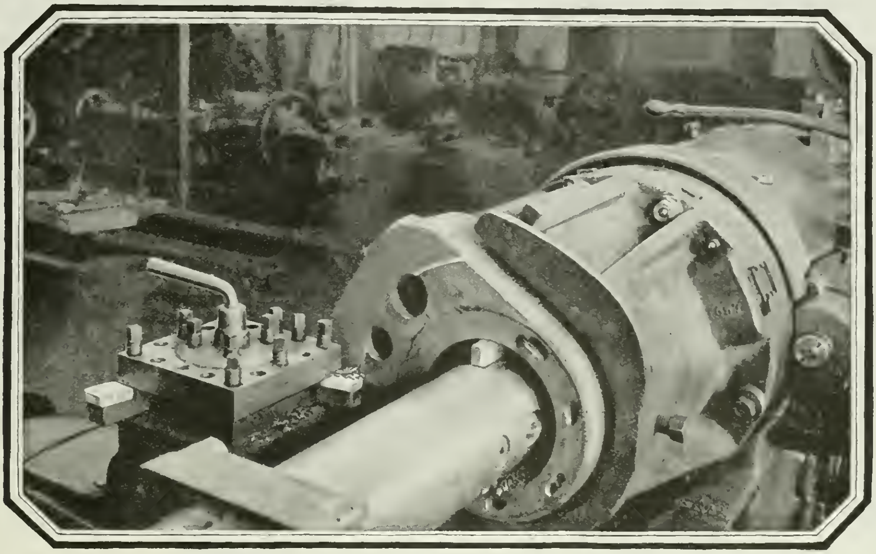
Erie Foundry Company.

—Write us for facts—

Vanadium Corporation of America

120 Broadway, New York

Remove More Metal at Higher Speeds



Stellite cuts time in half for big motor works

IT used to take 33 min. 30 sec. to rough-face and bore cast-iron cylinders at this large motor works. Now Stellite tools, applied exactly as described in the Stellite Reference Books, have sliced the cutting time to 13 min. 45 sec. With handling time the same, the Stellite time for the complete job (floor to floor) is approximately 50% faster than ever before.

The Stellite tools remove 2.45 pounds of iron per minute and require grinding but one-tenth as often as the other tools. Here are the facts:

	Other Tools	STELLITE
Rough-face top, and bore	28 min. 40 sec.	11 min. 30 sec.
Finish-face top	3 " 30 "	1 " 30 "
Counterbore	1 " 20 "	45 "
Total cutting time	33 " 30 "	13 " 45 "
Handling time	7 " 30 "	7 " 30 "
Total time, floor to floor	41 "	21 " 15 "
Av. No. pieces per grind	2	20

Send for Vols. 9 and 10 of the Stellite Reference Library

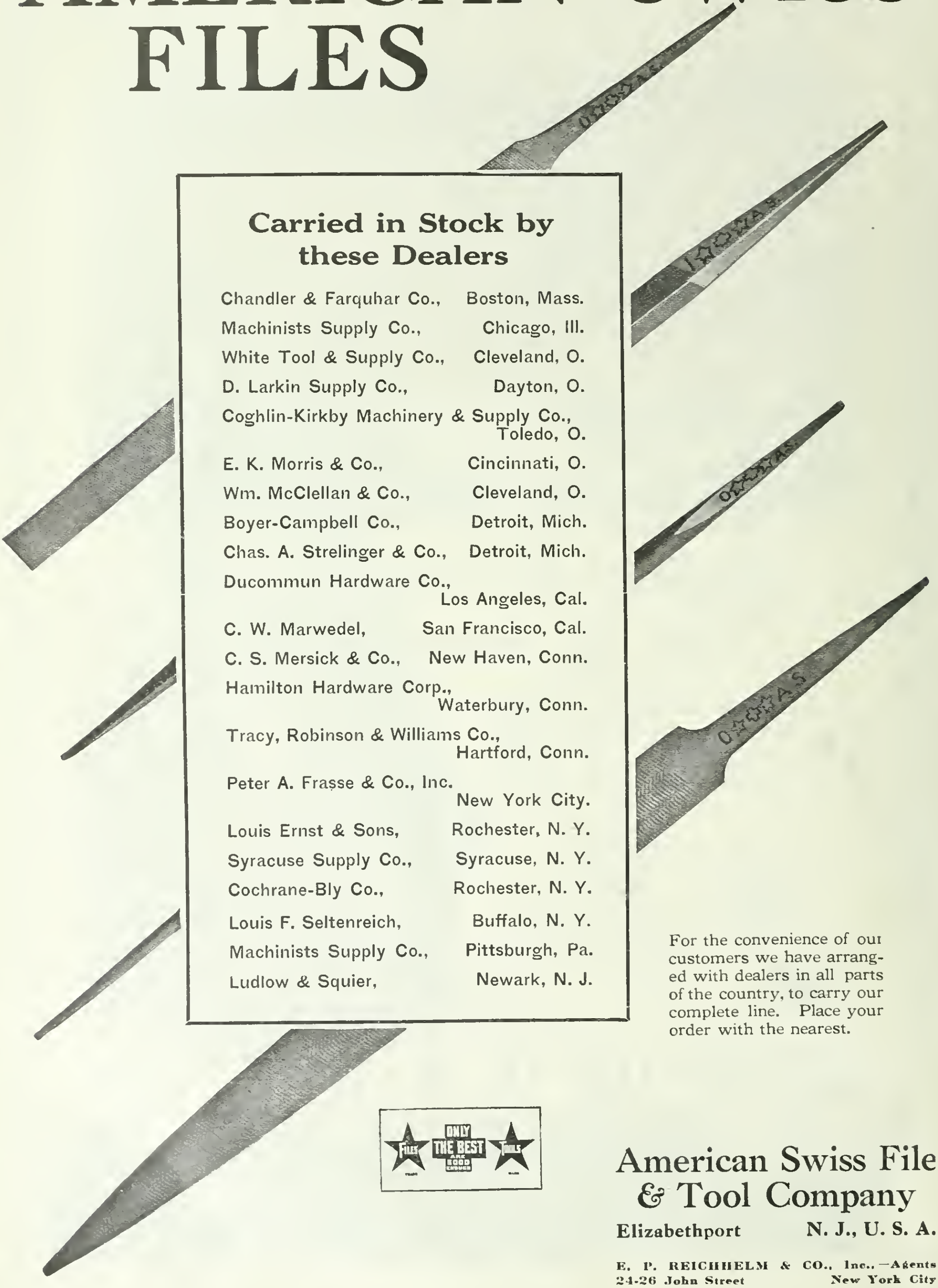
Perhaps you can apply Stellite to similar advantage in your shop. The Stellite Reference Books tell you how. They are consulted constantly by many of the biggest shops in the country to-day. Free copies sent on request.

HAYNES STELLITE COMPANY
Carbide and Carbon Building, 30 East 42nd St., New York, N. Y.

S-21-T16

STELLITE
WELDED-TIP TOOLS
Remove More Metal at Higher Speeds

AMERICAN SWISS FILES



Carried in Stock by these Dealers

Chandler & Farquhar Co.,	Boston, Mass.
Machinists Supply Co.,	Chicago, Ill.
White Tool & Supply Co.,	Cleveland, O.
D. Larkin Supply Co.,	Dayton, O.
Coghlin-Kirkby Machinery & Supply Co.,	Toledo, O.
E. K. Morris & Co.,	Cincinnati, O.
Wm. McClellan & Co.,	Cleveland, O.
Boyer-Campbell Co.,	Detroit, Mich.
Chas. A. Strelinger & Co.,	Detroit, Mich.
Ducommun Hardware Co.,	Los Angeles, Cal.
C. W. Marwedel,	San Francisco, Cal.
C. S. Mersick & Co.,	New Haven, Conn.
Hamilton Hardware Corp.,	Waterbury, Conn.
Tracy, Robinson & Williams Co.,	Hartford, Conn.
Peter A. Frasse & Co., Inc.	New York City.
Louis Ernst & Sons,	Rochester, N. Y.
Syracuse Supply Co.,	Syracuse, N. Y.
Cochrane-Bly Co.,	Rochester, N. Y.
Louis F. Seltenreich,	Buffalo, N. Y.
Machinists Supply Co.,	Pittsburgh, Pa.
Ludlow & Squier,	Newark, N. J.

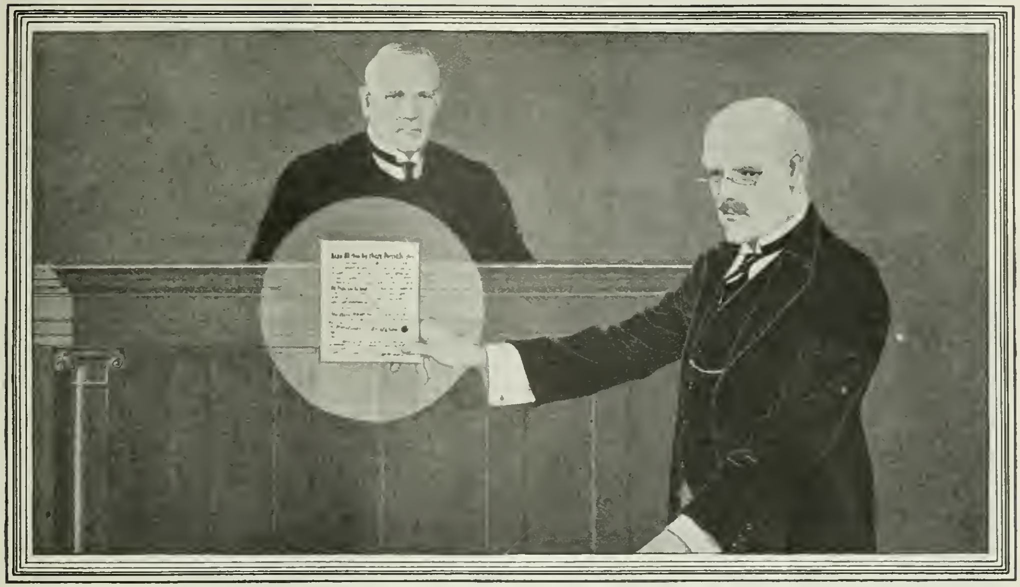
For the convenience of our customers we have arranged with dealers in all parts of the country, to carry our complete line. Place your order with the nearest.

FILES ONLY THE BEST ARE GOOD ENOUGH TOOLS

American Swiss File & Tool Company

Elizabethport N. J., U. S. A.

E. P. REICHHELM & CO., Inc.—Agents
24-26 John Street New York City



The Winning Evidence—a PHOTOSTAT Copy

The PHOTOSTAT Makes No Mistakes! It makes photographic, facsimile copies.

Send for our booklet containing letters from many companies telling how the PHOTOSTAT has saved and made thousands of dollars for them.

The case hinged upon the ability of the prosecution to produce certain documentary evidence. The original had been lost. In fact, the defence, knowing that it had disappeared, already considered the case won.

Then the unexpected happened. The Prosecuting Attorney introduced a PHOTOSTAT copy of the original document which had been previously made and filed as a matter of precaution.

The tables were turned—for PHOTOSTAT copies are legal evidence, because they are made direct from the original.

PHOTOSTAT copies of important documents are not only useful for filing as a precautionary measure in case of litigation, or in case of loss by fire or otherwise, but can also be sent out instead of the originals when desired.

Consider the importance of this in those numerous business controversies which never reach the court room, but where a settlement cannot be reached until valuable pieces of documentary evidence have passed from hand to hand several times.

Consider also the incalculable value of a duplicate file of drawings, plans, etc., if a fire loss should come.

The PHOTOSTAT has many every-day uses; it makes photographic facsimiles direct from pencil sketches, blueprints, maps, charts, catalog pages, documents, drawings, advertising layouts, etc., in every case saving minutes and in many cases hours or even days of time.

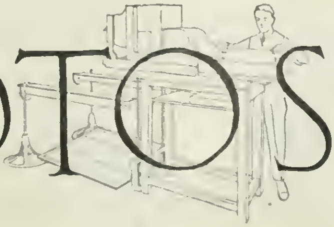
PHOTOSTAT CORPORATION

299 State Street Rochester, N. Y.

88 Broad Street, Boston.
7 Dey Street, New York City.
429 Monadnock Bldg., San Francisco.
19 South La Salle Street, Chicago.
1102 North American Bldg., Philadelphia.
700 Tenth Street, N. W., Washington.
Executive Office: Providence, R. I.

AGENCIES:

Alfred Herbert, Ltd., Coventry, England; Paris; Milan; Brussels; Amsterdam; Calcutta; Yokohama; Sydney.
Graham Brothers, Stockholm.

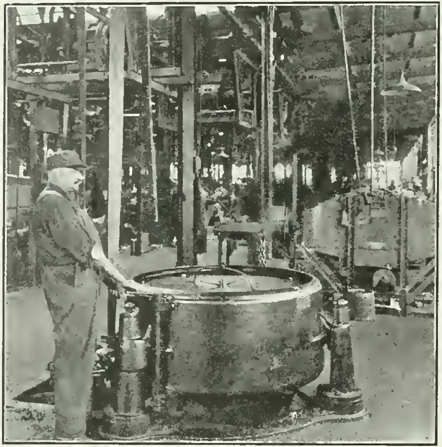


PHOTOSTAT

Tolhurst Chip Wringers

produce

Dividends From Waste

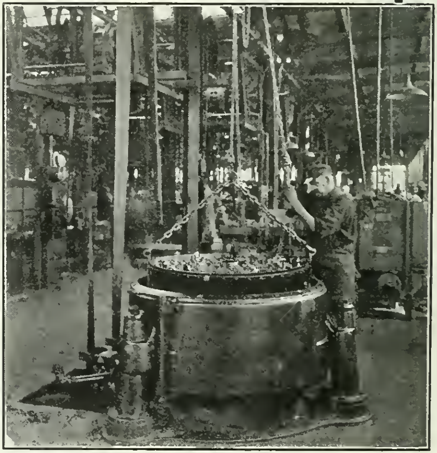


by extracting the cutting oil from steel chips and metal turnings. In doing this they more than pay for their cost; they *turn* loss into profit.

We illustrate the work **Tolhurst** Chip Wringers are doing in the Rolls-Royce of America plant at Springfield, Mass. The upper cut shows a machine in operation; the lower cut shows the basket of metal waste being removed after the oil has been reclaimed.

Tolhurst—Rolls-Royce: two famous names and two great machines.

The **Tolhurst** Chip Wringer is a Centrifugal Extractor designed expressly to reclaim oil and cutting lubricants from chips, turnings and small metal parts. The centrifugal is flexibly slung from three supporting columns, with a revolving basket mounted on large ball and roller bearings. The inner removable basket insures rapid loading and dumping. Baskets of 8.7 cu. ft. and 12.5 cu. ft. capacity care for from 3 to 6 loads per hour. Complete description upon request.



TOLHURST MACHINE WORKS

ESTABLISHED 1852 ***New York Office: 111 Broadway*** **TROY, N. Y.**

Southern Rep.
FRED H. WHITE
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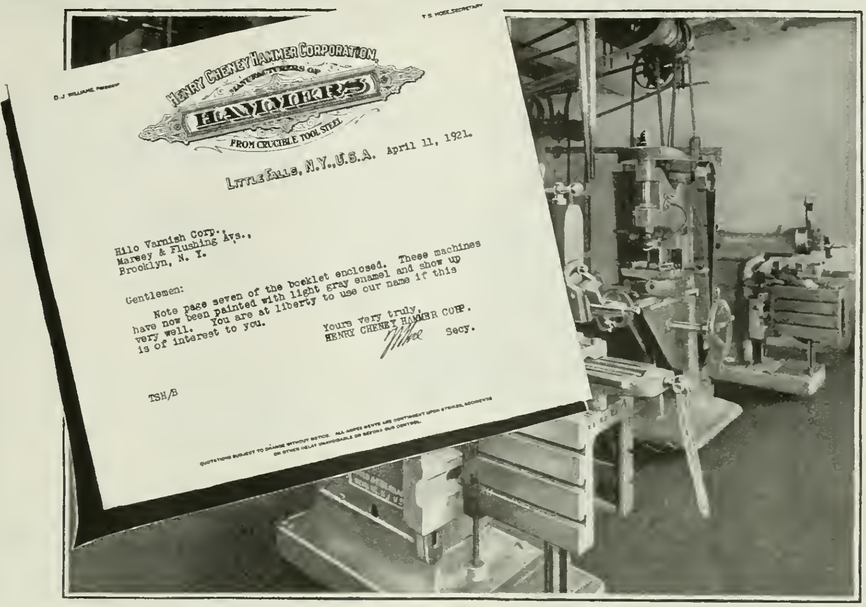


HENRY CHENEY HAMMER CORPORATION,
MANUFACTURERS OF
HAMMERS
FROM CRUCIBLE TOOL STEEL
LITTLE FALLS, N.Y., U.S.A. April 11, 1921.

Hilo Varnish Corp.,
Marcey & Flushing Avs.,
Brooklyn, N. Y.

Gentlemen:

Note page seven of the booklet enclosed. These machines have now been painted with light gray enamel and show up very well. You are at liberty to use our name if this is of interest to you.

Yours very truly,
HENRY CHENEY HAMMER CORP.
Secy.

TSH/B

"Lite-Gray" on your Machines appeals to customers

Right now when manufacturers are bending every effort to strengthen the saleability of their tools, Hilo "Lite-Gray" is proving its case one hundred per cent. This modern machinery enamel brightens up the machine, giving it distinction and placing it in a class by itself on the sales floor.

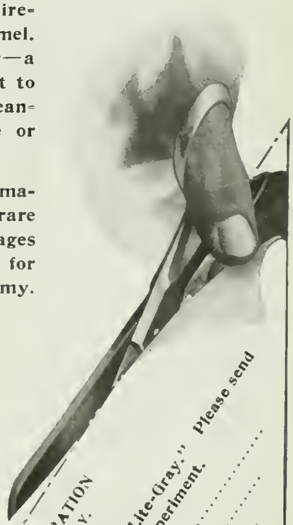
Hilo "Lite-Gray" increases the value of the machine itself.

It helps the operator work more steadily, because its light surfaces avoid eye-strain, it makes set-up jobs simpler and duplicate-production work less monotonous to the operator.

"Lite-Gray" answers every requirement of a modern machinery enamel. It does not lose its light color—a special process makes it resistant to oils and grease, and permits the cleaning of its surfaces with gasoline or benzine.

Try out Hilo "Lite-Gray" on your machines. The present slack offers a rare opportunity for testing its advantages—both for its sales-features, and for its influence on production economy.

There is a coupon attached for your convenience. Tear it out and mail RIGHT NOW before it slips your mind.



HILO VARNISH CORPORATION
Makers of Varnish and Enamels Since 1863

Marcy and Flushing Aves.
Brooklyn, N. Y.

2420-24 Washburne Ave.
Chicago, Ill.

"Lite-Gray"

HILO VARNISH CORPORATION
Brooklyn, N. Y.

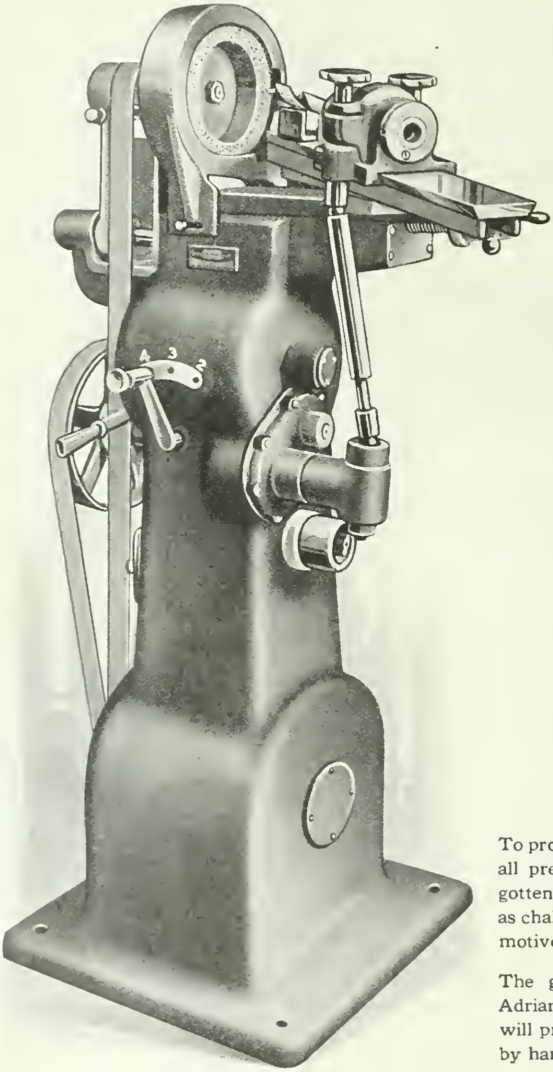
Gentlemen:
We are interested in "Lite-Gray." Please send us a free sample for our experiment.

FIRM ....

ADDRESS ....

By ....

M.A.



The New
AUTOMATIC

Radically
Different in—

Type
Principle
Operation

Wonderfully
Superior in—

Product
Speed
Results

To properly appraise the New Oliver Twist Drill Grinder all previous conceptions of such equipment must be forgotten. It's as different from the old style swing grinder as chalk from cheese; as superior as Baldwin's latest locomotive to Stephenson's "Puffing Billy".

The greenest hand in your plant, with the Oliver of Adrian Drill Grinder will produce what your engineers will pronounce the ideal drill point—impossible to obtain by hand and never before produced on a machine.

OLIVER INSTRUMENT COMPANY
Adrian, Michigan, U. S. A.

"OLIVER OF ADRIAN"

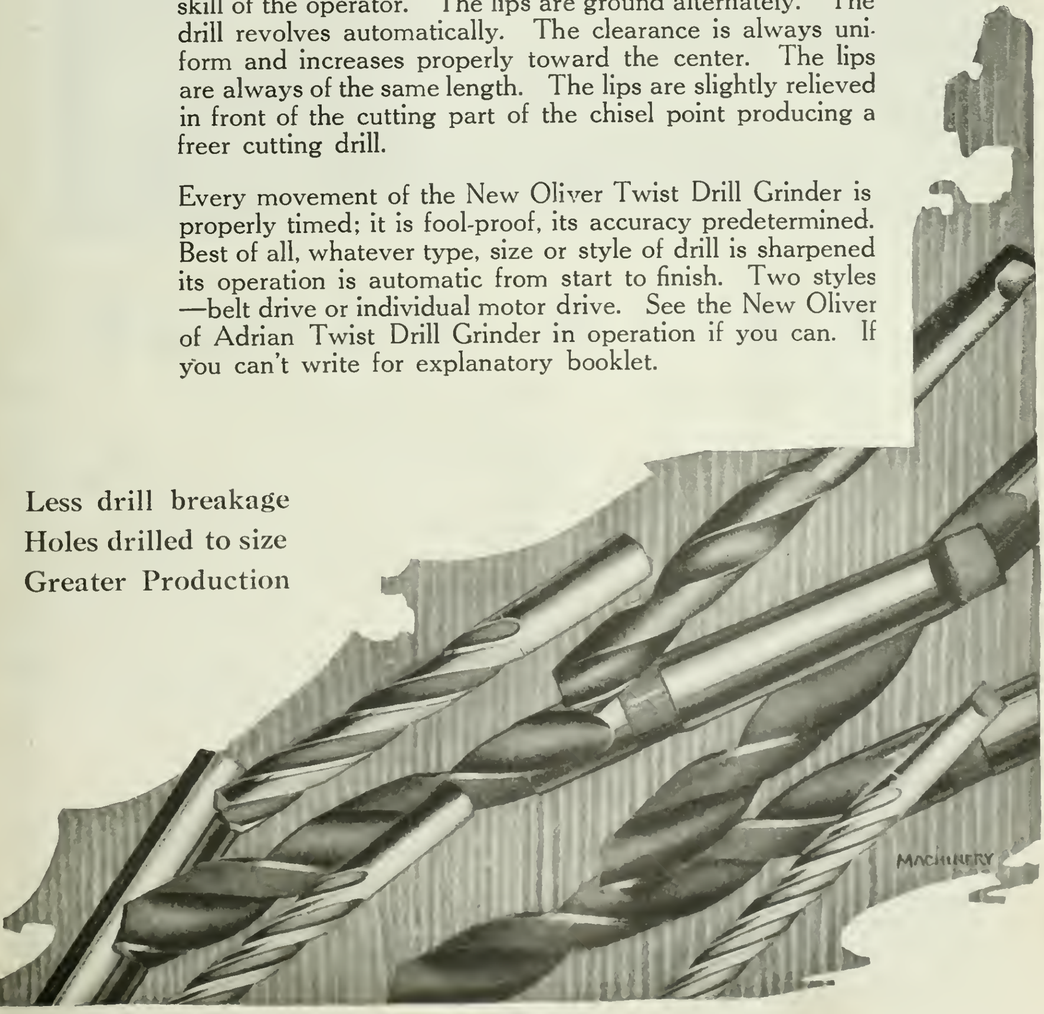
TWIST DRILL GRINDER

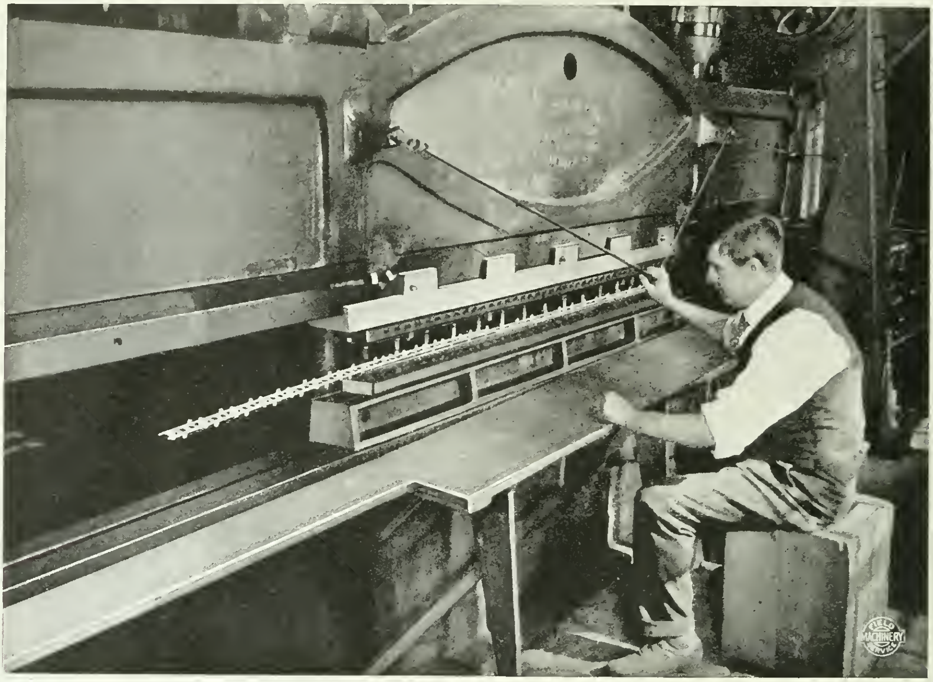
THE New Oliver Drill Grinder is devoid of complications, adjustments, uncertainties—it is equally satisfactory with two-, three- or four-lip drills.

Every point is accurately sharpened independent of the skill of the operator. The lips are ground alternately. The drill revolves automatically. The clearance is always uniform and increases properly toward the center. The lips are always of the same length. The lips are slightly relieved in front of the cutting part of the chisel point producing a freer cutting drill.

Every movement of the New Oliver Twist Drill Grinder is properly timed; it is fool-proof, its accuracy predetermined. Best of all, whatever type, size or style of drill is sharpened its operation is automatic from start to finish. Two styles —belt drive or individual motor drive. See the New Oliver of Adrian Twist Drill Grinder in operation if you can. If you can't write for explanatory booklet.

Less drill breakage
Holes drilled to size
Greater Production





KETOS STEEL

Unsurpassed for Large Composite Dies

Buying by brand protects the purchaser only if the name denotes an unvarying product. Ketos Steel has won as many friends by its uniformity as by its excellence. Today's order brings the same product as did last month's; it requires the same temperature and timing, has the same durability and gives the same protection against shrinkage, distortion and cracking.

The Lamb & Nash Company of Winchester, Mass., is an enthusiastic user of Ketos Steel; photograph taken in this concern's plant shows the parting of a corner head used for forming the corners of rooms in plastering. The punches and dies are of Ketos.

If you want to know more about what Ketos has done and can do, ***make a note now*** *to write for the Ketos Blue Book.*

HALCOMB STEEL COMPANY, Syracuse, N. Y.

Branches: New York Chicago Philadelphia Detroit Cleveland Boston

COLONIAL TOOL STEELS

for every tool making purpose

Chipping out all the inevitable seams in the billets is one of the precautions that keeps up the quality of the Tool Steels made in the Colonial mill.

Eliminating Tool Steel Breaks Before They Occur

No. 6 of a series of advertisements describing the production of Colonial Tool Steels.

AN ENTIRE DEPARTMENT in the Colonial Mill is devoted to removing seams and surface defects in billets. Each billet is critically examined, every imperfection marked with white paint, then chipped out and ground down to the solid perfect steel.

No seams are left for the finishing rolls to conceal; possible breaks in your tools are eliminated before they occur. It is an example of care, of the rigid adherence to quality standards, in every step in the making of all Colonial Tool Steels.

This Chipping Department is really yours, it belongs to every Colonial customer; it produces nothing for us directly—the one task it shoulders is to eliminate possible difficulties for you.

And this department pays a profit to the users of Colonial Tool Steels—it is a means of assurance of care-free, dependable work in your plant.

LIST OF TOOLS
and Grades of Colonial Steel
adapted for their use

Name of Tool	Grades of Steel
Arbors	Red Star
Augers, Wood & Bits	Red Star
Axe	Red Star
Ball Bearings	Superior
Bits, Channeling Machine	Red Star
Bits, Coal Mining	Anchor
Bits, Tong	Red Star
Bits, Well Stone Drilling	Standard Well Bit
Bush Hammer, Stone Tools	Red Star Sheets
Bunter, Heading	Red Star
Broaches, Machine	No. 7, High Speed
Bushings	Red Star
Center Punches	Red Star
Center, Lathe (see L)	Red Star
Chasers, Threading	H. S., No. 7, No. 14
Chain, Pipe, Links	Vanadium, Type A
Chisels, Pneumatic	No. 7
Chisels, Hand	Red Star
Chisels, Stone Cutters	Red Star
Chisels, Wood Working	Red Star
Cupping Tools	Red Star
Caulking Tools	Red Star
Claw Bars	Red Star
Creasers, Hot	H. S., No. 7 E
Counterbores	H. S., No. 14
Counterbores, Solid, Interchangeable	H. S., No. 7, No. 14
Collets, Bit Brace	Red Star
Collets, Spring	Red Star
Cutters, Fine Finishing	No. 5
Cutter, Pipe	H. S., No. 14
Cutters, Flue	No. 7, High Speed
Cutters, Flue Hole	No. 7
Cutters, Nail	High Speed
Cutters, Corn Stalk	Alto Sheets
Cutters, File	High Speed
Cutters, Milling, Plain	High Speed
Cutters, Form	High Speed
Cutters, Inserted Blade	High Speed
Cutters, Profile	High Speed
Cutters, Metal Slitting	High Speed
Cutters, Screw Slotting	No. 5
Cutters, Wood Forming	High Speed, No. 5
Cutting off Tools	High Speed
Dies, Bolt Threading	H. S., No. 7, No. 14
Dies, Blanking	H. S., No. 7, No. 14
Dies, Forming & Bending	No. 7, No. 14
Dies, Sub-Press	No. 7, No. 14
Dies, Drawing	H. S., No. 7, No. 14
Dies, Cartridge Shell	High Speed, No. 7
Dies, Hammer Dies, Power	Red Star
Flat Jack Jewelers' Dies	High Speed No. 7
Dies, Drop Forging	Red Star, Alto
Dies, Nail	High Speed
Dies, for Paper	H. S., No. 14
Dies, Pipe Threading	H. S., No. 7, No. 14
Dies, Solid & Adjustable Threading	H. S., No. 7, No. 14
Dies, Glove	No. 7, No. 14
Dies, Rivet	No. 7, Red Star
Dies, Shoe Knife	Red Star
Dies, Spring Screw, Threading	H. S., No. 7, No. 14
Dies, Solid Bolt	No. 7, No. 14
Dies, Adjustable, Round	
Dies, Split Threading	H. S., No. 7, No. 14
Dies, Spoon, Silver	No. 14
Dies, Silversmith	No. 7
Dies, Domino Screw Cold Heading	No. 7, Red Star
Dies, Cold Heading	No. 7, Red Star
Dies, Hot Heading	H. S. or No. 35
Dies, Wire Drawing	No. 14
Dies, Plates	No. 7, No. 14
Digging Bars	Red Star
Drills for Boring	Red Star
Drills, Tool Steel	H. S., Superior
Drills for Stone	Red Star
Drills, Twist	High Speed
Drills, Flat	High Speed
Engraver Tools	No. 14
Furnace Bars	Anchor
Flatters, Blacksmiths	Red Star
Fullers, Blacksmiths	Red Star
Forming Tools for Metals	H. S., No. 5, No. 14
Flange Tire Forming Tools	High Speed
Gear Cutters	High Speed
Gauges	Oil Hardening No. 6
Grip Dies for Rivets, Hot	No. 35
Hatchets	Red Star
Hammers, Blacksmiths	Red Star
Hammers for Crushing Machines	Red Star
Hammers, Pneumatic	No. 7
Hammers, Nail Machines	No. 7
Hammers, Riveting Pneumatic	No. 7
Hobs, Gear	H. S., No. 7, No. 14
Header Dies, Cold	No. 7, Red Star
Header Dies, Hot	No. 36
Jaw Chuck	Imperial
Jaw Vise	Imperial
Keys for Drop Hammers	Red Star
Knives, Pocket	Red Star Sheets
Knives, Carver	Red Star Sheets
Knives, Butcher	Red Star Sheets
Knives, Cleavers	Red Star Sheets
Knives, Back Spring	Alto Sheets
Knives, Heel Forming Shoe	No. 14
Knives, Shoe Makers	Red Star Sheets
Knives, Shoe Sole	Red Star
Knives, Surgical	No. 14
Knives, Table	Alto Sheets
Knives, Potato	Alto Sheets
Knives, Corn Knife	Alto Sheets
Knives, Drawing	No. 14, Red Star
Knives, Hog	No. 14
Knives, Machine	H. S., Red Star
Knives, Paper	H. S., or No. 14
Knives, Shear	No. 7, Red Star
Knives, Wood Working	H. S., Red Star
Knurling Tools	No. 7, No. 14
Lathe Centers, Dead	Red Star
Lathe Center, Live	Red Star
Lathe Tools for Metal Turning	High Speed
Lathe Tools for Woodworking	High Speed
Liners for Brick Dies	Imperial
Letter Stamps, Hand	No. 7, No. 14
Letter Stamps, Roll	No. 7, No. 14
Mandrels	Red Star
Mills, End	High Speed
Mills, Hollow	High Speed
Mills, Shell End	High Speed
Piercers, Hot	High Speed
Pick Steel	Alto
Pinion Bars	Red Star
Pins, Drift	Red Star
Pinch Bars	Red Star
Planer for Metal Tools	High Speed
Planer for Stone	High Speed
Planer for Wood	Red Star
Point Steel for Stone Cutters	Red Star
Punches, Cartridge Shell	No. 7
Punches, Hand—Hot or Cold Work	H. S., or No. 7
Punches, Drawing	No. 7, No. 14
Plug Gauges	No. 6, Oil Hard'ng
Pneumatic Tools	No. 7E or F
Reins, Tong	Red Star
Rods, Piston	Red Star
Reamers, Hand, Solid	H. S., or No. 5
Reamers, Shell	High Speed
Reamers, Taper	High Speed
Reamers, Rose, Chucking	High Speed
Reamers, Locomotive, Taper	No. 14, H. S.
Reamers, Bridge	High Speed
Reamers, Expansion, Hand	High Speed
Reamers, Drill & Center	No. 5
Rolls, Flue Expanding	No. 7
Ring Gauges	No. 6, Oil Hard'ng
Rivet Sets	No. 7, Red Star
Shear Blades—Hot Work	H. S., No. 7
Shear Blades—Cold Work	No. 7, Red Star
Saws, Circular Metal	H. S., Nikro
Saws, Circular Wood	Nikro
Scrapers for Scraping Machine Parts	No. 5
Scrapers, Tube	Red Star
Screw Drivers	Red Star
Set—Rivet	No. 7, Red Star
Sets—Button	No. 7, Red Star
Sets—Nail	Red Star
Splining Tool	High Speed
Shaper Tool	High Speed
Stamping Tools	No. 7, No. 14
Sledges, Blacksmith & Stone	Red Star
Snaps, Rivet	No. 7, Red Star
Springs	Red Star
Swages, Blacksmith	Red Star
Swaging Metal	No. 7
Taps, Tapper	No. 14, Red Star
Taps, Hand	Red Star Tap, Letters No. 14
Taps, Machine	H. S., Red Star
Taps, Automatic Machine Screw	High Speed, No. 7
Taps, Staybolt	No. 14
Taps, Pipe Taps	Red Star
Taps, Pipe Tap Chasers	High Speed, No. 7
Tire Turning	High Speed
Tool Holder Bits	High Speed
Wedge, Stone	Red Star
Wedges	Red Star
Wrenches, Track	Red Star

Full instructions for hardening and tempering all Colonial Tool Steels will be found in the *Colonial Heat Treating Book.*
MAILED FREE.

Colonial Steel Company

PITTSBURGH TOLEDO BOSTON DETROIT NEW HAVEN CHICAGO NEW YORK ST. LOUIS CLEVELAND

WE make and carry them, little and big, straight and bent, thick and thin—over 40 standard patterns in 1000 sizes of Superior Drop-Forged Wrenches. Ask your dealer.

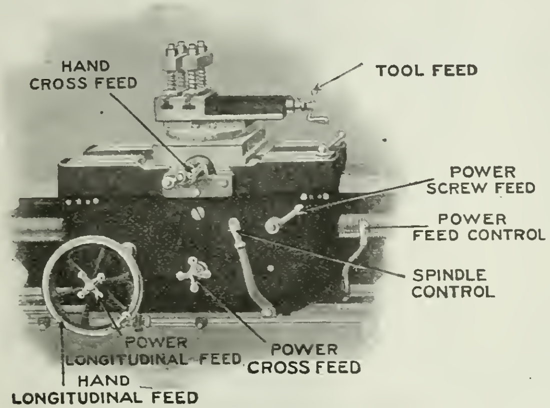
Wrench Book on request

J. H. WILLIAMS & CO.

"The Wrench People"

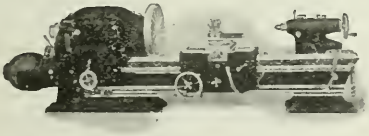
BROOKLYN	BUFFALO	CHICAGO
61 Richards St.	61 Vulcan St.	1061 W. 120 St.

St. Catharines, Ontario



Centralized Control

All controls are centralized on the apron.



Built for Production

Good mechanics will do more and better work and indifferent mechanics are likely to become better if you help them. As the operating point of a lathe is at the cutting tool, we have centralized the controls on the apron. From here the operator may start, stop or reverse the spindle instantly, engage, reverse, or trip the feed as well as traverse the carriage and cross slide.

Since piece work vanished this means more than it ever did before. You must see it work to know all that this means. We had production and the operator in mind when designing the Ryerson-Conradson line of lathes.

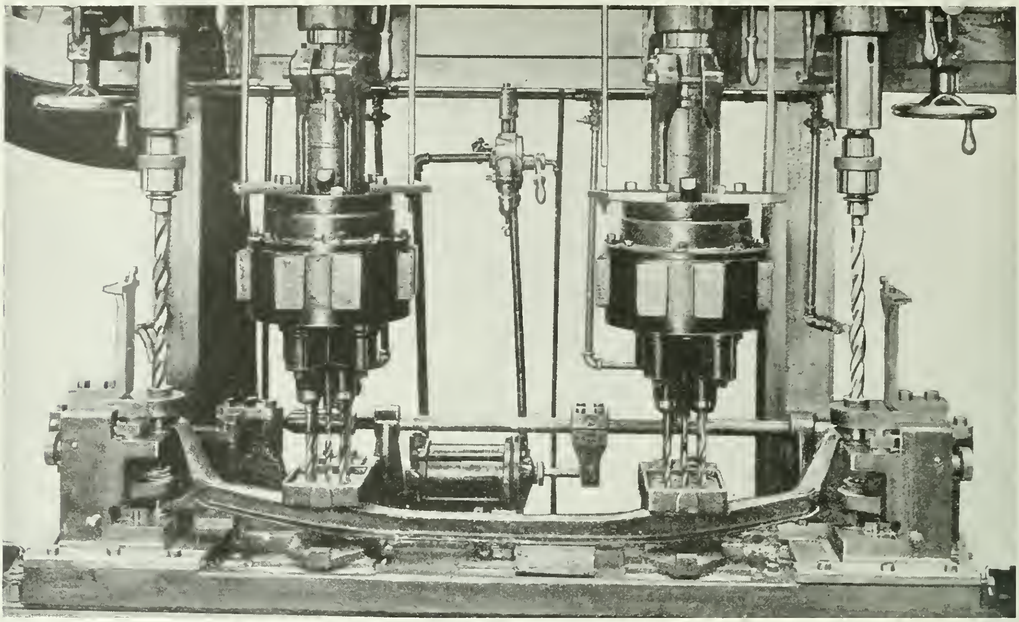
Other important advantages are featured in Bulletin 1301. Have you received your copy?

JOSEPH T. RYERSON & SON

Established 1842 Incorporated 1888

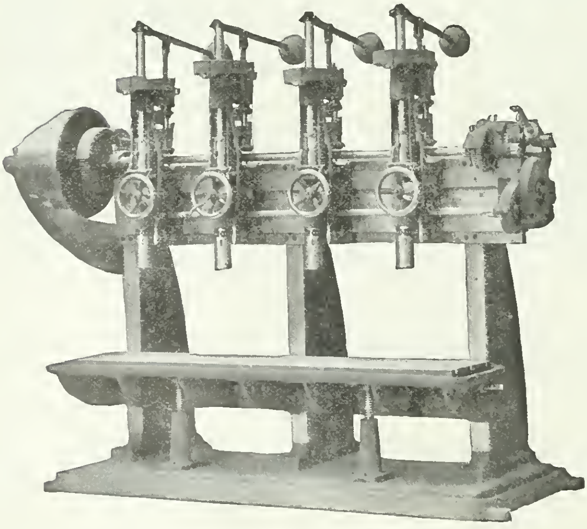
CHICAGO ST. LOUIS DETROIT BUFFALO NEW YORK

RYERSON MACHINERY



Another "Footburt" Aid to Rapid Production

FOOTBURT



Above is shown one of the many adaptations of the "FOOTBURT" Independent Feed Drilling Machine, which through the independent control of each head, has become widely known as the "Four-In-One" Drilling Machine.

On the work shown—drilling and reaming the king-pin holes, and drilling with multiple drill heads, the spring-pad holes in front axles—a steady production of twelve axles per hour is easily maintained.

The Foote-Burt Company

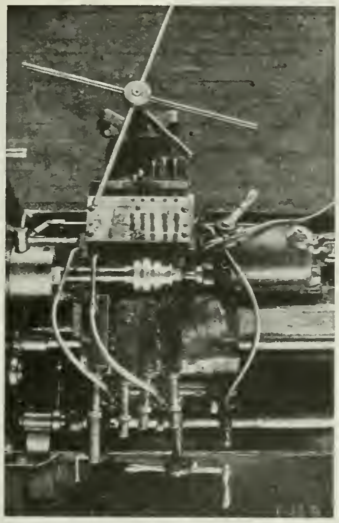
Cleveland **Ohio**

MILWAUKEE OFFICE
1143 Wells Bldg.

DETROIT OFFICE
1457 David Whitney Bldg.

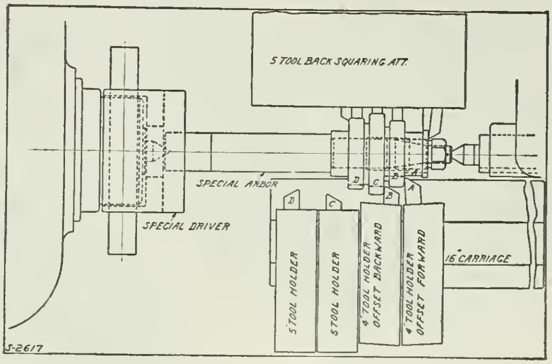
"Pioneers in Better Drilling Methods"

UNITED STATES: New York Representative—Mr. Herbert Kennedy, 695 Broadway, Paterson, N. J. San Francisco Representative—Mr. Louis G. Henes. Los Angeles Representative—Mr. Louis G. Henes. St. Louis Representative—Mr. Charles Spalding. Pittsburgh Representatives—Laughlin & Barney.
CANADA: Montreal Representative—Williams & Wilson. Toronto Representative—A. R. Williams Machinery Company.
FOREIGN AGENTS: Buck & Hickman, Ltd., London, Birmingham, Manchester and Glasgow. Moscow Tool & Engine Co., Moscow. Ing. Ercole Vaghi, Milan. R. S. Stokvis & Zonen, Ltd., Rotterdam. R. S. Stokvis & Fils, Brussels. Glaenzer & Perreaud, Paris, agents for France, Switzerland, Spain and Portugal. Mitsui & Co., agents for Japan, Korea and Manchuria.



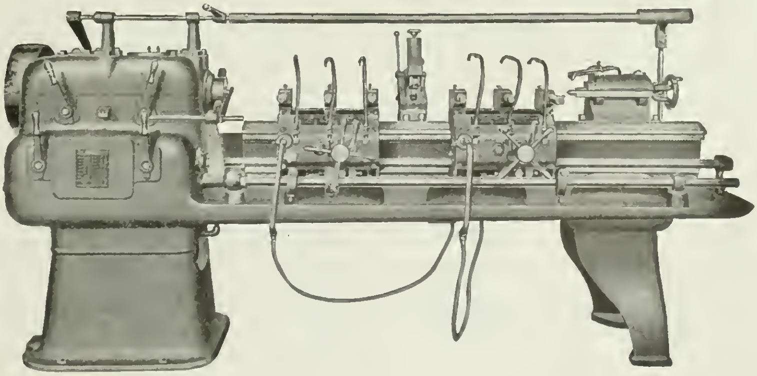
Lo-swing

Automatic Back Squaring Attachment


5 TOOL BACK SQUARING ATT.
SPECIAL ARBOR
SPECIAL DRIVER
D
C
B
A
5" TOOL HOLDER
5 TOOL HOLDER
4" TOOL HOLDER OFFSET BACKWARD
4" TOOL HOLDER OFFSET FORWARD
16" CARRIAGE
S-2617

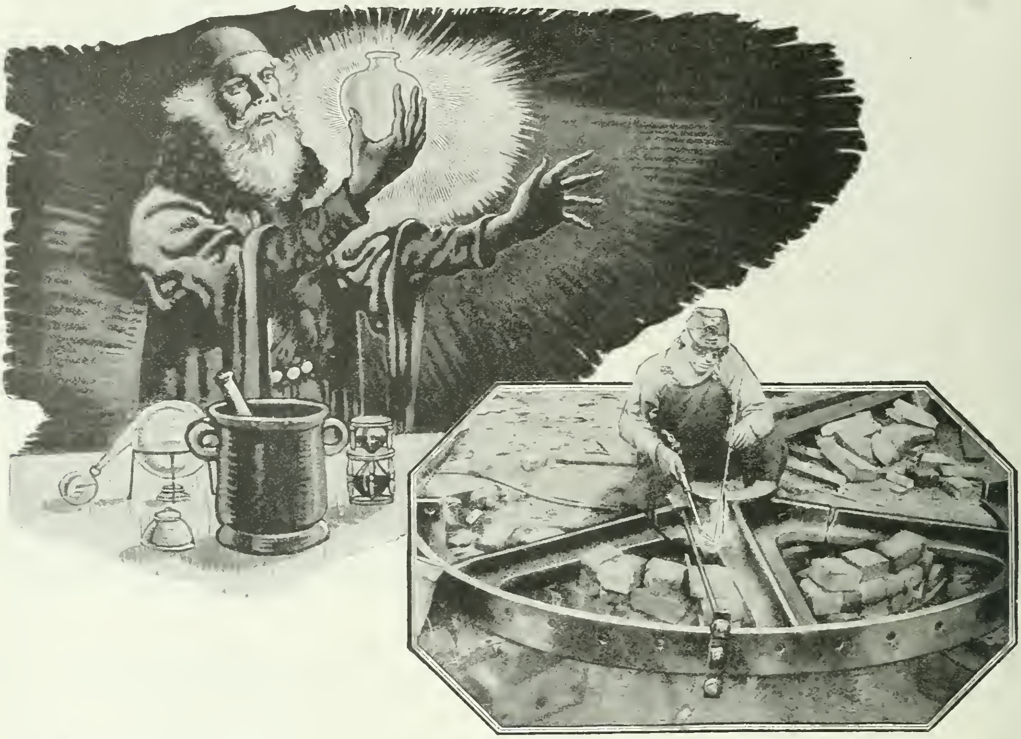
By use of the familiar Lo-swing principle of multiple tools cutting simultaneously applied to the back of the lathe the ends and shoulders of this cluster gear are squared and formed at the same time that all diameters are turned by tools mounted on the regular carriage, operating from the front. Piece is finished from rough stock at one setting in the lathe.

Send us drawings of similar work for production estimates.



Fitchburg Machine Works, Fitchburg, Mass.

REPRESENTATIVES Detroit and Cleveland District, W. H. Nettle, 236 Richton Ave., Highland Park, Detroit, Mich. Chicago, Milwaukee and St. Louis District, W. A. McCarrell, 429 Kenwood Boulevard, Milwaukee, Wis. Southern Continental Europe, G. E. Fogarty, 42 Rue de Peletier, Paris 9e, France. Northern Continental Europe, O Ericsson, Axelborg, Copenhagen B Denmark. British Isles, Buck & Hickman, Ltd., 2 and 4 Whitechapel Rd., London E 1, England.



The age-old dream of the alchemist is realized because of Linde

THROUGH countless centuries man dreamed of transmuting the baser metals into gold. Patiently, laboriously, often consecrating their very lives to the work, the Alchemists of old toiled on toward their elusive goal.

As late as 1873 James Price, the last of the Alchemists, sought death by his own hand rather than acknowledge the failure of his experiments.

Linde Engineers of to-day have made this dream of by-gone ages come true.

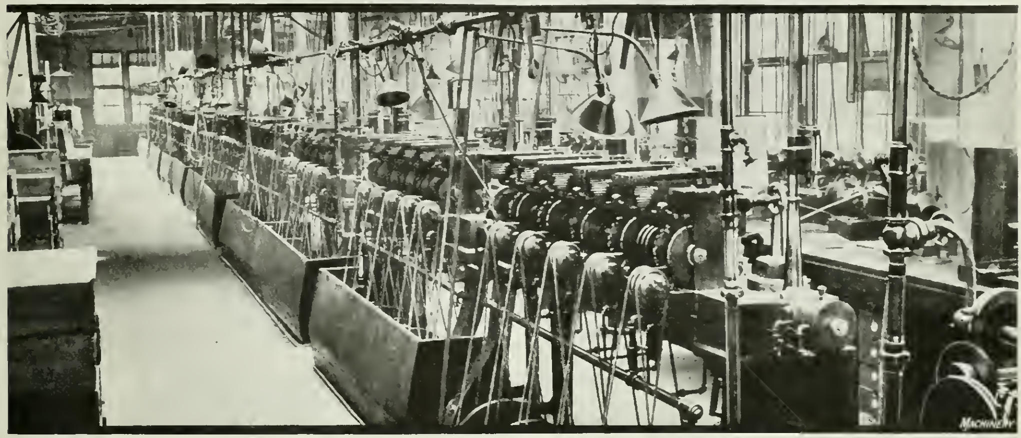
By producing uniformly pure oxygen in industrial volume, they have made it possible for oxy-acetylene welders and cutters to reclaim thousands of tons of metal machinery annually—turning base metal into gold—a saving in money far in excess of any vision of wealth dreamed of by ancient philosophers.

And Linde does more than supply oxygen of absolutely uniform purity. Thanks to a chain of twenty-nine plants and forty-six warehouses it delivers Linde Oxygen when and where it is wanted in any volume.

THE LINDE AIR PRODUCTS COMPANY
Carbide and Carbon Building, 30 East 42nd Street, New York
Balfour Building, San Francisco

THE LARGEST PRODUCER OF OXYGEN IN THE WORLD

L-500-21



Automatic Machines in a Watch Factory

Machines, Devices, and Methods Employed in the Plant of the Waltham Watch Co., Waltham, Mass.—First of a Series of Articles

By FRED R. DANIELS

THERE is probably no class of machinery in which the compressed air is used for actuating automatic movements more generally than in the equipment of the factory of the Waltham Watch Co., Waltham, Mass. Synchronized movements of operative parts are thus made possible which otherwise would require very complicated mechanism. In many cases the air is applied directly to the moving parts, while in others it is the prime mover, but is used in connection with springs, cams, and ratchets. The abrupt reversal or stoppage of rotation is often a necessary condition in the machines used. This is made possible in many instances by the installation of an air-operated countershaft, such as shown in Fig. 2. The air is admitted through the pipes *A* to an axial hole in the ends of the shaft the construction being the same at each end. The axial holes are connected by suitable air passages extending through the flanges *B*, and the air is applied directly to the adjacent face of each pulley. Between the two pulleys there is a thrust collar *C* fastened by a setscrew to the shaft, so that as the air is applied to the face of either pulley, the frictions which are interposed between the pulleys and the driving collar will rotate the shaft in a direction depending upon the belting of the pulley to which the air is applied. The design of the flanges *B* is such as to form an air-tight pocket between them and the adjacent face of each pulley. By the application of this type of countershaft to the various automatic watch-making machines, it is possible, with proper control valves, to secure the desired reversal of rotation or the abrupt stoppage of the operating members that is often necessary in this class of machines.

The series describing automatic machines employed in the manufacture of Waltham watches, of which this is the first article, deals with the application of mechanical principles to machines embodying an unusual degree of ingenuity, precision, and efficiency. This is the first time in the existence of the Waltham Watch Co. that anything has been published describing the operation of the company's automatic machinery. These machines represent a type in which compressed air has been applied for obtaining automatic movements to a greater extent probably than in any other machines. The late Duane H. Church, for many years in charge of machine design at the Waltham factories, and one of the world's greatest inventors of automatic watch-making machines, was mainly responsible for the development of the various machines here described.

In connection with the description of the machines which follow, it may be well to refer first to the view of an open watch, Fig. 1, showing the plates which are used in its construction to form the supporting structure. Briefly, these are as follows: The pillar plate *A*, which is adjacent to the dial face of the watch and which is recessed for the reception of a number of wheels, and the barrel bridge *B*, balance cock *C*, and train bridge *D*, the three latter being classified as top plates. Between these top plates and the pillar plate is inserted the mechanism of the watch. The balance cock, as the name implies, contains the upper bearing for the balance wheel pivot and has a dome turned at its outer end on which the regulating finger is assembled. The train bridge contains the bushings or jewels for the upper pivots of the wheels which make up the wheel train. The barrel bridge is recessed for the winding wheels or gears.

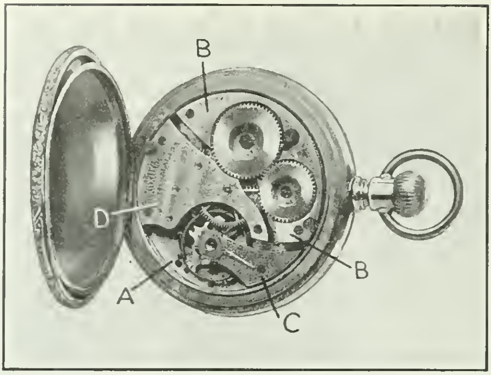


Fig. 1. Supporting Plates in a Waltham Watch

Plate Roughing Machine

The machine used to surface the barrel bridges, pillar plates, and train bridges is illustrated in Fig. 3, and contains three work-spindles, a tubular feed magazine at one end, and a delivery magazine of similar construction at the opposite end. The work is picked up by spring clips *A* and delivered by means of the carrier arms *B* from the feed magazine to the first spindle of the machine; simultaneously with this movement the other carrier arms are delivering the partly finished plates to the next spindle, and the last carrier arm is passing the finished plate from the spindle *C* to the delivery magazine, as shown at *D*. These carrier arms all operate in unison from a shaft located within the machine and operated longitudinally by an air cylinder at the farther end of the machine frame. The shaft has rack teeth cut in it at intervals, and as the shaft is moved back and forth the arms swing in unison, each on a vertical shaft which carries a pinion at its lower end, engaged by the rack teeth on the shaft. The tool-slides *E* are fed longitudinally and simultaneously by a cam on the opposite end of the machine, as the tools are fed across the face of the work at each station. The slides are returned to their starting position by springs.

The tubular feed magazine at the farther end, is similar in appearance to the delivery magazine *F*, and is connected at the rear with an air line, which advances the work to the front of the tube. It is prevented from pushing the work out, however, by spring jaws such as at *K*. When the work is to be picked up by the clip on the first carrier arm, these spring jaws are forced radially outward and the air advances the first piece of work into the clip where it is seated properly by being forced against a spring plunger which is advanced into a position similar to that shown at *G* at the delivery end of the machine. At the same time that this is occurring, the other carrier arms have swung to the left in readiness to receive the work from the various stations.

Provision has been made in the construction of the carrier arms to reverse the work when necessary, so that the same side of the plates may be presented to successive tools. This

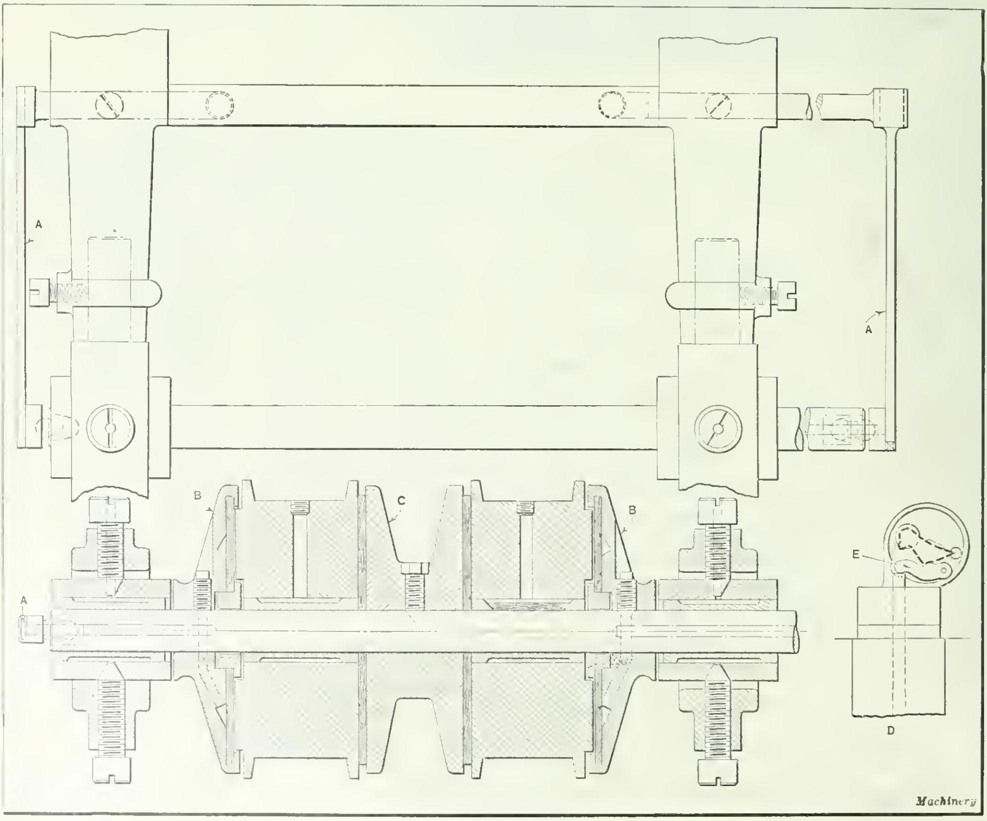


Fig. 2. Assembly of an Air Countershaft; also, at D, Partial View of an Air Chuck for Balance Cocks

is effected by an air cylinder *H* which delivers air to the arm in which the clips are carried as the port is opened at a certain point during the swing of these arms. The usual procedure in machining plates is to take two cuts on one surface at the first and second stations, so that the carrier which transfers the work between these stations must be provided with means for reversing the clip arms. Between the second and third spindles it is not necessary to reverse the work, because it should be deposited in the chuck in the third spindle in a reversed position for taking a cut on the opposite side. The tool carried in the last work station also provides for removing the sharp corners on the plates. The plunger which strips the finished work from the clip at the delivery station and forces it into the magazine is operated by a cam and lever, and when this tube is full it is an indication that the feed magazine at the opposite end is empty and must be replenished with fresh work.

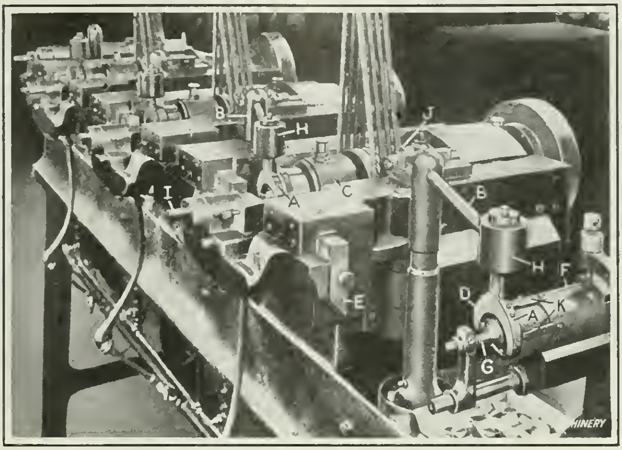


Fig. 3. Three-spindle Plate Roughing Machine for surfacing Watch Plates

As soon as the carrier arms have positioned the work in front of each chuck, the air plunger *I* advances with sufficient force to overcome the pressure exerted by a spring at the rear of each spindle and forces the work from the clips into the chuck jaws, which are thus opened and in readiness to receive the work. As soon as the air plunger recedes, the coil spring causes the chuck to advance sufficiently to grip the work. During the machining of each surface, the carrier arms swing back from the position shown in the illustration to a neutral position, where they remain until the work is almost complete, at which time they resume their movement, placing the clips in position to receive the finished plate as soon as the air-operated chuck is released and the spring advances the chuck. and forces the work into the clips.

The pieces shown beneath the delivery magazine are barrel bridges. When these parts are handled on this machine or when train bridges are surfaced, it is necessary, on account of the peculiar shape of the chuck required for holding these parts, to stop each spindle repeatedly in the same position, as otherwise the parts could not be entered into the formed jaws of the chuck. This requires the use of a one-lobed cam which can just be seen at *J* in back of the driving pulleys of the right-hand work-spindle. As air is admitted to the countershaft to reverse the direction of rotation, the lobe on this cam is brought up against a pawl which prevents reversal beyond this predetermined point and so stops the chuck properly for receiving the work.

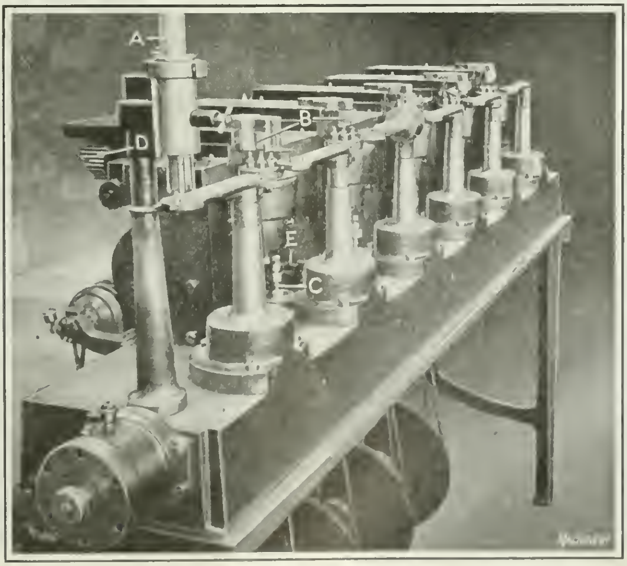


Fig. 4. Multiple-head Plate Drilling Machine of the Full Automatic Type

Multiple-head Plate Drilling Machine

Figs. 4 and 5 show front and rear views, respectively, of a five-head automatic drilling machine in which the numerous holes contained in a pillar plate are drilled, tapped, and countersunk. The plates are fed by gravity from a vertical magazine *A*, Fig. 4, in which they are suspended by spring clips according to the general arrangement described for the feed magazine used on the plate roughing machine. From its position beneath the magazine the carrier arm at the first station is raised until the chucking jaws at its end spread the spring jaws which hold the work and allow them to drop into place.

The six carrier arms oscillate in unison from an air-operated shaft, to deliver the work in various stages of completion, ready to be picked up by the spring jaws carried in chucks *B*. The work is located in these chucks above the tools, which are carried in turrets at each station and fed upward. The vertical driving spindle *C* located beneath the turret, is provided with a jaw-tooth clutch and driven by a twisted rawhide belt from the air countershaft shown at the rear of the machine, Fig. 5. One of the toothed cams carried on the camshaft *C* operates a lever to feed the spindle *C*, Fig. 4, upward against spring tension. This upward feeding movement is timed with the index of the turret, so that as the various spindles are successively brought into alignment with the driver, these may be rotated by the engagement of the clutch members on the two aligned spindles. Obviously, the use of the air countershaft permits the control of the direction of rotation as is required in the performance of tapping operations.

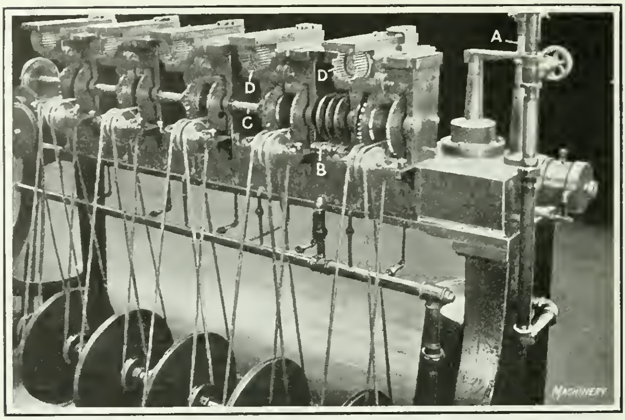


Fig. 5. Rear of Machine illustrated in Fig. 4, showing Cams for Regulation of Air Valves, Stops for limiting Slide Travel, and Driving Arrangement

With each index movement of the turret, there must, of course, be a corresponding relocation of the chuck in which the work is held, and compressed air is used for this purpose. Compound lateral and longitudinal movements of the chuck are obtained by the use of a cross-slide which rides on another slide that is capable of longitudinal movement. The release of the air valves for controlling these slides is effected by a series of cams carried on the camshaft *C*, Fig. 5, and the movements thus imparted to the top slide are limited by the stop-pins shown at *D*. The plate in which the stop-pins are carried, is indexed to bring successive pins into alignment with the bumper carried at the rear of the slide, so that by adjusting the amount of projection of these pins, the length of travel permitted by the application of air is controlled. The index plate is notched similarly to that shown at the right-hand end of the single-head drilling machine illustrated in Fig. 6, and is held in position by a pawl, which is located on the under side. This pawl is not discernible in the illustration Fig. 5.

There is another set of stops used for controlling the longitudinal movement of the under slide, but these stops are not shown in the illustration, being located at right angles to those shown and on the foot-end side of each station. Movement of the slides is positive and quick, and this series of movements in which the top slide reverses after each operation, slides longitudinally a predetermined amount, and is again advanced, must all transpire while the indexing of the turret is occurring.

Among other tools, the first turret carries three drills for drilling three dial foot holes which extend through the plate and which are used subsequently both in the remaining stations of this machine and in other machines to locate the plates by suitable dowel-pins. At the first station, the work is drawn up against a locating member in the chuck by a finger at the front, but at the other stations the pins only are used as a locating means. The arrangement of the driving mechanism is illustrated in Fig. 5, which shows the driving shaft, and the belting arrangement to the air countershaft by means of which the tools are reversed. This illustration also enables the air line installation employed on the machine to be seen and the levers *B* which are operated by the cams shown above them to actuate the air-valves. The front ends of these levers are shown at *E* in Fig. 4. The camshaft is driven by a worm and worm-wheel from a sheave shown at the extreme foot end of the machine, Fig. 5.

Single-head Drilling Machine

The single-head drilling machine illustrated in Fig. 6 is similar in operation to the multiple-head machine just

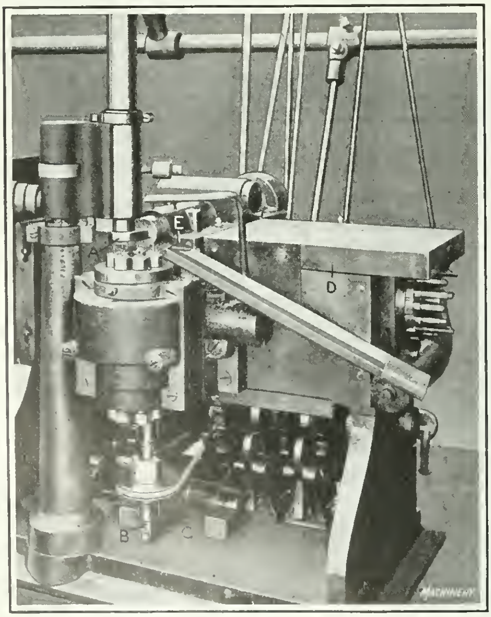


Fig. 6. Single-head Plate Drilling Machine operated similarly to Machine shown in Fig. 5

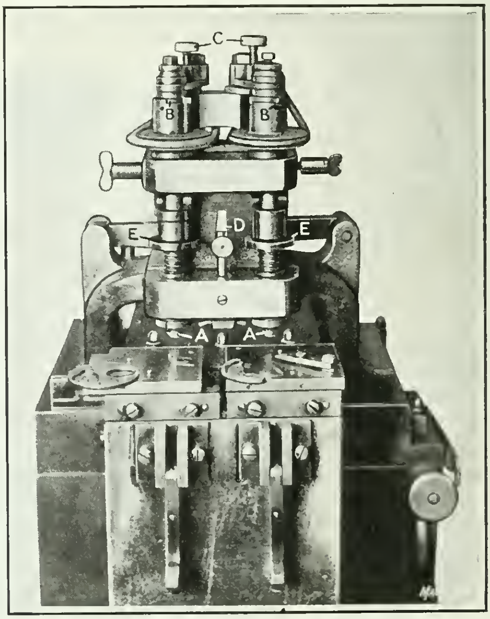


Fig. 7. Machine for taper-turning and taper-boring Steady Pins and Holes

described. Drilling, counterboring, and tapping operations are performed on train bridges, balance cocks, and pallet bridges on this machine. The feed arrangement, however, is somewhat different, this machine having its magazine located directly over the chuck and being equipped to deposit the pieces one at a time into the chuck, at the rate determined by the operation of the air valve which controls this release. The design of the chuck used in the operation shown in Fig. 6 is illustrated at *D*, Fig. 2. This chuck is used for holding balance cocks, and the position of the work is indicated by heavy dotted lines. A hinged finger *E* is operated by an air plunger, which bears against its outer end and forces the balance cock against the locating surfaces within the depression which carries them.

In Fig. 6 this chuck is indicated at *A* in the position that it would occupy during the drilling and tapping operations. The slide in which this work-holding chuck is mounted recedes, as determined by the operation of the air valves, to permit the chuck to be turned over and the opposite side of the work presented to the tools. This permits one chucking of the parts for drilling and tapping many more holes than would otherwise be possible. The levers and cams for operating the valves that control the movements of the slide, the indexing of the turret, and the feed of the spindles, are shown within the frame of the machine. The drive for the spindles is through driver *B* which is raised to bring the clutch on its upper end in engagement with the clutch on the spindles, by the cam-operated lever *C*, and this lever then transmits the feed to the spindles from a suitable cam. Disengagement of the driving spindle clutch to permit indexing of the turret is also taken care of by the design of this feed-cam.

Slide *D* in which the cross-slide *E* is carried is limited in its movements by a series of stop-pins carried in the plate at the right-hand end of the machine. Obviously, slide *D* must not only move to locate the work (in conjunction with the cross-slide) but also must traverse to the right in order to bring the chuck into position for discharging the work into the chute shown at the front of the machine. The opening of the chuck is accomplished by the release of the air which controls its action, as described in referring to the chuck in connection with Fig. 3.

Taper Turning and Boring Machine for Steady Pins

A machine for turning and boring steady pins is illustrated in Fig. 7. It is of the bench type and is used for simultaneously taper-boring previously drilled straight holes in pillar plates and for taper-turning a straight pin screwed into the barrel bridge. The machine provides for accomplishing these two operations with such a degree of accuracy that regardless of the slight variations in thickness of the two parts, they may subsequently be assembled with the assurance that the two tapers will accurately agree. The pillar plate is located on a finished table-plate which has three locating pins for engaging the dial foot holes in the pillar plate. Likewise, the barrel bridge is located by pins, and is clamped down by a suitable strap, as shown at the right in the illustration. These supporting tables are mounted on the machine so that they are free to slide, and they may be replaced when handling different sizes of watch parts.

The table of the machine is fed upward by air pressure until the work is brought in contact with stops *A*, which surround each tool, and at this point the tools start to operate so that the tapered surfaces produced by each, commence with relation to the top of the work and so assure the proper fit. Each spindle carries a tool-holder and a taper wedge against which the tools bear, and this cam action swings the point of the tool to produce the desired taper as the table continues to feed upward. At the top of the spindles there are specially designed clutches *B* which relieve the strain produced on the spindles by the belts, and thus diminish the amount of wear on the bearings. Screws *C* enable the adjustment of each spindle to be made as relocation of the vertical position of the spindles is required. A swinging key *D*, positioned between two spindles, may be dropped into a slot in either collar *E* to lock the spindle for convenience in removing or adjusting the tools. The positioning of these collars on the spindle is accomplished by the two gages shown suspended from the front of the machine; these are swung up on their hinges so as to engage the collars when making the setting. A pillar plate in which the holes are taper-bored is shown on the table at the left, and a harrel bridge at the right.

A description of additional types of watch-making machines will be given in the second installment of this series, which will appear in September MACHINERY.

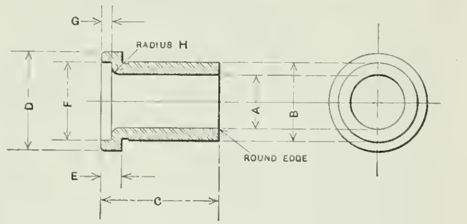
* * *

DRILL BUSHINGS WITH LUBRICANT RETAINING FEATURE

By F. W. SHUMARD

When parts made from drop-forgings, aluminum, or some of the various alloys are to be drilled in a jig, the use of a cutting compound or soluble oil is necessary. A large percentage of the lubricant employed, however, usually does not enter the drill bushing. Unless the lubricant is fed from a pipe line having a continuous flow, it is general practice to apply it to the tool with an oil-can or brush, and much of it is lost in this way, especially if the tool is revolving at high speed.

DIMENSIONS OF LUBRICANT-RETAINING DRILL BUSHINGS



All dimensions in inches.

A	B	C	D	E	F	G	H
1/16	3/16	7/16	5/16	3/32	7/32	1/32	1/32
⅛	¼	½	⅜	3/32	¼	1/32	1/32
3/16	5/16	9/16	½	⅛	5/16	1/16	1/32
¼	7/16	11/16	⅝	⅛	7/16	1/16	1/16
5/16	½	¾	11/16	5/32	½	1/16	1/16
⅜	9/16	13/16	¾	5/32	9/16	1/16	1/16
7/16	⅝	1	13/16	3/16	⅝	3/32	1/16
½	¾	1⅛	15/16	3/16	¾	3/32	1/16
9/16	13/16	1¼	1 1/16	7/32	13/16	3/32	3/32
⅝	⅞	1⅜	1⅛	7/32	⅞	3/32	3/32
11/16	15/16	1½	1 3/16	¼	15/16	3/32	3/32
¾	1 1/16	1⅝	1 5/16	¼	1 1/16	3/32	3/32
13/16	1⅛	1¾	1 7/16	¼	1⅛	3/32	3/32
⅞	1¼	1⅞	1 9/16	9/32	1¼	⅛	3/32
15/16	1 5/16	2	1 11/16	9/32	1 5/16	⅛	⅛
1	1⅜	2⅛	1 13/16	5/16	1⅜	⅛	⅛

Machinery

The accompanying table gives the dimensions of a line of drill bushings that are counterbored at the flanged end. This counterbore acts as a reservoir, or retaining chamber for the lubricant and thereby saves much of the fluid which would ordinarily be wasted. The over-all length *C*, as given, allows for a tool bearing length of about twice the drill diameter, which is standard practice for drills of ¼-inch diameter and larger. Drawings showing bushing details should always specify the rounding of the bottom edge of the hole, since a sharp edge causes the cutting tool to wear rapidly.

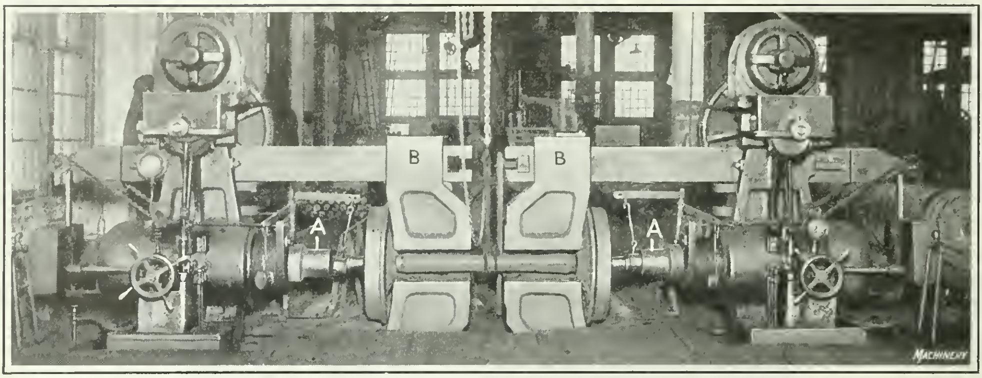


Fig. 1. Duplex Hydraulic Press used for pressing Car Wheels off their Axles

Railway Machine Shop Practice

Methods of Procedure in Making Common Types of Repairs that are Required on Passenger and Freight Cars—Fifth of a Series of Articles

Among the commoner jobs which come to the car repair department of railway machine shops, mention may be made of the re-turning of wheel treads, and of the journal bearings and wheel fits on the axle. Where it is required to re-turn the treads of a pair of wheels that have already been pressed on an axle, it will be apparent that considerable time would be saved by being able to handle this work without removing the wheels from their axle. Also, if the treads of both wheels could be turned simultaneously, a proportionate saving would be effected. Provision for accomplishing both these results has been made in the design of a machine built by the Niles Tool Works of the Niles-Bement-Pond Co., in Hamilton, Ohio. It consists of a machine set in a pit, so that the car wheels on their axle can be rolled into place for machining without lifting them from the floor.

A machine of this type is shown in operation in Fig. 2. There is a large herringbone driving gear at the center of the machine, which has a removable segment in its rim. This segment can be taken out to admit the axle carrying the wheels that are to have their treads re-turned. The axle is chucked at the middle, and there are two toolposts, one on each side of the driving gear, carrying tools that simultaneously turn the two wheel treads. In re-turning a pair of wheels in this way, a sequence of tools is used. Roughing and intermediate cuts are taken with suitably shaped tools, and a final finish-turning operation is performed with a formed tool that fits over both the flange and the tapered tread of the wheel and insures turning the work to exactly the required form. Gages of the form shown at *A* are employed to refinish all of the wheels on a car, to exactly the same size.

Pressing Wheels off their Axles

Fig. 1 illustrates a duplex hydraulic press built by the Niles-Bement-Pond Co., 111 Broadway, New York City, which is used for simultaneously pressing two wheels on or off their axles. In this illustration, the machine is shown pressing two wheels off their axles in order to re-turn the journals and the fits for the wheels. Tracks are laid in the floor to facilitate rolling the wheels up into place between the rams of the press. The two plungers *A* occupy a fixed position, and the rams *B* are drawn away from the work, so that they pull the wheels off their fits on the axle. After

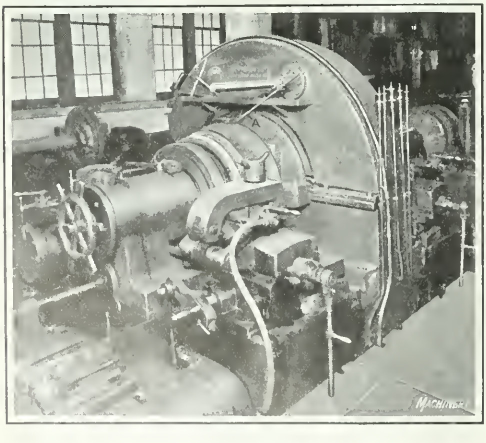


Fig. 2. Car-wheel Lathe used for re-turning Treads of Wheels while in Place on their Axle

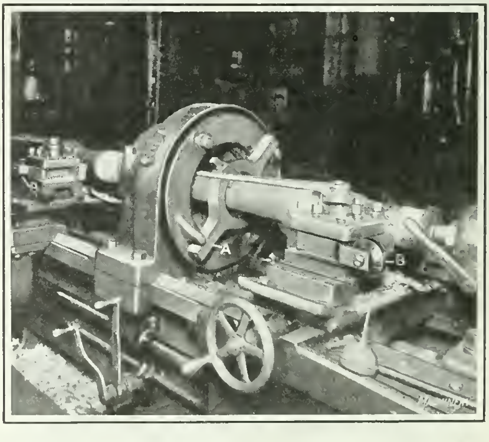


Fig. 3. Duplex Axle Lathe with Center Drive, used for turning Journals and Wheel Fits on Axles

this has been done, the axle is ready to go to a special type of lathe on which the required re-turning operations are performed.

Re-turning the Journals and Wheel Fits on Car Axles

Fig. 3 illustrates a duplex axle-turning machine built by the Putnam Machine Co., of Fitchburg, Mass., which is equipped with two toolposts and a centrally located chuck, so that provision may be made for simultaneously refinishing the two wheel fits and the two journals at opposite ends of an axle. It will be seen that a double-ended driving dog *A* is attached to the axle, and the tails of this dog come into contact with drivers on the centrally located driving gear, thus providing for rotating the work from the middle so that a carriage and toolpost can be mounted at each end of the lathe. It will be seen that a turret toolpost is provided on each of the carriages, and these toolposts carry the required sequence of tools for the performance of rough- and finish-turning operations. After these cuts have been taken, the final operation is performed, which consists of burnishing. This is done by means of a roller *B* carried by a tool shank held by each of the turret toolposts. Each roller is made of hardened steel, and after the finishing cut has been taken, it is pressed hard against the turned surface of the work; then the carriage movement provides for feeding this roller along the turned surfaces while the work rotates continuously. Experience has shown that the application of this method provides for rolling or burnishing down the surface of the work and imparting to it an excellent finish. The three jobs illustrated in Figs. 1 to 3 are shown in process in the Burnside shops of the Illinois Central Railroad Co., in Chicago, Ill.

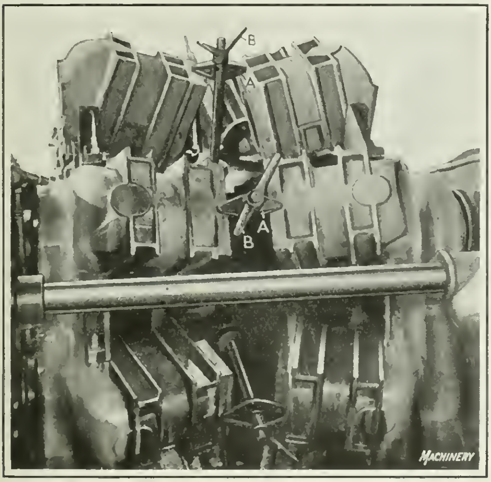


Fig. 4. Continuous Rotary Milling Machine for milling Cover Seat on Malleable Iron Railway Car Journal Boxes

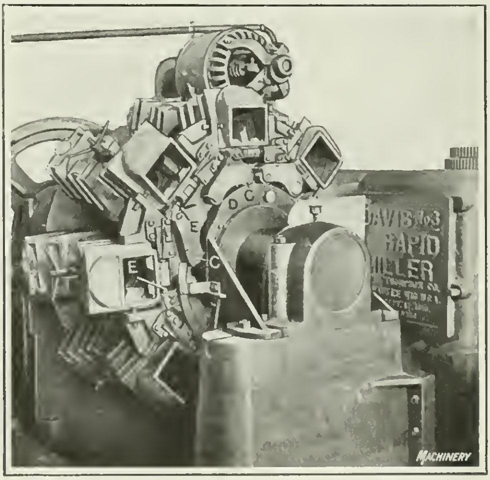


Fig. 5. Close-up View of the Work, showing Hand-operated Auxiliary Clamps which hold Each Casting at the Center

Special Continuous Milling Machine for Railway Car Journal Boxes

To provide for milling malleable iron railway car journal boxes in quantities, the Davis & Thompson Co., 251 Reed St., Milwaukee, Wis., has recently placed on the market the continuous rotary miller which is shown in operation in Figs. 4 and 5. With a plain milling machine, an operator was able to mill 220 journal boxes in a ten-hour day, but owing to the reduction of idle time of both the machine and the operator effected through applying the continuous rotary principle of milling, this machine has produced a full day's output at the rate of 105 castings per hour. However, this placed too heavy a demand on the operator for continuous production, although the machine is found capable of working at the rate of 80 journal box castings per hour without over-exertion on the part of the operator.

An important point in this connection is the fact that the work-holding fixture provided on this machine takes four different kinds of journal boxes, that is, practically all types that are in common use on American railways at the present time. The end of the journal box opposite the face to be milled rests on a small bracket which prevents it from tipping downward. When the operator has put two journal box castings into place, he simply slips on a slotted clamp *A*, Fig. 4, and tightens the wing-nut *B*, which prevents the work from slipping. As the drum of the continuous milling machine rotates, the roller mounted on each locking lever *C*, Fig. 5, runs up on a cam *D*, pushing a hardened pin *E* into the eye of the car journal box, and holding it in position while milling.

To those who are familiar with the general features of the continuous rotary millers built by the Davis & Thompson Co., it will be apparent that the present machine follows features of the previously established lines of design by having the two sides of the same general construction. The cutters are freely lubricated as shown in Fig. 4, in which the light streaks on the journal box show the lubrication flowing over the cutters and work. This machine is set up on a concrete foundation and returns all of the lubricant to a settling tank in the base of the machine, from which it is drawn for subsequent use.

* * *

The airship recently built by William Beardmore & Co., Ltd., England, and designed by the Admiralty for naval service, but which has been fitted with a passenger car providing day and night accommodations for fifty persons, is said to resemble in structure the airship which completed the double journey across the Atlantic in July, 1919. The actual over-all length of the new airship is 672 feet 2 inches, while the maximum diameter of the hull is 78 feet 9 inches. The height from the bumping-box to the top of the hull structure is 91 feet 7 inches. There are nineteen gas bags with a total capacity of 2,196,000 cubic feet, which give a gross lifting capacity of 64 tons under normal conditions. Of this, 16 tons is available for fuel, passengers, and freight. The aggregate horsepower of the five engines is 1570. The maximum speed with this power equipment is 65 miles per hour, while the normal cruising speed is about 50 miles per hour. At the latter speed, a range of action of a little more than 4000 miles is obtainable.

Organization of Large Contract Plants

First of a Series of Articles Dealing with the Organization of Plants Making a Variety of Products, and the Establishment of Planning, Dispatching, and Recording Systems

By GEORGE H. SHEPARD, Professor of Industrial Engineering and Management, Purdue University

PLANNING and dispatching are often the first principles of management to be applied in the organization of a plant manufacturing a large variety of products on a contract basis, or engaged in repair work, and as a result of such planning much practical benefit is derived almost immediately. This is due to the importance of foresight, advance preparation, coordination, and teamwork among the different departments, and to the impossibility of securing these advantages except through planning the procedure of the various jobs through the shops. The development of planning and dispatching systems includes the installation of adequate and reliable recording systems.

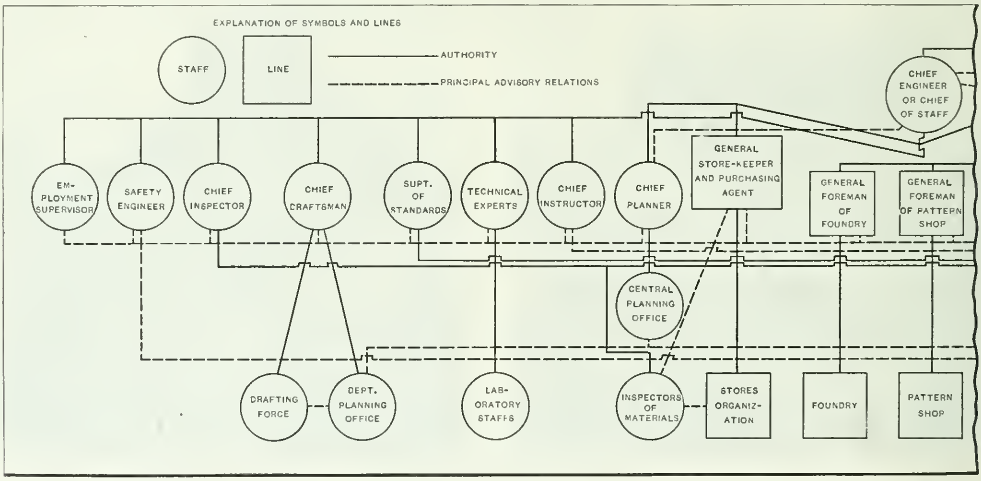


Fig. 1. Graphical Presentation of a Model Line and Staff Organization for a Large Jobbing or Contract Plant manufacturing

A fundamental principle of planning is to furnish definite information to shop executives as to the priority of work. Such data are often lacking, and, as shop supervisors are subjected to conflicting and insistent demands for deliveries from many different sources, the result is the starting and stopping of jobs in obedience to the last, most insistent, or most authoritative demand; the tearing down of set-ups only partly used; and general inefficiency.

Establishing Priority List of Jobs in Plant

The complete establishment of priority on all work is an ideal which is only gradually approachable and, in one hundred per cent realization, is unattainable and probably undesirable. However, it is both feasible and desirable to publish the priority of the main jobs of the plant. The way in which such a list may be arranged is illustrated in Fig. 3. This priority list should form the basis of the entire planning of the plant; its preparation is worthy of the personal attention of the general manager, and it should be prepared at a routine daily meeting of the general manager, the works manager, the chief engineer, and such department heads as the general manager considers should attend. Such meetings are usually held for other purposes, and so should not require much additional time. The chief planner, or, as he is frequently called, the production manager, should submit the order of jobs for the next working day at each meeting for revision and approval; its consideration requires only brief attention by those present.

A copy of the approved order should then be furnished promptly to every immediate subordinate of the works manager and the chief engineer, to the chief draftsman, heads of laboratory staffs, general and other foremen, and departmental chief planners. The laying out of schedules such as shown in Fig. 3 requires the immediate installation of the rudimentary planning staff known as "order chasers." These men watch the progress of orders, call the attention of the departmental supervisors to any job that is lagging, trace needed parts, and, in general, act as the direct representatives of the superintendents and foremen to keep up the necessary watchfulness over such orders as must come through on a close schedule, and help these department heads to attain the necessary cooperation of workmen. Order chasers are, however, only a makeshift, because a reasonable number of them cannot follow up more than a few of the most important orders.

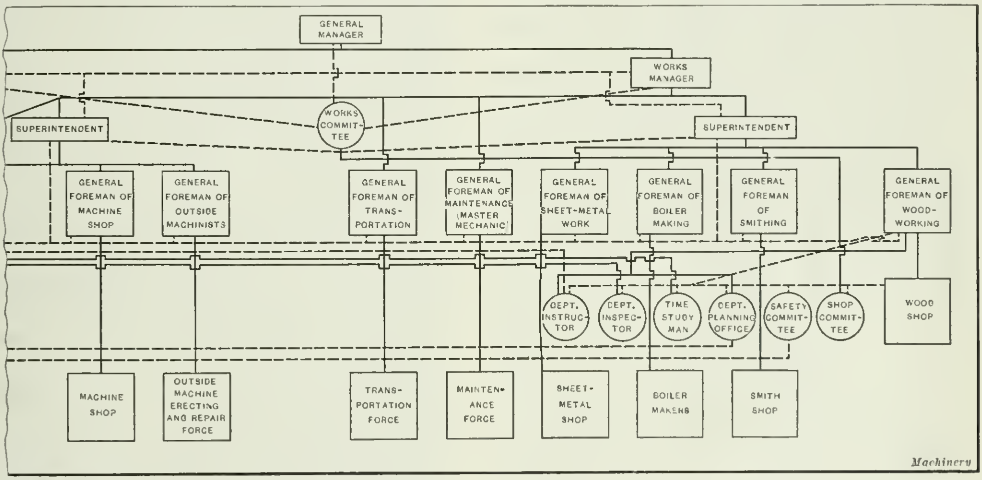
Insufficient Number of Shop Executives in Contract Plants

The further development of planning and dispatching systems must proceed step by step with improvements in other directions, of which one of the most important is that of establishing an efficient organization. Contract or jobbing shops are likely to have an insufficient number of shop executives who are burdened with details and especially those of planning and order chasing.

The continual variation of contract work makes it difficult to produce similar parts in quantities sufficient to warrant the attention of those high up in the organization. This condition necessitates machines designed for general work, instead of specialized types; all-around mechanics instead of machine operators; and abundant and skilled supervision of the work, more often than detailed study by technicians in a distant office or laboratory. Jobbing work usually includes a great deal of repair work, and as many of these jobs are emergency cases, most of them are in a rush. This condition calls for prompt and correct decisions by the men in immediate charge of the work, with comparative freedom from referring matters to those higher up for decision. The correct making of such decisions can only be obtained by having a strong, adequate, and competent supervisory force.

Organization of a Large Contract Plant

The organization and instruction of a supervisory force are important factors in the management of a contract plant. Attempts have been made to set hard and fast rules governing the number of supervisors of different grades there should be in a shop, as compared with the number of mechanics or other workmen, but such attempts have been incorrect in principle. An assistant foreman in a well-ordered shop, which is entirely visible from his desk, may successfully direct a large force of skilled mechanics. Another, with unskilled or semi-skilled men scattered about in positions of which no general view is possible, may find four or five men all that he can take care of. A study of individual conditions is necessary to make a correct decision as to the number of supervisors required.


GENERAL MANAGER
WORKS MANAGER
WORKS COMMITTEE
SUPERINTENDENT
SUPERINTENDENT
GENERAL FOREMAN OF MACHINE SHOP
GENERAL FOREMAN OF OUTSIDE MACHINISTS
GENERAL FOREMAN OF TRANSPORTATION
GENERAL FOREMAN OF MAINTENANCE (MASTER MECHANIC)
GENERAL FOREMAN OF SHEET-METAL WORK
GENERAL FOREMAN OF BOILER MAKING
GENERAL FOREMAN OF SMITHING
GENERAL FOREMAN OF WOOD-WORKING
DEPT. INSTRUCTOR
DEPT. INSPECTOR
TIME STUDY MAN
DEPT. PLANNING OFFICE
SAFETY COMMITTEE
SHOP COMMITTEE
WOOD SHOP
MACHINE SHOP
OUTSIDE MACHINE ERECTING AND REPAIR FORCE
TRANSPORTATION FORCE
MAINTENANCE FORCE
SHEET-METAL SHOP
BOILER MAKERS
SMITH SHOP
Machinery

a Diversified Line of Products. All Activities Other than those directly connected with Production are organized as Staff

The organization of a contract wood- and metal-working plant employing about six thousand men is illustrated diagrammatically in Fig. 1, in which the departments, foremen, superintendents, etc., considered in the "line" section of the organization, are represented by squares, while those considered in the "staff" section are denoted by circles. Attention is called to several points in connection with this diagram. Much repairing and erecting is done outside the plant on the premises of customers; nevertheless, a unified control is preserved at all times by the works manager, through the superintendent and foremen. All activities other than those directly connected with production are organized as staff, and staff functions are entirely advisory. The purpose of this arrangement is to obtain undivided authority and responsibility in the line management of managers, superintendents, and foremen, and, at the same time, to give the line officers the benefit of expert advice from those on the staff.

In order to secure the necessary independence of inspection, the inspecting staff is not under any line authority below that of the general manager. The inspection force of any department is in an advisory relation to the department and under the authority of the chief inspector only, who is under the chief of staff, the latter, in turn, being under the general manager. The inspection staff is, of course, authoritative in passing on the quality of products.

The technical experts are organized strictly as staff, and are without authority over the directly productive organization. These technicians are often organized as line superintendents with functional authority over the foremen. In a manufacturing plant where all activities are capable of a much higher standardization and much closer definition, this scheme may work satisfactorily, though, in general, it is better to preserve unified control in the line and to put all functional control into the staff. In a contract plant, however, it is impossible to differentiate functions clearly enough to avoid conflict of authority and division of responsibility, if the technical experts are made line officers. The line is thus made completely and solely responsible for production, and this burden of responsibility will cause line officers to seek and follow competent staff advice.

Planning is shown under functional control, the works manager having authority over the chief planner as to what work shall be planned, the priority the various jobs shall be given, and the different dates to be scheduled for the productive departments. The chief of staff has authority over the chief planner as to methods of planning, dispatching and keeping records, and the use of standards of labor, materials, etc., as determined by the superintendent of standards who is commonly known as the head of the "rates" or "time study" department. Authority over any departmental planning office is similarly functionalized between the line head of the department to which it is attached and the chief planner, through the central planning office.

In order to plan and dispatch a contract plant successfully, it is necessary to decentralize the planning organization and function, and to allow ample discretion and authority to the people on the job. As to the line organization, the pattern, foundry, and machine shops and the outside machine erecting and repair force, each under its own general foreman, are brought together under one superintendent, because of the close interdependence of these four shops. The sheet-metal, boiler, and smith shops are brought together for the same reason, and the wood shop is added to balance this superintendency with the other. The superintendents are likely to be omitted in an organization, leaving every general foreman to report directly to the works manager. This method results in overburdening the latter with details that should be handled by subordinates, and also in

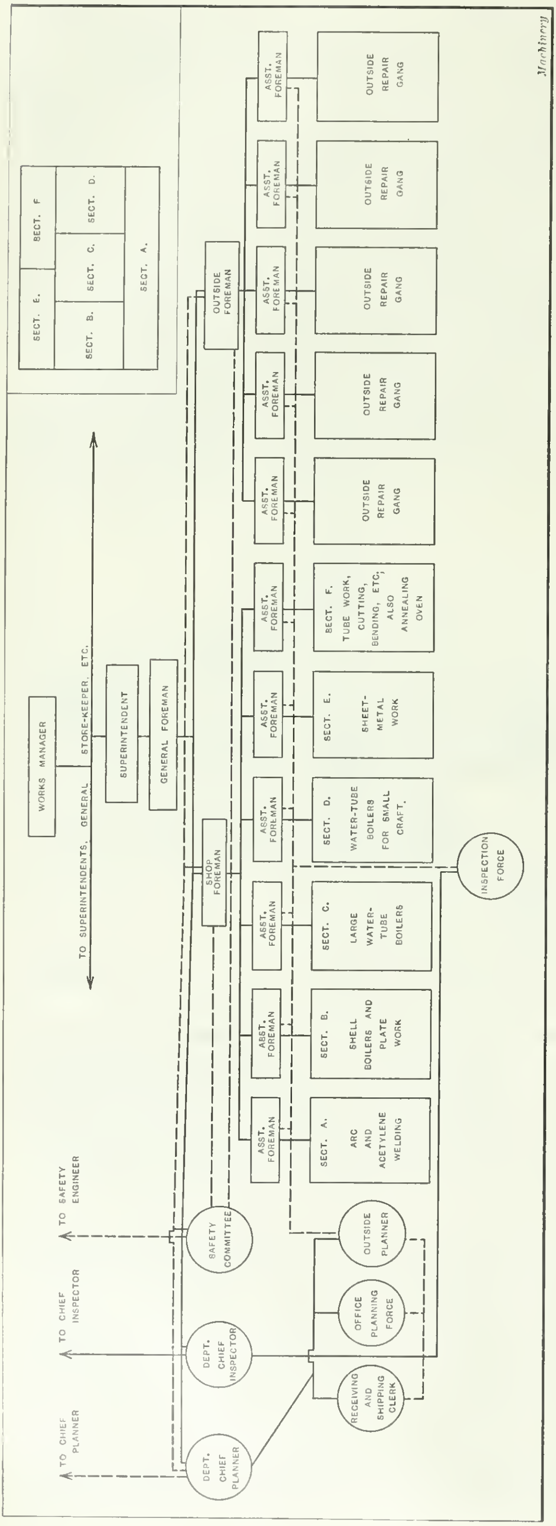


Fig. 2. Diagram illustrating Manner in which the Management of a Large Boiler Shop was reorganized for Greater Efficiency

poorer coordination between different shops than could be obtained if a closely related group had a line chief of its own.

The general store keeper and purchasing agent is made direct line subordinate to the works manager, so as to give the latter the necessary control of materials. It is common to find the purchasing agent of equal rank with the works manager and reporting directly to the general manager. In order to relieve shop foremen of attention to maintenance and transportation, to make sure of having equipment in condition for use and of having transportation equipment on hand, and to avoid breakdown of plans from failure in these respects, transportation and maintenance of equipment are each organized under a general foreman, who is responsible directly to the works manager. The plant under consideration was strongly unionized, and the representatives of the workmen constituted the works committee and the shop committee as shown. It would be unnecessary to give all the details of the departmental organizations; therefore only the departmental staff of the woodworking shop and its relation to the higher staff organization is shown.

Reorganization of a Boiler Shop

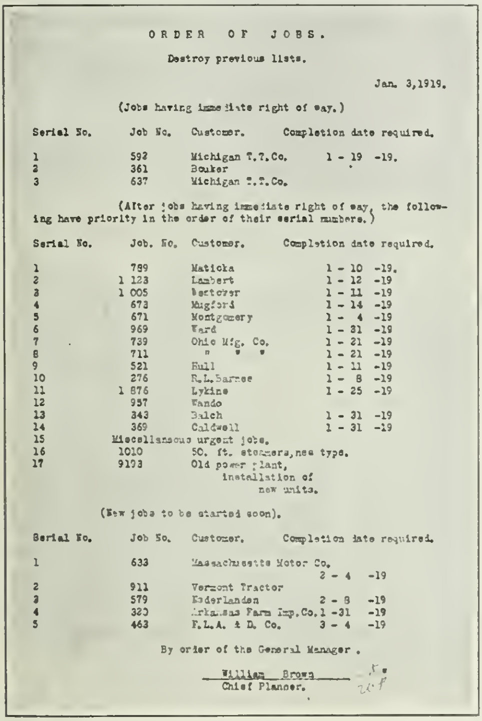
The reorganization of a boiler shop, of which the present managing arrangement is illustrated in Fig. 2, was undertaken with the following aims in view: To obtain adequate line supervision; to functionalize the line supervision; to locate responsibility more definitely; and to obtain adequate planning, dispatching, inspection, and instruction.

The assistant foremen in this shop had previously no definite sections, but were assigned by the foremen to certain jobs. An examination of the shop showed that it was adapted to the localization of work, as shown in the upper right-hand corner of Fig. 2, in which the classes of work handled in the different sections are as follows: Section A, arc and acetylene welding; Section B, shell boilers, stacks, condenser shells, and other plate work; Section C, large water-tube boilers; Section D, repairs to water-tube boilers of a special type; Section E, casings, small sheet-metal stacks, ash-pans and other sheet-metal work; and Section F, annealing and preliminary work on tubes, receiving them as they come from the tube mills and delivering them to Sections B, C, or D for installation in boilers.

By this localization it was possible to select assistant foremen who were specialists in the several lines of work, giving each of them supervision over his own specialty, and to keep the work on that specialty concentrated in a definite section of the shop. The outside work of overhauling, repair, and erection is, of course, variable in quantity and often extremely urgent. This requires the whole organization to be flexible, and so foremen are given authority to make such temporary shifts or reassignments of their personnel as is necessary. The usual practice, in case more assistant foremen are needed outside, is for the general foreman to draw them from the shop. The shop foreman then temporarily divides the sections of those assistant foremen taken away among those who remain. When the outside work lessens, the general foreman first returns shop assistant foremen to their respective sections and then sends temporarily spare outside assistant foremen to the shop foreman.

Outside Planners and Meetings of Shop Supervisors

This shop has a large amount of work which must first be disassembled and examined, repairs then being made as found necessary. In work of this kind, planning problems can best be solved by employing outside or "liaison" planners who serve as connecting links between the planning office and the shop. These men spend a great deal of time in the shop personally examining jobs, and keep the planning office in touch with developments. One of their main functions is to exercise that foresight which is so often lacking in repair work, and especially in emergency repairs. As soon as the need for any work appears, they also make preparations for its efficient performance. In large shops the chief outside planner has the rank of an assistant foreman and decides the details of a blanket order for overhaul and repairs. The use of competent men in these positions is a valuable source of economy. The departmental chief planner has the earliest information as to what materials will be needed and when, and should have immediate information concerning both arrivals and shipments. It is therefore advisable to put the departmental receiving and shipping clerk directly under his supervision.



O R D E R O F J O B S .

Destroy previous lists.

Jan. 3,1919.

(Jobs having immediate right of way.)

Serial No.	Job No.	Customer.	Completion date required.
1	592	Michigan T.T.Co.	1 - 19 -19.
2	361	Bouker	
3	637	Michigan T.T.Co.	

(After jobs having immediate right of way, the following have priority in the order of their serial numbers.)

Serial No.	Job. No.	Customer.	Completion date required.
1	789	Maticka	1 - 10 -19.
2	1 123	Lambert	1 - 12 -19
3	1 005	Westover	1 - 11 -19
4	673	Mugford	1 - 14 -19
5	671	Montgomery	1 - 4 -19
6	969	Ward	1 - 31 -19
7	739	Ohio Mfg. Co.	1 - 21 -19
8	711	" " "	1 - 21 -19
9	521	Hull	1 - 11 -19
10	276	R.L.Barnes	1 - 8 -19
11	1 876	Lykins	1 - 25 -19
12	957	Wando	
13	343	Balch	1 - 31 -19
14	369	Caldwell	1 - 31 -19
15	Miscellaneous urgent jobs.		
16	1010	50. ft. steamers, new type.	
17	9193	Old power plant, installation of new units.	

(New jobs to be started soon).

Serial No.	Job No.	Customer.	Completion date required.
1	633	Massachusetts Motor Co.	2 - 4 -19
2	911	Vermont Tractor	
3	579	Nederlanden	2 - 8 -19
4	320	Arkansas Farm Imp.Co.	1 -31 -19
5	463	F.L.A. & D. Co.	3 - 4 -19

By order of the General Manager .

William Brown
Chief Planner.

Fig. 3. Priority List showing Successive Order in which the Various Jobs in a Plant are to be completed

Meetings of shop supervisors, except meetings of managers and superintendents with the general foremen, should be held with groups only. The supervisors of one shop of a thousand men make by themselves a group as large as it is desirable to handle at once. The supervisors of smaller shops may be assembled in one meeting, bringing together shops which must cooperate closely. In a large contract machine shop, meetings which proved valuable were those especially devoted to planning. In these meetings the various foremen and the departmental chief planner were brought together daily to consider the schedules laid out by the planning office and to devise ways and means of meeting them. These meetings distinctly improved teamwork among the sections of the shop, brought out many good suggestions and greatly reduced the number of deliveries overdue.

Comment on Organization Diagrams

The organization diagrams in Figs. 1 and 2, show graphically a disadvantage of a strong line organization, in that the latter tends to separate along distant lines of cleavage from top to bottom, to the detriment, even to the destruction, of teamwork. The cross lines of staff activity correctly represent the fact that a good staff organization binds together the separate line units and produces the necessary cooperation among them. The function of the order chasers in bringing about cooperation is of permanent value. In this capacity they may well be retained as part of the fully developed planning staff. The dotted line of advisory relations connecting the departmental planning offices in Fig. 1. may then represent the activity of a modified order chaser, but this activity may be exercised through telephone or mail communication only, except where cooperation between departments is especially important or difficult. Order chasers may also be developed into the outside planner in Fig. 2.

The necessary connection between two shops may require even more attention than provided in the foregoing. Considerable trouble in this respect was experienced between a foundry and the machine shop to which most of its castings were delivered. The works manager finally ordered the chief planners of the pattern shop, foundry, and machine shop, together with a progress man from the central planning office, to meet daily. A few hours before the daily meeting, the chief planner of the machine shop sent to the chief planners of the foundry and pattern shop a list of the castings that he wanted on the next day; and, based on this, the chief planner of the foundry submitted to the meeting a list of the castings scheduled to be poured the next day The meeting revised this list, if necessary, and finally issued a satisfactory one. These meetings proved to be very successful in producing the necessary cooperation.

The next article in this series will be published in November MACHINERY.

* * *

THE BASIC "INDUSTRY"

We frequently think of the iron and steel industry or some other industry with which we are most familiar, as being the greatest and most important of the industries of the country upon which the prosperity of business mainly depends. But after all, the present business depression has shown that the country's prosperity depends largely on the buying power of the farmer. Nearly one-third of the people of the United States—or more than 30,000,000—live on farms. Nearly 20,000,000 live in communities having a population of less than 2500 and depend for their well-being mainly upon the prosperity of the farmer. In other words, nearly one-half of the population of the United States is directly dependent upon the farms for its income and its purchasing power. When this large part of the population begins to curtail its purchases to a minimum, as has been the case since the fall in the prices of farm products, every industry in the country suffers. In 1919 the value of the farm property in the United States was estimated at more than $50,000,000,000, or more than the combined capital of all the manufacturing establishments, railroads, mines, and quarries in the country. The value of the output of the farms at pre-war prices is estimated at $8,000,000,000.

* * *

THE LYONS FAIR

The fair to be held at Lyons, France, October 1 to 15, 1921, will be of great importance in the promotion of international trade. Full particulars will be furnished by the official delegate for the United States, Emile Garden, 150 Nassau St., New York City.

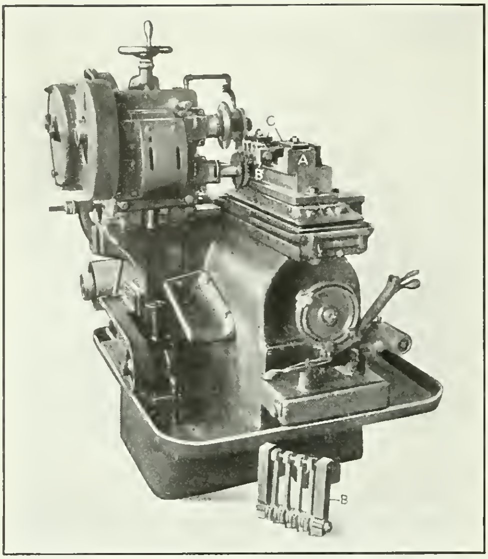


Fig. 1. Automatic Milling Machine equipped with Two-spindle Head for performing Milling Operations on Chevrolet Engine Connecting-rods

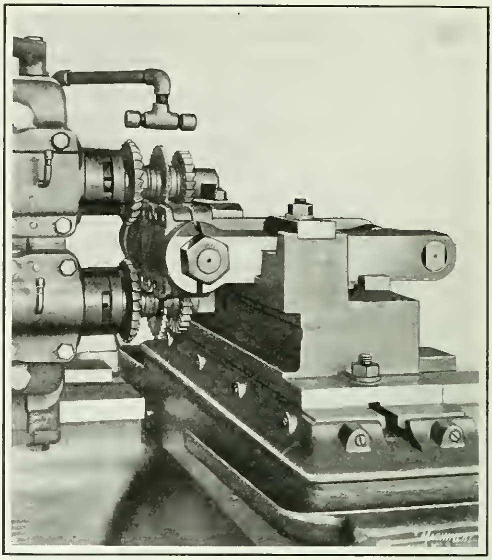


Fig. 2. Close-up View of Automatic Milling Machine equipped with a Duplex Head, as shown in Fig. 1, used for milling Hinkley Connecting-rods

Milling Automobile Connecting-rods

Equipment and Methods Used in Machining Chevrolet, Hinkley, and Duesenberg Connecting-rods

By J. M. HENRY, Engineer, Pratt & Whitney Co., Hartford, Conn.

THE writer has been very much interested in recent articles, published in MACHINERY, describing the manufacture of automobile connecting-rods for various types of motors. In this connection, he believes it would be interesting to present a description of the latest methods employed by the Pratt & Whitney Co., of Hartford, Conn., in equipping automatic milling machines of their manufacture for such work. The adaptation of a two-spindle head to the Pratt & Whitney standard machine has materially simplified the milling of rods, increased production, and cut costs to a considerable extent. A machine designed for handling Chevrolet rods is shown in Fig. 1. In this case the under side of the screw bosses is finished, the cap is cut off and the dipper on the cap, which provides for splash lubrication, is trimmed to length. The work-holding fixture is very simple. It consists of a base *A* having seats machined on it to receive the loading fixture *B*, which is held in place by two straps *C*. The loading fixture consists of a stationary strap with two arbors mounted in it, and a removable strap for loading and clamping the work. The arbors are hardened and ground to fit the crankshaft and wrist-pin holes in the connecting-rods, the large arbor being relieved to provide a two-point bearing in the crankshaft hole.

Provision for Locating the Work

As the tolerance allowed for center distance between these holes is 0.020 inch, the arbor at the wrist-pin end is made sufficiently under size to compensate for this variation. The straps at the crankshaft end, where the milling actually takes place, are cut away so that a two-point bearing is provided on the face of the cap. This is necessary as the rods are rough-forged at this point. In addition, the removable strap has bell-mouthed holes, which facilitate mounting it in place when it is ready to be clamped. The larger arbor, at the crankshaft end of the rod is threaded for a hexagonal nut which does the actual clamping of the rods, the arbor at the small end merely serving as a locating bar.

Binding of the loading fixture in the base may be expedited by the use of a single lever at the operator's end of the base, which will operate the two binding clamps at the same time; this would do away with the two hexagonal nuts and the loose wrench. A groove in the straps, corresponding to a tongue in the fixture base, provides for locating the loading fixture in the correct relation to the cutters. A close-up view of the two-spindle machine working on Hinkley connecting-rods is shown in Fig. 2.

The operations on these connecting-rods consist of cutting off caps $\frac{1}{2}$ inch deep by $1\frac{5}{8}$ inches long, cutting off the end of the dippers, and milling the ends of the screw bosses. The material is carbon steel forgings containing from 0.35 to 0.45 per cent of carbon. For milling a load of four rods, the total table travel is 8 inches, and the table is fed at the rate of 5.39 inches per minute. The maximum cutter speed, based on the diameter of the saw and the speed of spindle rotation, is 116 feet per minute. For loading and unloading four forgings, the time is one minute forty-five seconds, and thirty seconds are required to take out and replace the loading fixture *B* in the base fixture *A*. The time for completing one cycle of operations is one minute twenty-five seconds, which includes the high-speed advance of the table from the loading point to the cutting position, feeding through the work, and the return of the table at high speed to the loading position. This cycle of movements is automatically controlled. On this milling operation the production is from 100 to 120 connecting-rods per hour.

Use of a Single-spindle Machine for Milling Connecting-rods

Where the production is such that it is not necessary to use the machine continuously for the work on which it is engaged, the selection of a single-spindle machine may be advisable, so that it may be released for other work. Such is the case on the machine used for milling Duesenberg connecting-rods, as shown in Figs. 3 and 4. Under these conditions, the loading fixture is turned over and a second cut taken on the opposite side of the work to complete the milling operation. It will be noted that the screw boss is milled on the cap at a slight bevel, thus providing for clearance. The fixture used is practically the same as the one previously described, with the exception that the arbor at the wrist-pin end is removable, being provided with a knurled handle for this purpose. The end fitting into the removable strap is squared off to give a four-point bearing for easy locating and to minimize the friction.

In this case it will be seen that five forgings are set up in the fixture at a time, and for milling such a load of work the total length of cut is 11¼ inches. The table is fed at a rate of 3.19 inches per minute and the cutter speed is 65 feet per minute. The time required for loading and unloading five pieces in the fixture is two minutes thirty seconds; and the time for placing the loading fixture in the base and clamping it in place, is forty-five seconds. For releasing the loading fixture, turning it over and reclamping on the base, an additional forty-five seconds is consumed, and the actual cutting time for two cuts is seven minutes thirty seconds. On this complete cycle of operations the rate of production obtained is twenty-five connecting-rod forgings per hour.

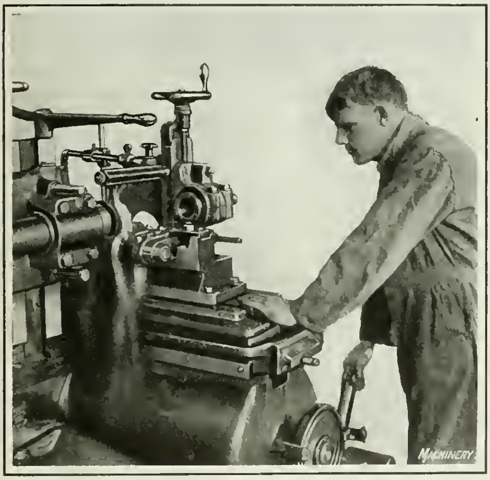


Fig. 3. Automatic Milling Machine with a Single Head, used for milling Duesenberg Connecting-rod Forgings at Two Settings of the Work

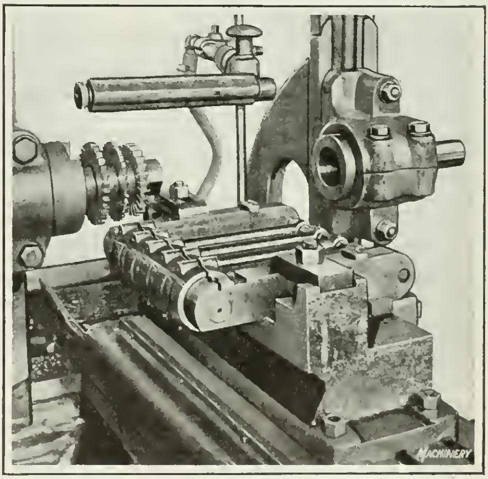


Fig. 4. Close-up View of Work, Work-holding Fixture, and Milling Cutters on Machine shown in Fig. 3. Five Forgings are held at a Time

* * *

The Bureau of Standards has recently completed the analysis and microscopical examination of about one dozen samples of ancient armor from the Metropolitan Museum of Art in New York City. The analysis indicates that the armor in each case was made from pure wrought iron converted into steel by the old cementation process. As the material was too thin and corroded to furnish separate samples from different layers, the carbon determination was made on the entire cross-section. The microstructure indicates that the process used in the production of the original iron was very similar to that employed in the production of wrought iron at the present time. The wrought iron was in all probability hammered into sheets which differed in hardness, the hardness being determined by the amount of carburization. The different sheets were welded together, forming a single plate which was then hammered into shape, and quenched.

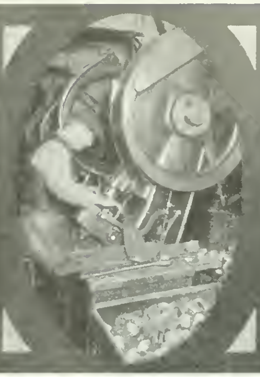
MAKING HOLLOW DRILL STEEL

The method employed by the Ludlum Steel Co., Watervliet, N. Y., in the manufacture of hollow drill steel was described in a paper by P. A. E. Armstrong recently presented before the American Institute of Mining and Metallurgical Engineers. A high-grade low-carbon mild steel tube, which has been suitably cleaned by sand-blasting, is inserted in the ingot mold, and the hot metal cast around it. The tube is filled with an air-excluding material so as to prevent oxidation and scaling of the inside of the tube, a high grade of sand being generally used for the purpose. The ingots are then rolled down to the finished size, bars are cut to the required length, and the sand extracted by a special method.

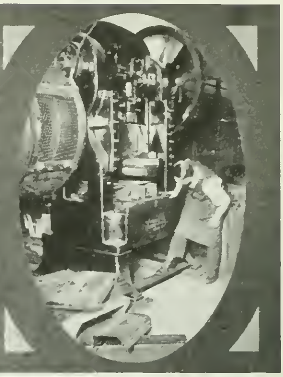
During the casting of a hollow ingot by the tube method, the hole diameter is increased. The mild steel tube, when heated to the high temperature imparted by the cast metal, is enlarged and continues to enlarge until the maximum temperature is reached. The tube then shrinks while the ingot cools, and thereby relieves the exterior surface of the ingot from cracking and from the strain to which it would be subjected if the ingot were solid. The tube withstands this movement without giving way, whereas with an ingot cast hollow but without a tube, the wall of the hole would be first under tension and then under compression. These alternating stresses would naturally have a deteriorating effect on the metal.

* * *

Vibration caused by loose bearings results in excessive wheel wear unless harder wheels are used than those required when the machine is rigid, says *Grits and Grinds*, published by the Norton Co., Worcester, Mass. The hardness of the wheel, however, cannot be increased indefinitely to counteract poor machine conditions. In a plant manufacturing stoves, crystolon, vitrified wheels 20 and 24 grain, grade S, are used in a snagging operation. The grinding machines in this plant are of a heavy type and are kept in an excellent condition. The wheel wear averages about 1.7 cubic inches per day for each wheel. Another plant, where exactly the same class of work was performed with the same kind of grinding wheels, but where the equipment was lighter and not kept in nearly as good condition, had an average wheel wear of 3 cubic inches per day for each wheel. By using a wheel one grade harder, the wear was reduced to 1.7 cubic inches per wheel per day.



Safety Devices for Power Presses



Guards and Safety Measures Provided for the Power Press Equipment in the Cleveland Metal Products Co.'s Plant, Cleveland, Ohio—First of Two Articles

THE need for various types of guards for the moving parts of machines, and particularly for the protection of the operators of such machines as power presses, has resulted in the development of some very interesting designs of safety devices which are of such general applicability that they may be used on almost any machine of this classification. The Cleveland Metal Products Co., Cleveland, Ohio, whose chief product consists of "Perfection" oil stoves and Aladdin aluminum and enameled cooking utensils, has done considerable work along these lines and has equipped all of the three hundred or more power presses contained in its Platt Avenue plant with some form of protective appliance for the operator. This company does not manufacture these safety devices commercially, but realizing the help that it may confer to the metal-working trade by permitting these devices to be described in the technical press, has lent its cooperation to the end that these guards and their operating mechanisms may be here presented in detail. It is felt that the description of some of these devices will lead to a still greater application of safety devices to machine tools.

There are two general safeguards taken in the shop referred to, which may be mentioned before the devices illustrated are described. These are, first the shortening of the power press crank throw on machines engaged in blanking and punching operations. The stroke is shortened sufficiently to prevent the operator's hands extending in between the punch and die, allowing only space enough for the insertion of the stock. In some shops pliers are furnished the operators, and a set of instructions issued requiring them to use these pliers in placing the work on the die. If a man is discovered feeding the press without using the pliers, he is immediately discharged. Under such conditions, too much depends upon the ever-present human tendency to take a chance, and accidents are almost sure to occur. The second measure taken to reduce the number of accidents in the power press department of this company is the provision of a set of rules and regulations which is attached to every machine. These rules, which are shown in Fig. 1, are lithographed on a metal plate and attached to the presses, regardless of whether they are furnished with fool-proof guards or not.

RULES FOR THE OPERATION OF THIS PRESS

1
Belt must be on loose pulley when setting dies.

2
After die-setter has finished setting press, clutch lever must be in locked position with latch provided for same.

3
In no case shall a die-setter or operator polish a die or punch or adjust gages without first throwing in safety latch, throwing air handles backward and placing a piece of wood not less than 4 inches square between the punch and die.

4
When peening the cutting edge of a die or punch, the belt must be on the loose pulley to allow shearing in by hand.

5
A die-setter or operator must not operate a press unless the machine and safety device are in perfect working order. The foreman in charge must be immediately notified if anything is wrong and work on that press must not be resumed until press and safety appliance have been restored to perfect order.

6
Anyone failing to follow these rules will be discharged.

Fig. 1. Rules contained on Lithographed Plate which is attached to Power Presses

Double Arm Gate Guard

The guard shown in Fig. 2 is attached to a number of Bliss No. 21 inclinable presses, and is so constructed that it covers the full width of the bolster plate and allows no opening through which the operator can extend his hands immediately before the press ram descends. The mechanism which operates this gate is so synchronized with the operation of the power press clutch that as the treadle is depressed the gate descends to a given point before the clutch is released. If the operator's hand happens to be under the punch at the time, the operating mechanism of the clutch cannot operate until his hand is removed and the gate permitted to swing downward to a given point.

The operating mechanism of this type of guard is clearly illustrated in Fig. 3. This is a side view of the upper part of the power press with the driving pulley removed. When the foot-treadle is depressed, the treadle-rod *A* swings the gate arms *B* downward until the arms engage the lower end of the eye in latch-rod *F*. This pulls the latch *E* from engagement with the clutch dog and permits the press to trip. Before the latch *E* is fully disengaged, however, the dwell-arm *D*, which travels down with the arms *B*, becomes engaged with the dwell bracket *G*, aided by the tension exerted by spring *K*. By the time that the latch *E* has been completely disengaged, the gate has traveled downward about 1½ inches from the position occupied when arm *D* is first engaged with bracket *G*.

Upon the release of the treadle, dwell-arm *D* again becomes engaged with bracket *G*, due to the tension exerted by spring *C*, thus preventing the raising of the gate while latch *E* is disengaged and the clutch of the machine in operation. There is a cam *H* attached to the crankshaft of the machine for the purpose of releasing dwell-arm *D* and permitting the gate to be pulled up, and this cam is so adjusted on the shaft that the raising of the gate does

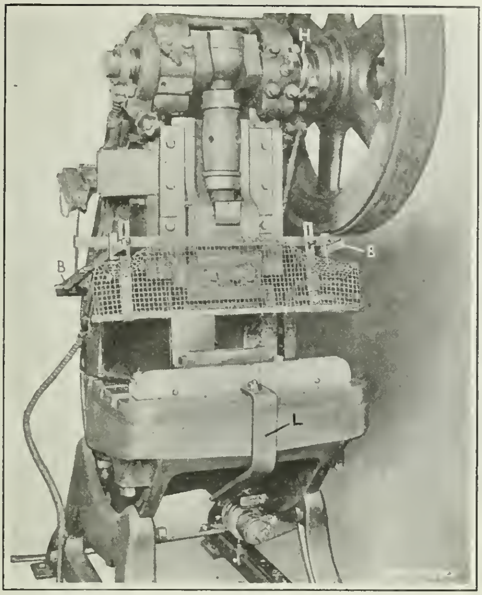


Fig. 2. Power Press with Swinging Gate Guard

not occur until after the ram of the machine is on its upward stroke. The 1½-inch rise of the gate which occurs when the treadle is released, and which is limited by the engagement of dwell-arm *D* with bracket *G*, brings the bottom of the gate to the top of a wooden guard, which is shown attached to the bolster of the machine in Fig. 2. This provision makes it impossible for the operator to reach into the die just as the press is about to be tripped. The operator might have such an impulse if he found that the blank was improperly placed in the die, but by simply releasing the dwell arm *D* from engagement with bracket *G*, by hand, the gate will rise and the latch be brought into position for preventing the tripping of the press. This is made possible by having the mechanism so arranged that when the dwell-arm is engaged the latch will be only partly disengaged, enabling it to be returned to engagement with the dog before the press trips.

The latch-rod is made in two parts with a connection, and there is a casing *J* which encloses this connection, so that in case the latch-rod breaks or the threads strip in the connection, the two parts of the latch-rod will be held together and latch *E* will always be moved in a direction to stop the operation of the press, but it will be impossible to start the press again until the latch-rod has been repaired. Should the spring *C* break, the gate will drop, but if there is anything extending in from the front of the machine over the wooden guard attached to the bolster, the gate will not be able to drop sufficiently to cause the clutch which operates the tripping of the press to become operative. Thus, even if the operator's hands were in the die it would be impossible for the press to trip in case the gate should accidentally drop. The design of the arms *B* at that portion which operates in the eye of the latch-rod *F*, is such that when these arms are depressed, the entire length of the slot will be filled, thus forming a solid connection to the latch-rod. By this construction there is no lost motion of the arms in the eye, so that when the treadle of the machine is released the latch-rod will be positively returned to its upward position. If, however, the latch failed to return to the position which would stop the press, the machine would continue to operate, but the gate could not rise because the design of arms *B* is such as to prevent this until the arms have swung clear of the upper end of the slot in the latch-rod. This cannot occur until the latch-rod is in its upper position. A sheet-metal guard is attached, as shown, to protect the extending arms against injury from trucks, etc., which might occur in case the press should be located near an open aisle.

Eliminating Injury Due to Machine Breakage

This power press is also furnished with a shin guard *L*, Fig. 2, consisting simply of a piece of strap iron attached to the bolster of the machine, as shown, and extending under it to support the spring or rubber cushion, as the case may be. This prevents the cushion from falling down in case the bolt, by means of which these buffers are attached to the machine, should break. Often serious injury may result from this cause.

On the heavier types of power presses there is always the liability of the pitman screws breaking, permitting the ram to drop on the operator's hands. Numerous accidents of this kind have occurred, but they may be entirely eliminated by the simple provision of an auxiliary emergency supporting means. In Fig. 4, which shows a No. 31½ Bliss geared press, this precaution is taken by attaching a chain to the ram, both at the front and the rear, connected by a wire cable and hook, so that the length of the chains may be changed when it is desired to adjust the pitman screws. It will be seen that this machine is also provided with a swinging gate guard of the type used on the machine shown in Fig. 2.

This guard is similar in construction to the guard previously described, except that the dog with which the clutch-release latch engages also acts as a cam for the dwell-arm, engaging the upper end of the arm by a bevel or cam surface on the side of the dog. The arm has a notch in its lower end, instead of an eye as in the other design, and this notch engages the gate arm, holding the gate down until the cam surface on the side of the dog knocks the arm to one side, thus permitting the gate to swing up. This release is timed to occur after the ram has started to ascend, similarly to the synchronization of the gate and tripping movements described in connection with the No. 21 press.

The design calls for a somewhat different arrangement of the working parts than that shown in Fig. 3, but the method

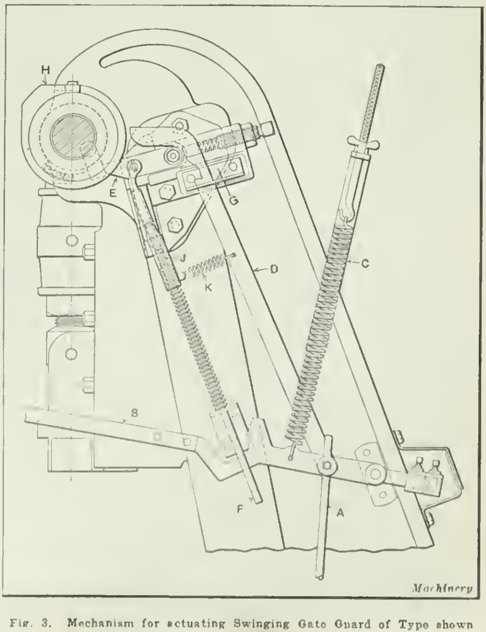


Fig. 3. Mechanism for actuating Swinging Gate Guard of Type shown in Fig. 2

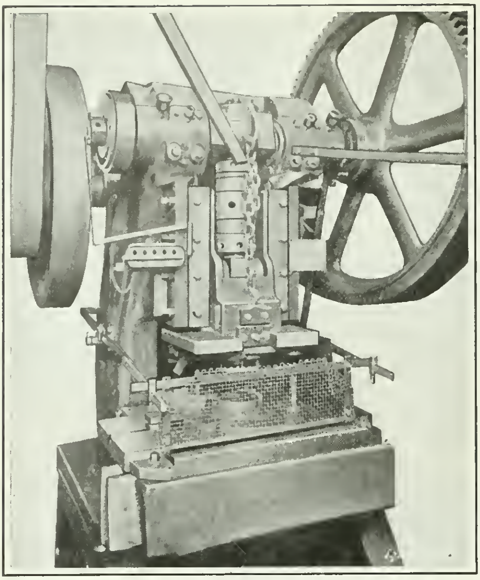


Fig. 4. Press with Emergency Support for the Ram in Case the Pitman Screws break

of operation is substantially the same. The spring for raising the gate when released, for example, instead of being placed above the arm, is attached to the base of the press at the rear, and is connected to the extending end of the gate arm, the upward movement of the gate being stopped by a suitably located rubber buffer against which the arm strikes. The detailed construction of this, as well as of all other devices here described, will be furnished to those interested in using them in their own shops, but not for commercial use.

An auxiliary support for the ram may also be provided in the manner indicated in Fig. 5. This is a smaller press than the one shown in Fig. 4 so that a support of the kind shown is fully adequate. It consists simply of a strap *A* attached to the center bearing of the crankshaft and twisted so as to be fastened to the side of the ram. Provision is made for adjusting the barrel on the pitman screws by an elongated slot for the clamping bolt *B* and a toothed construction where the strap is attached, so that it may be securely clamped by the use of but one bolt. This is the same type of machine shown in Fig. 2 with the gate guard removed.

Air-operated Drop Gate Guard

An interesting design of gate guard is shown attached to a No. 354 Bliss double-action press in Fig. 6, while a completely assembled view of the guard and its operating mechanism is illustrated in Fig. 7. This is an air-operated guard, with an interesting application of compressed air for operating the press. In operating the machine, it is necessary that both the workman's hands be used, but if for any reason the press should repeat or operate without the application of air (in which case the operator's hand might be under the ram), the gate is automatically released and falls down on the workman's hand, thereby warning the operator that the press is repeating. The blow caused by the falling gate is not severe enough to injure the hand. The operation of the controlling mechanism of the guard may be clearly understood by referring to the two illustrations in connection with the following description.

The air line is shown at *A*, and the direction in which the air flows is indicated by arrows in Fig. 7. As soon as the two air valves are opened, requiring the use of both hands, the air is permitted to flow until it reaches the air gun *B*. Plunger *C* is then forced out until it operates the lever *D*, which is attached to the cross-shaft *E*. This results in turning the shaft to which the fingers *F* are also fastened, disengaging the lugs *G* which are a part of the gate slides *H*, and permitting the gate to drop.

The gate has now dropped, but the press does not operate until the plunger *C* has been forced out, permitting the air to pass downward from air gun *B* and enter the air gun *J*, which controls the release of the press-operating clutch. The construction of this gun is similar to that of gun *B*, and when the plunger is forced upward it operates against lever *K*, releasing latch *L* by means of a connecting-rod and a series of levers. The releasing of latch *L* permits the lifting rod *M* to drop, thus engaging the clutch of the machine and causing the ram to descend. The gate is automatically raised with the ascent of the ram by any suitable mechanism connecting shaft *E* with the throw of the crank, which will result in turning this shaft and hooking the fingers *F* under lugs *G* of each gate slide. The method of producing this movement is somewhat different in the machine shown in Fig. 6 from that shown in Fig. 7, but the results are the same. In fact, any means by which the throw of the crank can be utilized is suitable. Two coil springs on shaft *E* hold fingers *F* in engagement with lugs *G* until the shaft *E* is again turned.

If the press should operate without air, that is, if it should repeat, the gate will be dropped before this movement can be completed. There is a pawl which may engage lug *N* on the left-hand finger *F*. Should the gate be lowered with the accidental descent of the ram, this action would disengage fingers *F* from lugs *G* and permit the gate to drop suddenly on the operator's hands. Spring buffers *O* are provided to absorb the shock of the falling gate on the bolster

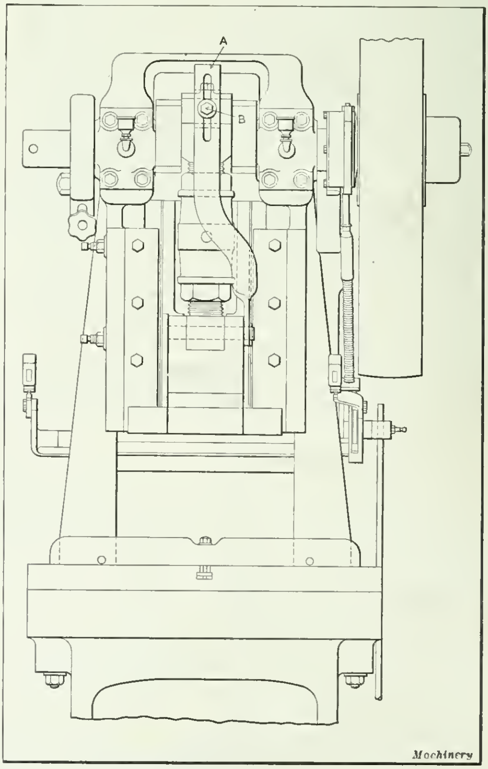


Fig. 5. Method of guarding against Breakage of the Pitman Screws by Means of a Strap attached as shown

plate. The gate is so constructed that it can swing outward on swivels *P*, so that the operator may easily withdraw his hands, but the guard cannot swing in toward the dies. The upper brackets through which the side-rods on which this gate operates extend have the holes in them liberally countersunk on both sides, so that by removing the knurled nuts *R* the device may be swung forward and readily removed from the press, should it be desired to do so. It will be noticed that there is an oil-cup in the line so that the air guns may be lubricated with atomized oil from time to time, as required.

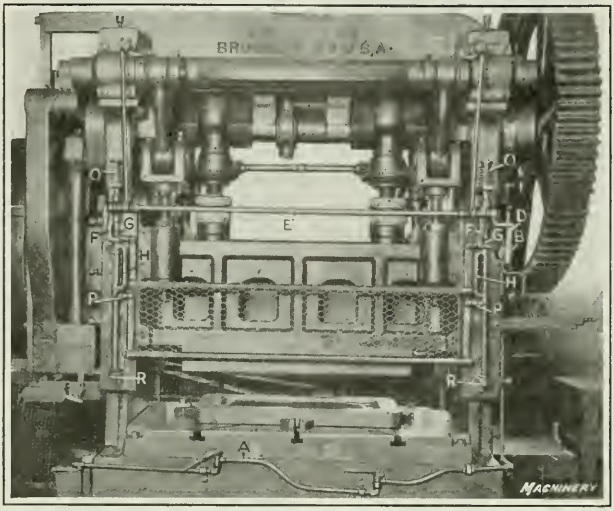


Fig. 6. Double-action Geared Press with Air-operated Drop Gate Type of Guard

Mechanically Operated Drop Gate Guard

In another design of drop gate applied to a No. 5½ Bliss power press, a somewhat modified application of this guard is made. In this design, instead of using an air gun to release the gate, the latter is designed to hang below the level of the die and to be raised by a series of levers actuated by the crank throw of the power press. In this arrangement, air is used to trip the press, the air line being identical in arrangement with that shown in Figs. 6 and 7 except that the gun shown at *B* is not required. When the ram of the press is in its raised position, the gate is down and the connections by means of which the gate is raised are designed to operate as the ram descends, thus acting as a safety device by pushing the operator's arms away from the die; conversely, with the ascent of the ram the gate is again lowered. The gate is made in two pieces, the top part being adjustable to bring it level with the top of the die when the gate is lowered, which, of course, requires adjustment according to the height of the die.

In the next article, which will appear in September MACHINERY, additional types of gate guards will be shown, including guards of the sweeping type, sliding guards, stationary guards, and guards for shears.

* * *

The exports of steam locomotives from the United States, according to a recent Commerce Report, increased from 491, valued at $4,475,429 in 1913—the last pre-war year—to 959, valued at $30,275,728 in 1919—the first peace year—and to 1711 in number valued at $53,629,847 in 1920.

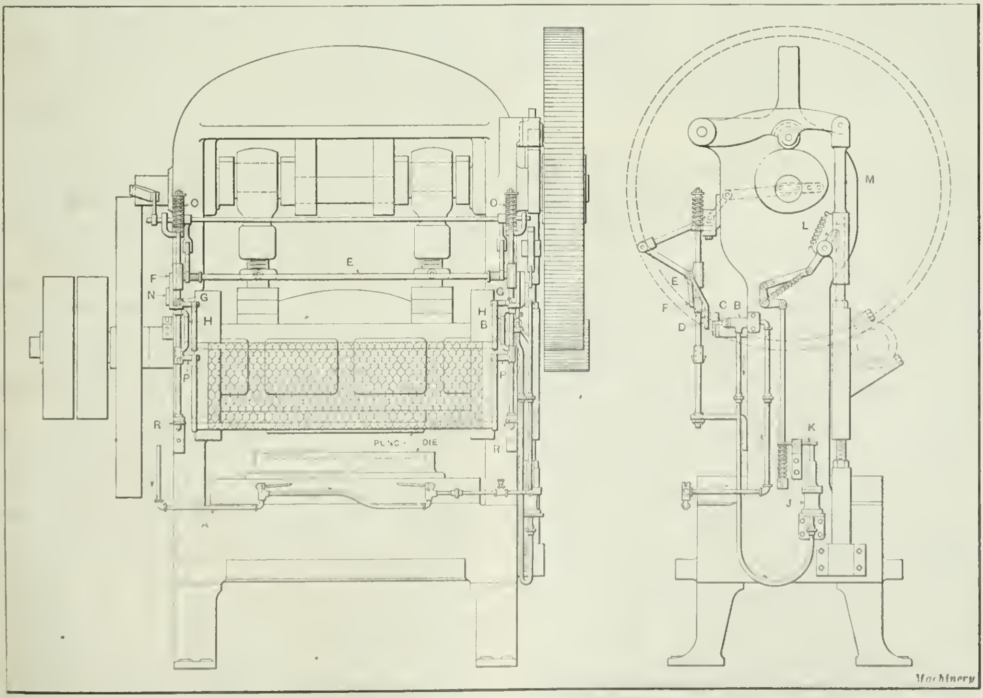


Fig. 7. Assembly View of the Drop Guard shown in Fig. 6, from which Application of the Air-operated Mechanisms may be seen

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TIDING MEN OVER A DEPRESSION

Manufacturers in Springfield, Mass., prominent among whom are the builders of the Indian motorcycle, have adopted a plan to mitigate the hardships of unemployment among their men during the present depression. The plan, which is in operation in nearly a score of plants in that city, is this: Instead of complete and continuous employment for many, and continuous unemployment for others, the men alternate in the different jobs, on the principle that it is better for two men to be working part time than for one to be employed continuously while the other is idle continuously. In this way the pinch of hard times is made less severe for a great many, and in the motorcycle plant mentioned it has been found that this rotation of men in the different jobs from week to week adds nothing to the cost of production, nor does it affect the steady flow of the product through the plant.

This method of providing part-time employment for the greatest possible number of men would differ in detail in every shop; but if it is desired to give a maximum number of men some wages for the time being, instead of none at all for many, the plan, adapted to suit the conditions peculiar to any shop, will be found practicable.

In cases where the work is of a highly specialized nature, requiring unusual skill or long training, it would not be practicable to alternate, except where a considerable number of such skilled men were unemployed, but for ordinary production work, where the employe is mainly an operator, there should be no great difficulties to overcome. The method has the further advantage of keeping the desirable men employed and at hand, so that when business starts up again, a regular working force is available, and production can be increased as desired without the necessity of finding and training green help—which is always expensive.

* * *

STANDARDIZATION OF MACHINE TOOLS

The development of machine tools has not yet reached the point where a consistent policy of standardization can be adopted, but we should look forward to the time when a considerable number of the different types and sizes that are now built can be abandoned, and when the designing of machine tools will reach a point where increased efficiency cannot readily be obtained by making changes from year to year. Some time ago a manufacturer of drilling machines stated that, taking into consideration all the types and sizes differing in some detail from the standard type, his firm had made about three hundred different kinds of machines. The same is true in a lesser degree of other machine tools.

Some day it may become possible to standardize machine tools so that they can be built in large quantities by interchangeable manufacturing methods, much the same as automobiles are now made, and under such production conditions both the manufacturer and the buyer would share in the advantages gained. It would be cheaper to manufacture machine tools in that way, the cost of the original design and the experiments which must always be made in developing new models being distributed over a large number of machines, so that the purchaser would obtain tools at a lower price and the manufacturer would obtain greater returns for the ingenuity and labor put into the machines.

Such standardization is not possible in the immediate future, because there are still so many improvements to be made in machine tools that any attempt at a complete standardization of types at the present time would be impracticable. But just as electric motors and automobile engines have been so nearly standardized that hundreds of thousands are built without change and the designs remain practically the same for years, so it is conceivable that some day machine tools will have developed to a point where the best possible features will be incorporated into machines which may remain the standards for years and which could then be produced in large quantities.

It is also likely that in the future there will be still further specialization among manufacturers, so that one manufacturer can concentrate not only upon one line of machines, but possibly upon certain types of that line. In that way costs would be decreased and the heavy burden now carried by the machine tool industry for development work—which is sometimes duplicated in half a dozen shops simultaneously—would be avoided.

While some of these developments are in the distant future, there are many present possibilities for standardization in minor details entering into the design of machine tools, such as spindle noses, toolposts, T-slots in tables, keyways, etc. Much would be gained, for example, if chucks of similar size were interchangeable between all the lathes in a shop, and if all spindles would take collets of the same kind.

* * *

ORDERING REPAIR PARTS

While modern machine tools are so heavily constructed that breakages occur less frequently than formerly, certain parts are subjected to such heavy wear and excessive stresses—and sometimes to abuse by careless or incompetent operators—that sooner or later it becomes necessary to replace them. Then it often happens that the machine remains idle much longer than necessary because proper care is not taken in ordering replacement parts. Machine tool builders frequently receive letters asking to have certain parts replaced, but the names given to the parts are entirely different from those given by the maker, and the description or specification is so inadequate that it is not possible to determine exactly what parts are required.

In their carefully prepared catalogues, machine tool builders generally give specific directions for the ordering of repair parts, in order to save their customers mistakes and delays. In the absence of such directions, a machine tool user ought to make a simple drawing of the part required, giving the important dimensions. In that case it would be easy for the manufacturer to identify the part and to ship exactly what is needed.

Another mistake often made when breakdowns occur, is to merely order a repair part, letting the machine stand idle until it arrives, instead of having a competent mechanic examine the machine at once to see whether some simple repairs might not keep it running for a few weeks while waiting for the required part. The more highly specialized a plant is, the more likely it is that machines stand idle when breakages occur, until the broken parts have been replaced by new ones of exactly the same kind and type as those that failed. In the smaller shop—generally less highly organized—troubles of this kind are usually carefully looked into by a foreman or the superintendent himself, and in that case some makeshift remedy is promptly applied and the machine keeps on producing until more permanent repairs can be made.

The Present Situation and the Outlook

More Letters on Today's Problems from Practical Business Men

KEEPING EVERLASTINGLY AT IT

By F. H. MOSES, President and General Manager, Adriance Machine Works, Inc., Brooklyn, N. Y.

The condition of the industrial world today may be likened to the condition of a patient in a very low state; a stimulant is clearly needed. The great purchasing public, including the manufacturer, must be stimulated to buy. The starting of one cog, whether by the public in general or by the manufacturer in particular, must necessarily involve action in all the others. Every order placed now, every additional employe placed on the payroll, means that we are approaching so much nearer to a solution of the industrial problem.

Our own efforts have been concentrated in an endeavor to stimulate trade by various methods of direct and indirect advertising. In one branch of our industry we are making an appeal directly to the public without directly referring to our own product, believing that what is for the benefit of one must necessarily be for the benefit of all. In other lines, we are sending out demonstrating units, mounted on trucks, prepared to give a practical working demonstration to the man at the door of his plant. This we have found to be an appeal that decidedly stimulates interest, and it has brought orders even from sections of the country where lethargic conditions prevail.

The foregoing plan is, of course, not adapted to the selling of heavy machinery which makes up a large part of our line, but we have found by extending our service, by following up, as far as possible, all inquiries with a personal call—in other words by injecting the necessary stimulant or stimulus into business, we already see signs of resuscitation in that very live corpse—American Industry.

In the timely letters of constructive thought and business advice published last month, representative men in the machine tool field expressed themselves on many of the industrial problems of today, with the definiteness characteristic of the practical business man. A number of additional letters are published this month, dealing with such important subjects as standardization, the need for up-to-date equipment, publicity and advertising, and many other problems that demand careful consideration. An exchange of ideas is the most valuable form of cooperation at this time.

STANDARDIZATION A VITAL FACTOR

By E. J. SKINNER,
General Manager, Skinner Chuck Co., New Britain, Conn.

Our attitude toward the future is that we can look forward to good business again in the machine tool and supply line. We are manufacturing our product for stock with an idea of giving the best service possible to our customers when they shall be in need of our products.

It seems to the writer that the dominant thought of today should be that now is the time for standardizing machine shop equipment. What a decided advantage it would be if all electric drill manufacturers used the same size and kind of fittings for attaching chucks of like capacity, for example, instead of some using a taper arbor and others a threaded spindle.

What a great improvement it would be if all drill chucks of like capacity had the same size recess to receive an arbor. This would relieve the dealers from carrying in stock such a variety of arbors and would enable the manufacturers to produce arbors in such quantities that they could be sold at a lower price.

We are considering problems of this kind during the summer dullness, together with labor problems and greater efficiency in manufacturing. The manufacturer who makes a product of superior quality and is prepared to give service is going to reap a reward with the revival of business that is sure to come, but we do not consider ourselves able to predict the date of its coming. However, we mean to be ready when the time arrives.

THE INFLUENCE OF FEAR IN BUSINESS READJUSTMENT

By F. O. HOAGLAND, General Manager, Reed-Prentice Co., Becker Milling Machine Co., and Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

[Owing to a typographical error, a paragraph in Mr. Hoagland's letter published last month became unintelligible, and the force of his statement was impaired. His letter is therefore republished this month.—EDITOR]

Eliminating all the causes of the present business depression which have previously been brought up, such as the war, the labor situation, overproduction, banking facilities, etc., my opinion is that the real reason is plain *fear*. There is a lack of confidence between individual men, between classes, between the people at large and the administration, and also between nations, and one *fears* what the other is going to do next.

If a man does not have more than one dollar and he does not see where the next one is coming from, he is very apt to hesitate about spending it; he may call it waiting for prices on labor and material to come down or what not, but the fundamental basis is that he is *afraid* to invest or spend his money, because he does not have full confidence in the man he is dealing with, and the only remedy I know for this is *time*.

After a great loss, whether it is a member of your family or part of your savings, you feel it very keenly immediately after it happens, and for some time afterward; but after awhile it will wear off and the pangs are felt less keenly you gather yourself together, and proceeding with caution you are soon back to your old strides again.

I know of specific cases where money is available for purchasing commodities, but the decision to buy is being delayed, waiting for prices to come down, sufficient confidence not being placed in the seller's statement that prices have reached rock bottom—*fear* again of having to pay a higher price than the goods may be bought for later.

The machine tool industry is, as usual, the last to be affected by the return of good times, and unless the machine tool builders can devise improved machines for manufacturing purposes which would plainly prove to the user that even with the present limited production he cannot afford to get along without them, it is apt to be some time yet before conditions in the machine tool industry will be normal.

When a man is under the influence of *fear*, his brain does not function normally and his planning ability is affected; this is a sufficient reason for ours not working to the best advantage at present.

IMPORTANCE OF STANDARDIZATION

By W. E. MOORE, President, W. E. Moore & Co., Engineers, Pittsburg, Pa.

We believe the outstanding feature of the present machinery trade situation is the vital necessity for radical cost reductions. Germany is rapidly getting in shape to export machinery at very much lower prices than are now being quoted here.

We, of course, have to maintain quality, but it is absolutely essential to standardize the parts of our products and systematize and concentrate production in such a way as would tend toward the maximum economy in production and sale costs. As an instance of this, we might mention that there are more than a dozen manufacturers of dividing heads or index-centers for standard milling machines, each manufacturer making one to four models and making these in small quantities. A centralized manufacturing concern for index-centers could, by concentrating on three or four models, turn these out in standardized form to suit all manufacturers, and could not only make them in more perfect detail, but also market them at very much reduced prices. This standardization would not only help the manufacturers of milling machines to cut their costs, but would be a vast economy to the users of milling machines as well.

There is another matter that has long needed attention—why should we have two different standards for taper centers for machine tool tapers, namely, the Morse taper and the B. & S. taper? It surely seems that these two sizes should be merged into one with merely the modification of tang tops where required. This would cut out a multiplicity of standardized small tools and a variety of adapters, etc., which are necessary in machine shops.

It is most important that manufacturers get together and standardize milling machine and lathe spindle noses. This is causing a vast amount of complication in machine tool manufacture and still more to the users of machine tools. It seems most important that American manufacturers get together on such basic matters for standardization, in order to get on the most efficient basis for meeting competition.

ADVERTISING AS A FACTOR IN BUSINESS RESTORATION

By GEORGE WILFRED WRIGHT, Newark, N. J.

Manufacturers of machine tools and allied products no longer have to be urged to employ advertising as a selling factor for enlarging their market. The question at issue is: How can the appropriation be made to yield the greatest results, and what can be done with the power of advertising to help bring about better selling conditions right now?

It may be unnecessary to state that the way to keep up industrial depression and to thicken the gloom-pervading atmosphere is to curtail the advertising budget and turn down every helpful plan that is presented as an aid to stimulate business. And it is not saying too much to assert that this is exactly what has been done by a number of manufacturers within the last year. The very last asset a business man can dispense with, in these times of restoration. is his advertising program, provided he has one based on a thoroughly safe and well defined line of action.

The business and trade magazines of today furnish a vast fund of information for the advertiser. Research bureaus are established where both foreign and domestic market reports, together with the various leading publications covering those markets, and the best means of directing advertising therein are carefully analyzed and arranged in an intelligent manner, in order that the advertiser may have a well organized plan when he launches a campaign to expand his business.

How many merchants and manufacturers know that nine hundred million dollars worth of merchandise has been sold by the Government to private concerns through advertising alone, during the last fourteen months? And this was done on an appropriation of less than $640,000 or less than one quarter of one per cent. And sixty-five per cent of this appropriation was spent in trade and business magazines. If this great object could be carried out so successfully through a dull, flat, lifeless business period, why do some manufacturers let up on their efforts and say: "There is no use, we've got to wait until things take a turn."? Why wait until things turn? Why not go out and turn them yourself? Why not perfect the product and get it entirely ready to market? Why not make a new study of the market—study it from all angles, instead of one? Why not make a closer study of advertising as applied to sales, and determine to link it up closer with the sales organization and then select the publication that will reach the most desirable fields? Last but not least: Why not secure the services of those men who are working in the field, and who know the various phases of advertising, even more accurately than the advertiser himself?

The most progressive and successful concerns are working out their problems on this basis, and the coming year promises a forward stride in the machine tool field. It behooves the smaller manufacturer to use advertising to the utmost limit in the trade publications, and to follow up his inquiries carefully. The time to treat the publicity matter as a side issue is past; and with a clear conception of the obstacles to be overcome, the results will more than justify the expenditure.

RESTORING CONFIDENCE IN THE FUTURE

By R. K. CHENEY, Sales Manager, Tolhurst Machine Works, Troy, N. Y.

The underlying fundamentals of this world-wide business depression have been discussed by the greatest intellects of both continents. We are all somewhat familiar with the generalities of international finance and know that the foreign public and private indebtedness to these United States amounts to about eighteen billion dollars. It has been pointed out to us that our products are today in excess of our maximum consumption and that if we are to utilize our enlarged production, we must depend upon the foreign absorptive power. This, of course, is limited by the present condition of international finances.

We have more intimate knowledge of our federal and state taxes and know the burdens placed by them upon American manufacturers. It appears that the Budget Bureau of the Treasury Department and the possibility of an international agreement concerning disarmament may mean such a curtailment of federal expenses that we shall know an alleviation of this handicap.

There are two factors contributing to our present condition which we may try to improve upon:

The limitation of output imposed by labor is a very serious drag upon industry. It may be rectified by many processes or combination of processes, but probably the road of least resistance and of most permanent results is through a closer personal relationship between employer and employe. When the employe can be made to realize that his interest in the business is as real as that of the employer, but only smaller in quantity, then will he appreciate that normal production rather than curtailed output is to his personal advantage.

To my mind a most important factor is the morale of business. Many times each day we are informed that "there isn't any business." We read it—the salesmen calling on us preface their remarks by saying they are on a missionary trip and do not expect to sell us, while our own salesmen write letter after letter to the same effect. We are working in a groove if we believe that there are no buyers left.

The only solution is for each and everyone to realize that we must replace our own obsolete equipment, repair where we can, and install such other equipment as may be necessary to cut our manufacturing costs. When we can lift ourselves out of our present groove and make our salesmen realize that there is a need for machine tools and that we are here to sell equipment—not the services of a missionary —then we shall see business return to a normal basis.

Do not forget that the textile industry of this country was about as hard hit as any, and yet today it has recovered and some branches are running night and day; the average is about 75 per cent of normal operation. There are orders waiting for the man who has confidence in the machine tool industry.

NECESSITY OF LOW PRODUCTION COSTS

By B. L. CALKINS, Sales Engineer, Peerless Machine Co., Racine, Wis.

Our opinion is that cost-cutting machinery and methods must be installed in both the large and small shops of all industries in order that low production costs all along the line, together with lowered freight rates, will permit of normal first costs, normal sales prices, and normal profits.

UP-TO-DATE EQUIPMENT WILL BE NEEDED

By EDMUND J. HENKE
President, American Electric Fusion Corporation, Chicago, Ill.

I have just returned from a trip through most of the states east of Chicago, and though I have brought home not a single order, I have plunged into work with a new vigor, because of the things I have seen and talked about with various shop executives. They all realize that though labor costs will come down some, they will never be back to the pre-war level. Thus, labor being the most important and expensive item, it must be saved and utilized with least waste; and there is only one thing that will do it—that is, modern up-to-date production machinery. They all know it, and as soon as there will be some general business in sight, the machinery business will come back with a vigor and snap not hoped for even in our most daring dreams in these times of depression.

The machine tool business is but an auxiliary branch, doing its part to produce the necessities of life. The demand for these necessities has been greatly curtailed through the lost confidence of the buying public in the stability of prices. They all look for the bottom to drop out of everything, but instead of that liquidation comes in driblets and each drop shakes the confidence more; this process will continue until most of us will see that by waiting to buy to save $100 we are losing $1000 by remaining idle. The demand in the machine industry in the meantime is nil.

During the last few years almost anything that would work and could be delivered promptly could be sold. We had no time to think of how to improve our product, and the buyer had to put up with many grievances. But now the buyer will take his time to make a careful choice and the best will win. My advice is: Improve your product as much as you can. Tool up so as to produce it efficiently, to be able to sell it in a stiff competition at a fair profit.

Advertise and let people know what you have. And do it now, when they all have time to read your message, which if brought out efficiently will stick in the minds of those that buy your product. Do not do it with a splurge and then quit; you may quit just at the time when the man that wants your product has made up his mind to buy. You will lose then, because he will not be able to find your message in the current number, and surely you would not expect him to go through a stack of magazines hunting for your advertisement. Do not expect a stack of orders because of a single advertisement. Miracles may happen, but the buying of machinery is not done whimsically, because a man likes your advertising. He will remember you, but will buy when he needs your product, and then it's up to you to make it easy for him to find you.

Above all prepare now for better business and prompt deliveries, for when business returns everyone will be wanting deliveries day before yesterday.

BELGIAN MACHINE TOOL TRADE

A recent report from Acting Commercial Attaché Samuel H. Cross, Brussels, reviews the situation in the Belgian machine tool industry and market. There are only four important Belgian plants manufacturing machine tools—two located in Brussels and one each in Liége and Bruges. One of the Brussels plants specializes on lathes from 14 to 40 inches swing; while the other, having a capacity for building from 1000 to 1200 machines a year, builds lathes, shapers, and hammers for forge shops. The Bruges plant builds several sizes of boring mills which have acquired a good reputation.

The principal export markets for Belgian machine tools are France, England, and Italy. The prices are generally from one-third to one-half of those at present asked for American tools in Belgium. For instance, a plant in Liége turns out a wheel lathe selling for one-third the price of a well-known American make, but the lathe has not anywhere nearly the capacity of the American competitor, because it weighs only one-third as much as the American machine, and hence would never compare with it in production work. Belgian machine tool builders have frequently imitated American machines, and one case is noted where an imitation of a small American drilling machine sells for 650 francs in comparison with 1200 francs asked for the American make.

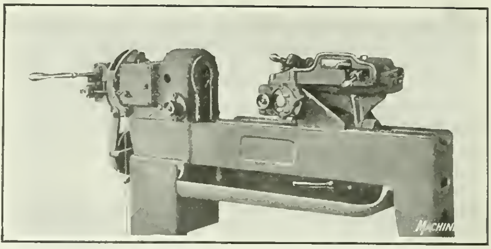
According to local machine tool dealers, before the war 70 per cent of all machine tools imported into Belgium were of German origin. For reconstruction purposes after the armistice, however, American machine tools were sold in Belgium in large quantities; the United States War Department alone disposed of $3,500,000 worth of tools through the cooperative body known as the Construction Metallique, and it is estimated that fully as large a sum was spent in purchasing machines privately. Later, German machines reentered the field at relatively low prices. While it is generally recognized by Belgian machine tool users that the German product is not of the same high quality as the American product, the present exchange rates and the lower German prices are strongly in favor of the German machines. Several agents for American machine tools who carried large stocks suffered severe losses during the latter part of 1920, and at least one of these agents was forced, by economic conditions, to take an agency for German machines. Except in this one case, the sale of German machine tools is in the hands of relatively small and unimportant commission houses, whose methods render competition difficult at the moment.

In the small tool and accessory field, there are greater possibilities for American products at the present time than in the machine tool field. Grinding wheels and small tools sell with comparative ease, although the market is practically closed to American twist drills, English and German firms offering active competition. A 1½-inch carbon steel drill is offered in Brussels by German firms for 6.25 francs in comparison with 35.15 francs asked for a well-known American drill of the same size. German prices on micrometers make it possible for them to hold the market in these tools much the same as in drills. A German product, not of very high finish but of entirely accurate construction, is sold in Brussels for 31.20 francs, while the price asked for the corresponding American micrometer is 96 francs. German competition is particularly active in measuring tools. German tools of this kind placed on the local market in Belgium bear no mark indicating their origin but the German manufacturer will stamp, upon request, the name and address of the dealer free of charge.

* * *

According to a recent Commerce Report, the prohibition on the importation of American passenger automobiles into Italy has been removed.

Hanson-Whitney Centering Machine



SUBSEQUENT operations, such as grinding, or the milling of a worm, on large numbers of parts produced from bar stock in turret lathes and automatic screw machines can frequently be best performed when the work is supported on centers. In order to provide accurate centers on work of the type mentioned, the Hanson-Whitney Machine Co., Hartford, Conn., has developed the machine shown in the accompanying illustrations.

In this machine, the work is rotated during the centering operation, the left-hand end being driven by a chuck in the work-head, while the right-hand end is supported in a steadyrest. By this arrangement the same degree of accuracy is obtained as when the operation is performed in a lathe provided with a steadyrest. The machine, therefore, should increase the field of usefulness of turret lathes and automatic screw machines, because it makes it practicable to handle parts on these machines which otherwise it would often be considered necessary to machine while supported on centers during every operation, in order to obtain the required accuracy. The machine is also equally well adapted for rough parts.

The various units are mounted on a bed amply proportioned and equipped with a pan of generous dimensions for catching chips and lubricant. The regular bed accommodates work up to 24 inches in length, but longer beds can be furnished to meet practically any requirement. The work-head is a stationary unit provided with a tight and loose pulley drive so that the machine may be driven directly from a lineshaft. The spindle is mounted on ball bearings; in addition to the advantages usually gained by this construction, this enables the starting and stopping of the spindle to be sensitively controlled. An accurate and substantial chuck is used for driving the work, and this is built into the work-head as a component part. It accommodates work ranging from ⅜ to 3 3/16 inches in diameter, and any size within its capacity can instantly be gripped with a uniform pressure, which is obtainable without adjustment of any kind. The lever that controls the opening and closing of the chuck is so located that it can be easily manipulated from the working position of the operator.

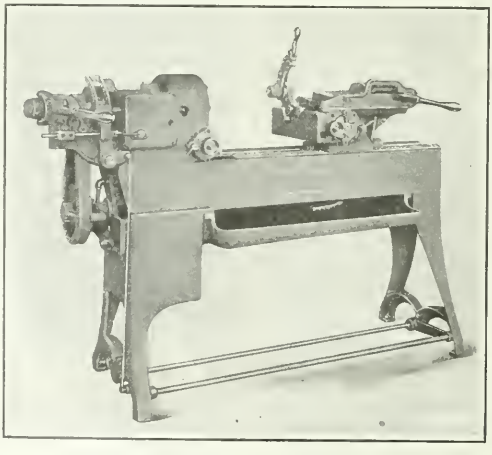
The belt-shifting mechanism is semi-automatic in operation. A rod mounted on the bottom portions of the legs and extending the entire length of the bed, serves as a foot-treadle, and by its operation the belt is shifted to the driving pulley. When the chuck is opened to release the work, the belt is automatically returned to the loose pulley and an automatic brake almost instantly stops the spindle from rotating. An adjustable V-rest is located in the front section of the work-head for supporting the work as it is advanced into the chuck. In setting this rest for work of a given diameter, the latter is first gripped in the chuck and then the rest is elevated by rotating a knob on the side of the head. The clamping action is such that the rest automatically recedes 1/64 inch to provide proper clearance for the work.

The steadyrest is of an improved roller type, having two rollers in the lower member and one in the swinging member. The two lower rollers can be adjusted to suit different diameters, the movement of both rollers during the adjustment being controlled simultaneously through a dial indicating device having both English and metric graduations. The upper roller can be swung into the proper position regardless of the diameter of the work.

Two tools are provided on the machine for producing centers, the first being a combination drill and reamer which is used to drill and rough-ream the center, while the second is a "one-half" type center reamer which takes a finishing shaving cut. The tool carriage has two tool-holders which are rectangular in cross-section and mounted in a bracket that can be oscillated for positioning the cutters. Provision is made so that the tool-holders can be conveniently centralized if this should be necessary. The longitudinal travel of both tool-holders is controlled through one lever, a locking device forming part of the construction, so that both tool-holders must be in the neutral position before it is possible to swing the bracket for engaging either tool. This design prevents the tools from becoming injured through faulty manipulation.

Stops control the depth of the center from the end of the work, thus insuring a uniform depth irrespective of variations in length. The tool carriage is adjustable longitudinally on the bed to accommodate parts of various lengths. The machine is equipped with a pump for supplying lubricant to the cutting tools, the lubricant being conveyed through the tool-holders directly to the tools. This arrangement has been found to work out well. A tank is cast integral with the left-hand legs of the machine and the pump is mounted directly over this tank.

The operation of the machine is as follows: The operator locates the work-carriage longitudinally, sets the lower steadyrest rollers to suit the work diameter, grips one end of the work in the chuck, swings the upper steadyrest roller into position, elevates the guide rest until it comes into contact with the work, binds this rest, and starts the machine by depressing the foot-treadle, the machine being stopped when the chuck is opened.



Centering Machine built by the Hanson-Whitney Machine Co.

Problems of the Machine Tool Builder

By CALDWELL R. ROSBOROUGH, Secretary, Williams, White & Co., Moline, Ill.

IN response to a request by the editor of MACHINERY, the writer has endeavored to give below his ideas as to the way in which some of the pressing problems now facing the machine tool industry must be met. It is evident that these problems are seen from different angles by different men in the business, and the writer has merely attempted to give his own views along these lines. In so doing he has considered eight important points as follows: (1) preparation for better business; (2) restoring confidence; (3) advancing machine tool design; (4) the labor problem; (5) standardizing machine shop equipment, and adopting better machines and tools; (6) efficient marketing at home and abroad; (7) greater efficiency in works management; and (8) cooperation between manufacturer and customer.

Preparing for Better Business

In the writer's opinion manufacturers should use this time to get their house in order, as it were; that is, to put their plant in a good state of repair and see that all their machinery is put in first-class shape. There has been no opportunity to do this in the last few years, and it would seem that now is a very good time. Further, it will give some men employment and it will be an expenditure that will not be wasted in any way, since it will constitute a real improvement to the plant. This should apply not only to the production end of the business, but all the way through, in the engineering, sales, and general administration of the business. The weak spots and undesirable features that have developed under the stress of busy times should be eliminated, and methods installed and provision made for handling the business in a way that the experience gained during the rush times through which we have passed has proved to be beneficial.

As to the second point—that of restoring confidence—if the work suggested in the foregoing were carried out, it would certainly create a feeling that the management of the business was not apprehensive of the future, but was making plans for the development and extension of the business at the earliest opportunity. It would thereby create a feeling of confidence and optimism in the entire business world that would replace the present feeling of depression.

Advancing Machine Tool Design

It seems to the writer that what should be done along the advancement of machine tool design at the present time is for the designing or engineering department of every firm engaged in a business of an established reputation to study their particular line in an intensive way, with a view to improving designs and eliminating duplication of parts and the consequent additional expense, wherever possible. Much can be done along this line in almost every branch of the industry. It might be advisable to withhold decisions as to changes that should be made in designs until a careful study of the subject could be made, not only from the manufacturers' but from the customers' standpoint as well; but the time to study the subject is now, when production does not present pressing problems.

Dealing with Labor

The best policy, in dealing with labor at this time, is to follow a very conservative plan of action that contemplates the utmost consideration for the men in the shop, with a view to making the conditions as favorable as possible for them from every standpoint. It seems to the writer that the day of an inconsiderate attitude toward the workmen is a thing of the past. Even though there may be two or three men for every job, it must be recognized that the day of coercion and lack of sympathy toward the men in the shop has gone forever.

Standardizing Shop Equipment and Adopting Better Machines, Tools, and Methods

The question as to what can be done in standardizing machine shop equipment is one that can best be answered by every individual shop, but it may be laid down as a general rule that standardization not only of the product but also of the equipment in the shop where the product is manufactured is highly desirable. If the equipment that is used in the manufacture of a certain product is standardized, it is more than likely that the product itself will become more and more standardized, uniform, and of improved quality as time goes on. If the various plans for improving designs and equipment were carefully studied by the management of each industry, better machines, tools, devices, and methods would be adopted automatically.

Efficient Marketing at Home and Abroad and Greater Efficiency in Management

It would seem that if a plan were worked out, whereby a number of firms would join together to establish branch offices or agencies in the different centers for the sale of their products, both for domestic and foreign trade, it would be of advantage to the producer. Of course, where the organization is large and one firm manufactures a wide line, such a method of marketing can be adopted by a single organization; but the comparatively small manufacturer can do so only by joining with others with a view to organizing branch sales offices, each firm paying its share of the expenses and receiving its share of the profits.

The human element always enters into the management of any enterprise, either manufacturing or otherwise, but it would seem that one of the things that would tend toward the efficiency of works management more effectively than any other, would be always to aim at the greatest cooperation between the different departments in the plant—sales, engineering, and production. If all departments would work closer together than is often the case, it would tend to make for greater efficiency not only in the works management itself, but in the individual efforts of everyone in all departments of the business.

Greater Cooperation between Manufacturer and Customer

It would seem that better understanding and more cooperation between the buyer and the seller—the manufacturer of machine tools and the user—can be established only by each having the utmost confidence in the other. This, in turn, can be brought about only by the manufacturer turning out an honest product and doing everything within his power to satisfy the customer, while the latter, on the other hand, will do everything in his power to treat the manufacturer fairly and squarely and not make complaints about defects for which the manufacturer should not be held responsible. If each is willing to assume responsibility and not try to pass expenses on to the other without justification, confidence can be created. In a relationship of this kind each will have the utmost respect for the other and feel that the other fellow is trying to be square with him. When such a relationship has been established, the most satisfactory cooperation between manufacturer and customer is possible.

Prospects of the French Machine Tool Trade

From MACHINERY'S Special Correspondent

Paris, July 12

BUSINESS is greatly influenced at present by the financial conditions of the government and of a number of banks who have been somewhat venturesome in supporting businesses that were not well stabilized. Recently there have been various rumors that a financial crisis was impending, but conditions have been exaggerated; and if some of the banks are embarrassed, most of them are in good condition. The result, however, is that all banks have been forced to deal very cautiously with their clients, and commerce and industry has lost the necessary elasticity of funds, which tends to accentuate the present depression.

It is certain that the lack of brisk buying is not due to purchasers waiting for further price reductions, but to the fact that the demand for their own products is slight. Iron and steel, and a great deal of manufactured material, are being sold at one-third the price paid less than a year ago; yet the present prices are still from two and one-half to three times the maximum prices of 1913. These high prices are due to the cost of labor.

Likelihood of Price Agreements

On the one hand it seems that the metal-working industry cannot resume normal activity without further reducing prices, but on the other hand it cannot reduce prices without aggravating a condition that is already serious. This stagnation will hold the industry in its grip as long as it suffers from the tremendous cost of coal, labor, and transportation. No considerable reduction in these items may be expected very soon; and to prevent financial disaster manufacturers must agree among themselves not to reduce prices further, either for domestic or foreign markets. Your correspondent has not only made a study of these conditions among the producers, but has pursued this inquiry to government officials, and does not believe that he is divulging a secret in saying here that steps have actually been taken to form an agreement between steel manufacturers as to the best course to pursue. Other manufacturers would support such an agreement on the condition that their interests be protected, because the instability of the prices of raw materials so greatly affects the prices of manufactured products that no stability can be expected in the machine shop industry until there are stable prices of raw materials.

French Machine Tool Imports and Exports before the War

In order to be able to forecast the future, it is necessary to analyze the conditions in the machine tool trade in France previous to the war. France imported annually an average of 22,900 tons of machine tools. The average price was 2050 francs per ton, so that the annual value of the imports was nearly 47,000,000 francs. These machine tools were imported almost entirely from Germany, England, the United States, and Belgium—Germany supplying 51 per cent; England, 18 per cent; the United States, 19 per cent; and Belgium, 9 per cent.

Previous to the war the average annual exports of machine tools from France amounted to 6200 tons at a value of 12,700,000 francs. It will be seen that the exports from France were about 27 per cent of the imports into the country, and that the excess of imports over exports was equivalent to 34,300,000 francs. The exports were mainly to South America, Belgium, the French Colonies, Holland, England, Switzerland, Italy, and Spain.

Machine Tool Production in France before the War

Before the war, France produced, on an average, 16,000 tons of machine tools annually, while it consumed over 32,000 tons; that is to say, it produced about one-half of its requirements of machine tools. During the war, the manufacture of machine tools in France was practically discontinued, the imports averaging during three years of the war 42,000 tons annually. As there were practically no exports during those years, France imported in this period about 30 per cent annually in excess of its normal pre-war needs. Nevertheless, we find the imports of machine tools going on at a heavy rate in the two years following the war—33,000 tons in 1919, and 56,000 tons in 1920. The latter figure includes 13,000 tons of machinery returned from Germany, making 43,000 tons as the total of actually imported new machines.

It is estimated that the productive capacity of France for machine tools has increased since the war to about 20,000 tons annually. In 1919, the exports amounted to only 2600 tons, and in 1920 to 7300 tons. Considering, therefore, both the imports and the domestic production in 1919 and 1920, and subtracting from these figures the exports, we find that the actual consumption of machine tools in France was 50,400 tons in 1919, and 55,700 tons in 1920. This is some 18,000 and 23,000 tons, respectively, in excess of the average consumption previous to the war.

From an examination of these figures it will be seen that it was not the surplus machinery on hand from the war years, but rather the enormous importation and the slight exportation during the two years immediately following the war that caused the present lack of demand.

Estimated Future Needs for Machine Tools

Assuming that the future normal requirements for machine tools in France will be practically the same as before the war, or, say, 33,000 tons annually, and with 20,000 tons manufactured in France, it will be seen that 13,000 tons would have to be imported annually, no allowance being made for exportation of domestic French machine tools. But as there is certain to be an export trade to such countries as South America, Poland, the Balkans, etc., the actual imports into France must rise much higher. If it is assumed that the average price for machine tools stabilizes at about 6000 francs per ton, then the machine tool importations in the future would amount to 78,000,000 francs annually, not counting the excess of imports required to balance whatever exports may be made.

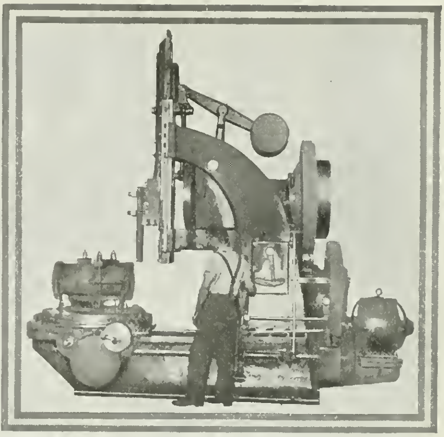
This figure is not exaggerated, as the normal needs of the country have been figured merely on the basis of the average of a number of years before the war without any increase, whereas actually the consumption of machine tools did increase by 4000 tons a year during the last few years before the war. It would seem that the figures quoted show not only the possibilities for the manufacturer of machine tools in France, but also for the exports of machine tools to France from other machine tool building countries, just as soon as conditions become stabilized and exchange returns to a somewhat more favorable basis.

French manufacturers are being encouraged to plan for an intensified production of machine tools and to concentrate on the production of lathes, grinding machines, planers, etc.; while machines such as broaching machines, automatic machines, turret lathes, etc., would be imported, particularly from the United States.

Slotting Operations on Production Work

Tooling up Slotters and Keyseaters for the Performance of Vertical Planing, Shaping, Slotting, and Keyseating Operations

By EDWARD K. HAMMOND



THE term "slotter" is somewhat misleading, as from it, one would naturally infer that the slotter is a machine adapted for performing a highly specialized line of work, similar to that handled by a keyseater. Actually, such is far from being the case, for in railroad shops and many other plants where equipments of this kind are employed, it is found that they are well adapted for handling a variety of operations, of which both internal and external vertical planing and shaping are typical examples.

Unlike the planer or shaper of standard design, the slotter handles its work while held on the table in such a way that it may be reached by a vertically reciprocating tool; and as the table is provided with a graduated circle and means of either continuous or intermediate rotation, it will be apparent that the slotter may be employed for the generation of concave or convex cylindrical surfaces, or for the planing of flat surfaces at specified angles to each other. Examples of typical jobs, where the slotter shows its productive capacity and flexibility to advantage, will be illustrated and described in the following.

Planing Gear and Pinion Teeth on the Slotter

A slotting machine built by William Sellers & Co., Inc., of Philadelphia, Pa., is employed in their plant for planing the teeth of large gears and pinions used in machine tools of this company's manufacture. Fig. 1 shows this slotter engaged on a pinion cutting job, and from this illustration it will be apparent that the cutting tool *A* is accurately formed to produce the space between two adjacent teeth. To attain accuracy in cutting gear teeth by this method, great rigidity of the tool is absolutely essential, and this is provided for by means of a jack *B* that supports the overhanging portion of the tool.

The tool starts cutting at the periphery of the blank, and the work is fed up to the tool until a stop is engaged, showing that the tooth space has been sunk to the required depth. When the operation has reached this point, the work is withdrawn from the tool and indexed through one pitch by a notched dividing plate *C* and pawl *D* that furnish a means of quickly and accurately accomplishing this part of the operation. Then the work is again fed up to the tool to cut the next tooth space, this sequence being repeated until all the pinion teeth have been cut. The blank is located by a pilot *E* which enters the finish-bored hole.

Mention has already been made of the fact that this equipment is also used for cutting gears, some of which are of considerable size. All work that does not exceed the diameter of the slotter table is handled as shown in Fig. 1; but for cutting the teeth in gear blanks of larger size, an auxiliary support is furnished, which is arranged as shown in Figs. 2 and 3. Fig. 2 shows the work of planing teeth in a boring mill table gear, and it will be seen that the cutting tool and method of supporting it are the same as for the pinion job previously illustrated. Fig. 3 gives a better idea of the method of setting up a large gear blank. On the auxiliary bed *A* it will be seen that there is a pilot *B* on which the work is located from its previously bored hole. This pilot is supported on roller bearings, so that large pieces of work which are of considerable weight can be readily indexed for cutting successive tooth spaces.

It will be noticed that the stand *C*, by which pilot *B* is carried, is supported on a slide on the bed *A*, and that connection is made with the saddle of the slotting machine by means of two straps *D*, so that the automatic feed may be employed for advancing the work to the tool. To make this movement as easy as possible, rollers are placed between the bed *A* and stand *C* on which the work is carried, thus reducing frictional resistance to a minimum. Provision is made for outboard support of the work by means of blocks *F* and *G*, and after the work has been properly located for cutting a tooth space, it is secured in that position by means of straps and clamping bolts clearly shown at *H*. Indexing of the work is accomplished by scribing reference lines on the face of the gear blank corresponding to the tooth centers. Carried on the slotter table there are two fingers *I* which extend over the top of the work and have lines scribed on their upper surfaces. The reference lines on the gear blank are centered under these fingers, after which the casting is securely clamped by means of straps *H*, ready for cutting a tooth space.

It is not claimed that this method is capable of competing with specialized forms of gear-cutting machines that are used for handling work of this kind. However, for a shop where there is a considerable amount of slotter work to be done, and where only a moderate number of coarse-pitched gears and pinions are required, the use of a slotter fixture of this kind saves the time involved in sending such work out to a gear-cutting shop, or the investment in a gear-cutting machine that would only be kept busy for a relatively small part of the time.

Slotting machines are used for handling a widely diversified line of work. In the present article, the examples selected have been chosen with a view to setting forth the possibilities of this type of machine, and of explaining methods that might be applied in plants engaged in the manufacture of a variety of products requiring planing, shaping, slotting, and keyseating operations that may be performed on slotting machines.

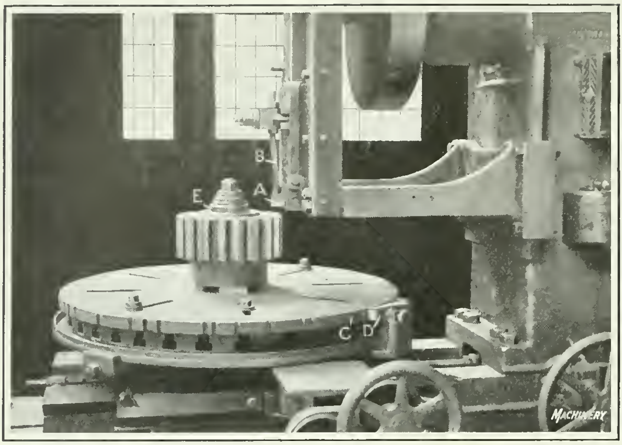


Fig. 1. Slotter equipped for cutting Teeth of Pinions

Planing Valve Body Flanges on the Slotter

As an example of the way in which a slotter can be used for the economical planing of two or more surfaces on a piece of work, where a precise angular relationship is required between such faces, attention is called to Fig. 4 which shows a slotter built by the Jones Machine Tool Works, of Philadelphia, Pa., engaged in planing a 9-inch cast-iron valve body which has flanges *A* and *B* that are 15 inches in diameter. As the work comes to this machine, the facing of flange *C*, on which it is shown standing, and all the interior machining has been completed on a vertical boring machine. A roughing and a finishing cut are taken on both flanges *A* and *B*, and it will be apparent that after flange *A* has been faced, the power drive to the rotary table and the indexing mechanism provided make it an easy matter to turn the work quickly through exactly 180 degrees ready for finishing the face of flange *B*. This can be done in less than one minute, and as the job can be completed at a single setting, it will be apparent that there is a substantial saving in time, as compared with the use of a machine where two settings would be necessary. On each face, a roughing cut is taken with a round-nosed tool and a finishing cut with a square-nosed tool; the time required for setting up and taking the two cuts over both surfaces is approximately two hours.

Slotting Cutter-heads

For use on milling machines of their manufacture, the Newton Machine Tool Works, Inc., Philadelphia, Pa., frequently receive orders for rotary cutter-heads, and in Fig. 5 is shown a 24-inch crank slotter built by this firm, which is engaged in cutting equally spaced slots around the circumference of a beveled blank. In this operation, it will be evident that two points must receive careful consideration, namely, the setting up of the blank at such an angle that vertical reciprocation of the ram provides for cutting the slots to a uniform depth; and the provision of means for indexing the work between the cutting of successive slots, in order to insure that the spacing will be uniform. Reference to the illustration will show that the angular setting is accomplished by means of a parallel strip *A* placed under one edge of the fixture, which raises it so that the angular face of the work is brought into a vertical position for cutting the slots.

Also, it will be seen that the work-holding fixture is provided with a mandrel *B* that enters the previously bored hole in the work, so that it is centrally located; and the fixture is held down on the slotter table by means of the familiar arrangement of straps and stops. Evidently, the tool is made the desired width of the slot, and the saddle is moved inward to feed the work to the tool as it reciprocates back and forth across the beveled surface, which is held vertically. After one slot has been cut, the work is backed away from the tool and indexed by means of a worm meshing with worm-wheel teeth *C*, cut in the periphery of the fixture, a dividing head being used to obtain the desired spacing.

Application of Portable Slotting Machines

Slotters are used to a considerable extent in engineering works engaged in the building of heavy machinery. For handling work of this kind it is quite often found desirable to take a machine to the work, instead of following the usual procedure of carrying the work to a machine. Particularly is this true in the case of large castings which are not only difficult to handle, but where the size and weight are such that the time required to set up a casting on a stationary machine is likely to far exceed the actual time required for making a cut. To meet the requirements of

Machining Segment Bearings on the Slotter

Another job performed on Jones slotters is the machining of cast-iron segment bearings for printing presses. The machining is done in the bore of the bearing, which is 18½ inches in diameter by 21¾ inches long, with the length of the segment one-third of its diameter. Each of these bearings is set up in a vertical position on the slotter table, and rotated continuously by power as the tool reciprocates back and forth over the work. This combination of a rotary movement of the work and reciprocation of the tool in contact with it provides for the generation of an accurate cylindrical surface. Work of this kind is frequently done on a horizontal boring mill, with the work held stationary to have the cylindrical surface generated by a rotating tool which is fed through the work. The handling of a job of this kind on the slotter is another evidence of the possibility of using machines of this type for other classes of work.

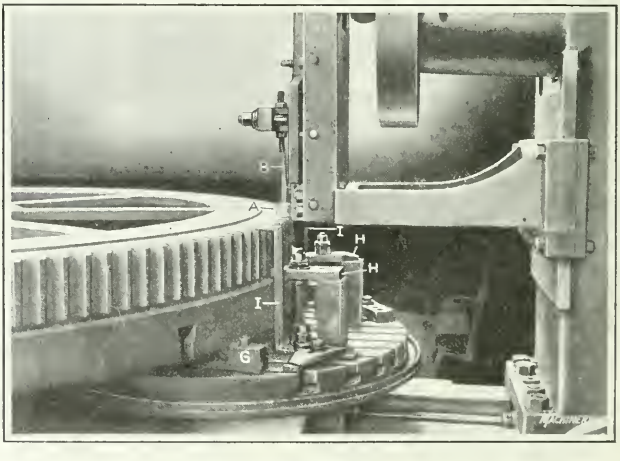


Fig. 2. Slotter shown in Fig. 1, engaged in cutting Teeth of a Gear to mesh with Pinion shown in Previous Illustration

work of this general type, many shops are provided with floor plates of the type shown at *A* in Fig. 6, on which a casting can be set up for laying out and machining.

This illustration shows the use of an auxiliary table or raising block *B*, in connection with one of these floor plates, for elevating the casting *C*, so that clearance is provided beneath it to allow a tool carried by the ram of a portable Newton slotter, to be used for facing the end of the work. Although not clearly shown in the illustration, this slotter, in common with portable machine tools built by other firms, is provided with a yoke at the top of the column, by which it can be easily picked up by the hook of a traveling crane and carried to any position in the shop where there is work requiring the use of a machine of this type.

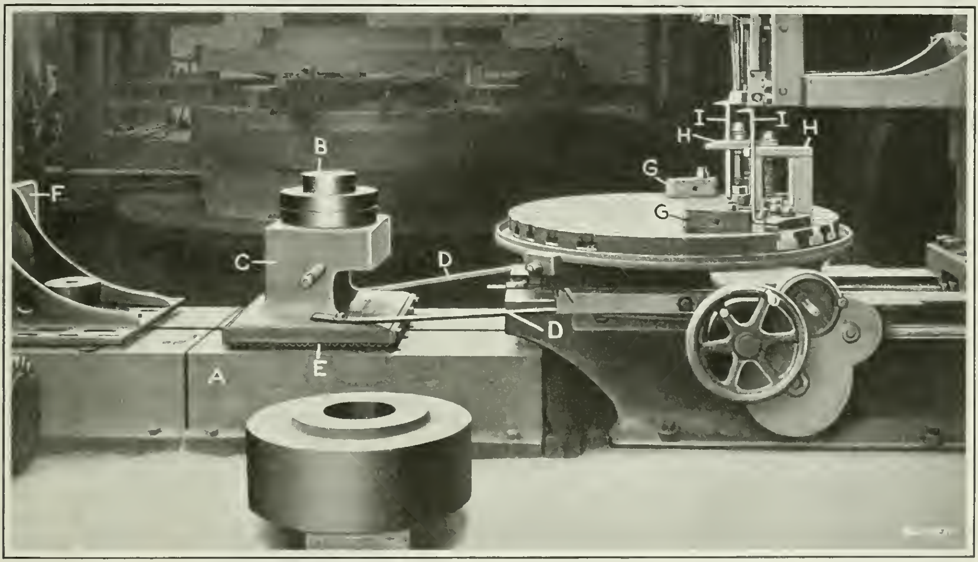


Fig. 3. Slotter with Work removed to illustrate Auxiliary Bed A carrying Arbor B, and Provision for supporting Gear at Each Side

Severity of Service for which Slotters are Adapted

Most modern slotters are rugged machines, and they are adapted for taking the heaviest cuts under the highest speeds and coarsest feeds that can be handled by high-speed steel cutting tools. Fig. 7 illustrates one of the rack-driven slotters which are built by the Newton Machine Tool Works in strokes of from 36 to 72 inches, engaged in performing a heavy rough-planing operation on a gray iron casting. This job is of interest on account of the heavy cut that is being taken, and also on account of the arrangement of the tool *A*, which facilitates handling a job of this kind. Evidently it is desirable to have as little overhang as possible for a tool that is required to take a heavy cut under coarse feed and high-speed. In the present instance it will be noticed that instead of using a cutter-bar which holds the tool bit at a considerable distance from the ram, the tool is transversely clamped to a short head, secured close to the face of the ram. As a result, there is very little danger of the development of an objectionable amount of spring, vibration, or chatter.

As a further example of the severity of service for which well built slotters are adapted, consider the case of a Newton 56-inch slotter engaged upon the planing of steel die-blocks. Working at a cutting speed of 25 feet per minute, and returning the ram at a 2 to 1 ratio, it is stated that this machine showed no signs of distress when taking a cut 1½ inches deep, with a feed of ¼ inch per stroke. Evidently a performance of this kind is one that commends the slotter to the careful consideration of men in the planning department of a shop which has a lot of work, where it is desirable to remove a considerable quantity of excess metal as rapidly as possible.

Cutting Shrinkage Relief Slots in Locomotive Driving Wheels

It is a matter of general knowledge among foundrymen that the amount of shrinkage which occurs in steel during the period of transformation from the liquid to the solid condition, and in subsequent cooling, is greater than that of cast iron and certain other commonly used metals. As a result, the steel foundry must take certain precautions to avoid trouble from conditions caused by the development of severe shrinkage strains in the work. An example of this kind is illustrated in Fig. 9, which shows a cast-steel driving wheel center for a locomotive. Distributed around the periphery of this wheel it will be seen that there are cored slots *A* extending almost all of the way through the rim.

The purpose of these slots is to provide a certain amount of play, which will allow the wheel to adjust itself for shrinkage strains, and thus prevent danger of either breaking the casting or of so far impairing its strength that the finished wheel would be likely to fail in service. However, it will be evident that it would not do to leave these slots as they are shown in the illustration, and the method of procedure followed in the Burnside shops of the Illinois Central Railroad Co., is to set the casting up on a slotter built by the T. C. Dill Machine Co., Inc., of Philadelphia, Pa., and to slot out each of the cored openings in the rim to receive a filler block 1 inch in width. These blocks are carefully machined to be a pressed fit in the slotted openings *A*, so that they may be driven into place and constitute practically the equivalent of integral parts of the wheel rim.

The slotting operation is quite simple, consisting merely of feeding the table in toward the column of the machine, to provide for finishing one opening in the work; and after this has been accomplished, the table is withdrawn and indexed to bring the next cored opening to a position where it can be machined by the slotting tool. This process is repeated for each of the slots around the rim of the casting. The dial *B* which is graduated on the circumference of the

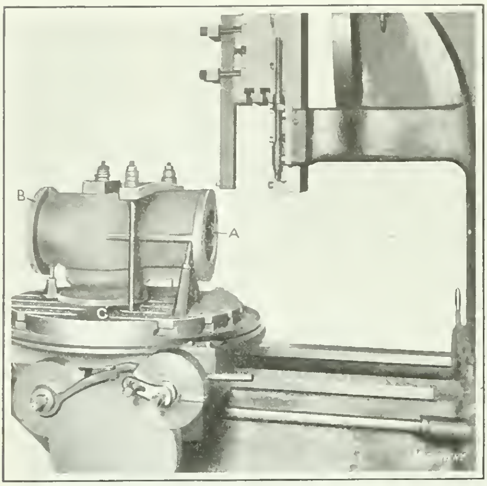


Fig. 4. Close-up View of Slotter used for facing Opposite Ends of Large Valve Body

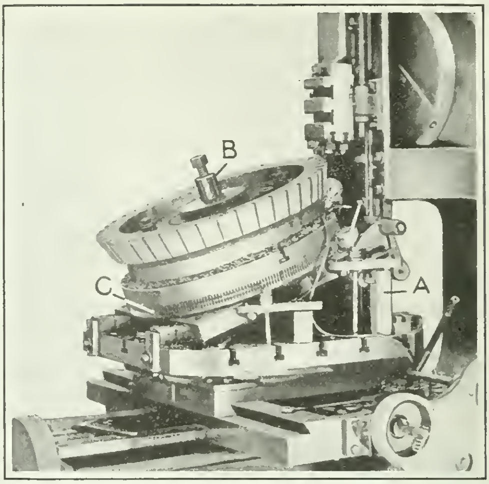


Fig. 5. Slotter used for cutting External Tool Slots around Periphery of Cast-steel Cutter-head

Dill slotter table facilitates the quick and accurate setting of a job of this kind for successive operations. As the casting comes to this machine, the hub has been bored and faced so that it can be used as a locating point. The work is placed over a central pilot, and held down on the faced end of the hub by means of straps and bolts *C* entering T-slots in the table.

Provision for Cutting the Keyway at the Same Setting

One of the important features of design of the Dill slotter is the provision made for carrying the reciprocating cutter-bar or ram on a traveling head, the position of which may be changed to adjust the reach of the slotter to suit its work. In handling the job under consideration, this feature makes it possible also to cut a keyway in the bore of the wheel center without changing the setting of the work. For this purpose, it is merely necessary to run the head out so that the tool is located over the bore where the keyway is to be cut. It will be recalled that the work is located over a mandrel at the center of the slotter table and, bearing this fact in mind, it will be evident that special provision must be made to furnish clearance for the bar carrying the keyway cutting tool. The mandrel over which the wheel center is located is not over one inch high, and its periphery is cut away at one side to allow the cutter-bar to pass below the work sufficiently to complete the keyway. The arrangement of the arbor is similar to that shown in Fig. 12. It is necessary to raise the wheel center slightly above the level of the slotter table by supporting it on blocks.

An alternate method would be to take advantage of the fact that the hole at the center of the Dill slotter table is threaded. The locating mandrel could be made with spanner holes so that after the work was located and strapped down, the mandrel could be removed while the keyway was being cut. The straps would prove adequate to hold the work for the keyway cutting operation, without the mandrel. The first method is recommended for cutting keyways in large bores, while the latter method is more useful in the case of medium and small sized holes. Still another method would be to place the wheel center approximately central with the table, then clamp it down without the use of a centering mandrel, and obtain the required adjustment by revolving the table at high speed and centering the work by applying a piece of chalk to its circumference. The chalk is slowly moved toward the rotating wheel until it just comes into contact with the point farthest from the center of the slotter table. Then the table is stopped and the wheel is tapped with a soft hammer to correct its eccentricity with the table. This test is repeated until the chalk can be applied and will make a continuous mark all around the wheel, thus indicating that the wheel is concentric with the slotter table. Where there are only a few pieces to handle, this method would

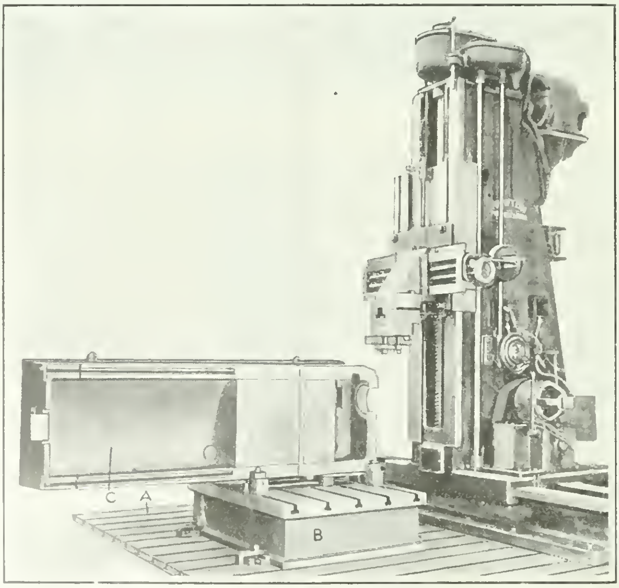


Fig. 6. A Case where it is more Convenient to take a Portable Slotter to a Large Piece of Work than to carry the Work to a Stationary Machine

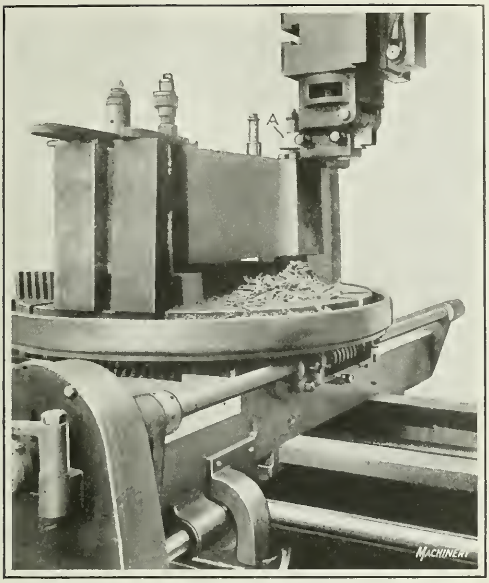


Fig. 7. A Heavy-duty Planing Operation on the Slotter

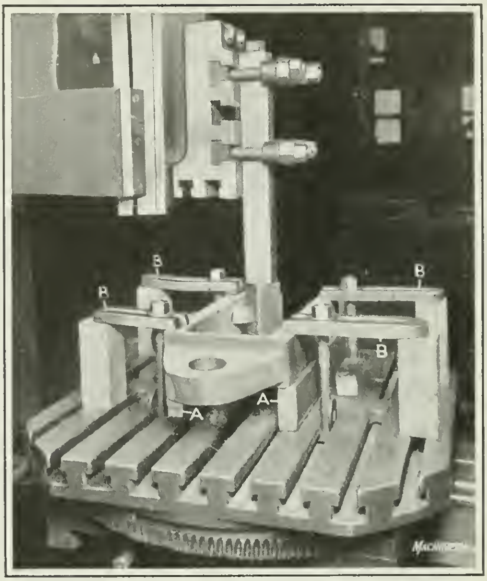


Fig. 8. Planing the Sides and End of a Side-rod Strap

be more satisfactory, because it would save the expense of making the mandrel; but, of course, it is not as rapid as the methods previously described.

Slotting the Middle Connection Side-rod Strap

It has already been explained that the field of application of the slotter extends far beyond the machining of those openings that would properly be termed "slots." A case in point is shown in Fig. 8, where a crank slotter built at the Bement-Miles Works of the Niles-Bement-Pond Co., 111 Broadway, New York City, is shown in the Burnside shops of the Illinois Central Railroad Co., engaged in machining the three sides of the opening in a middle connection side-rod strap for a locomotive. As the work comes to this machine, the upper and lower edges of the strap have been planed, so that they constitute convenient locating points; and the work is set up on the slotter table on parallels *A*, on which it is held down by clamps *B* of the usual form.

For performing operations of this general type on the slotter, attention is called to the fact that these parallels *A* raise the work sufficiently from the table, so that clearance is provided for the slotting tool to have an over-travel beyond the under side of the work. In handling an operation of this kind, advantage is taken of the combination of longitudinal, transverse, and rotary table movements that are available. On this particular job, the transverse and rotary movements are those chiefly employed. The transverse feed carries the work past the slotting tool, and after one side of the opening has been planed, the rotary table movement is utilized to index the work through 90 degrees to bring the next side into position for planing. This operation is repeated a third time for finishing the final side of the work.

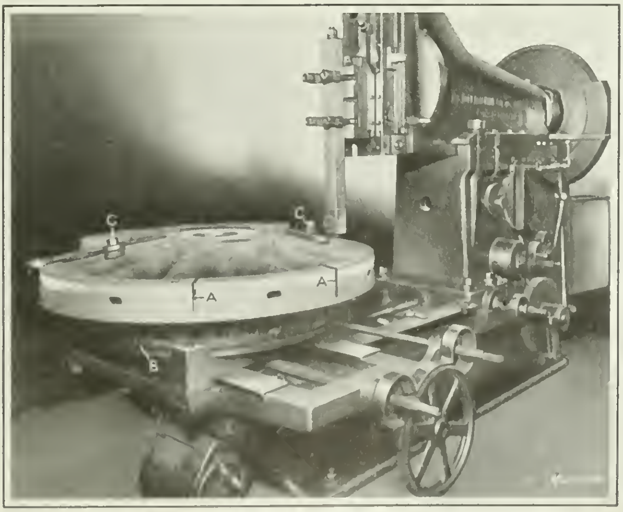


Fig. 9. Slotting out Cored Shrinkage Relief Openings in a Locomotive Wheel Rim

Shaping Locomotive Driving-boxes

Sometimes the statement is made that the majority of the slotters built in this country are sold to railroad shops and to shops engaged in the manufacture and repair of railway equipment. Be that as it may, many slotters are found performing operations in this field, and one of the more interesting jobs for which they are used is the shaping of the seat in driving boxes to receive the bearing brass. Fig. 10 illustrates one of the 30-inch, draw-cut, slotting machines built by Baker Bros., of Toledo, Ohio, engaged in performing such an operation.

A cylindrical seat is machined in the driving-box, that extends around slightly more than a semicircle, with a shoulder at each end so that the bearing brass may be pushed into place by a hydraulic press. Provision for the shaping of this cylindrical segment on the slotter is readily made by first planing the sides of the

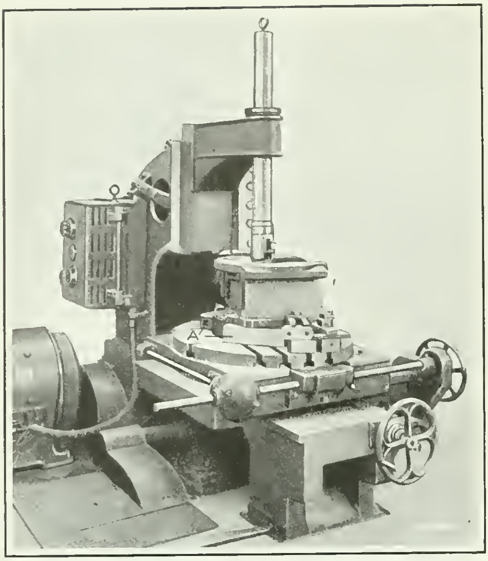


Fig. 10. Use of Continuous Rotary Table Movement on the Slotting Machine for shaping Inside of Locomotive Driving-box

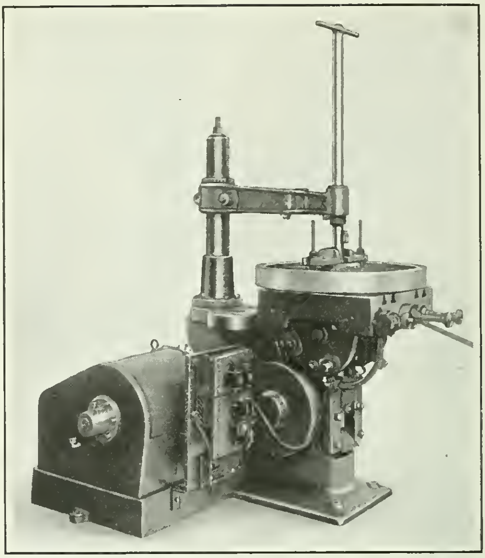


Fig. 11. Performance of a Keyseating Operation in the Hub of a Flywheel held on the Table of a Keyseating Machine

driving-box, and then setting it up on parallel raising blocks *A*, so that clearance will be provided for the tool under the work. Clamped in this manner, the tool is started at one end of the seat, and as it reciprocates over the work, the table is continuously rotated to generate the required cylindrical surface. One of these machines is capable of taking a cut $\frac{7}{8}$ inch deep, with a feed of $\frac{1}{4}$ inch per stroke, in these cast-steel driving-boxes. The cutter-bar is piloted in both the table and the over-arm, so that it is maintained in accurate alignment when working under such severe operating conditions.

Keyseating Operation on a Flywheel

In Fig. 11 is shown a keyseating machine built by Baker Bros., engaged in cutting the keyway in a flywheel casting. The method of operation is quite similar to that of the slotter shown in Fig. 10. However, in the present instance, the tool bit is made the same width as the keyway to be cut, so that it is merely a case of feeding the work straight up to the cutter as it reciprocates through the bearing hole. As in the case of the slotter illustrated in Fig. 10, it will be seen that the bar is piloted in both the over-arm and in the table of the machine, so that accurate alignment is maintained.

Referring to Fig. 12 which illustrates a work-holding fixture of the general type used on the machine shown in the preceding illustration, it will be seen that a hollow pilot *A* is furnished, over which the finished bore of the work is located, so that it is centrally positioned relative to the keyway cutter *B*. As in the case of previous slotting operations, the fixture *C* is cut away in the center to provide for raising the work sufficiently from the table, so that it serves the double purpose of affording clearance for the keyseating tool at the bottom of its stroke, and for chips as they are cut from the work.

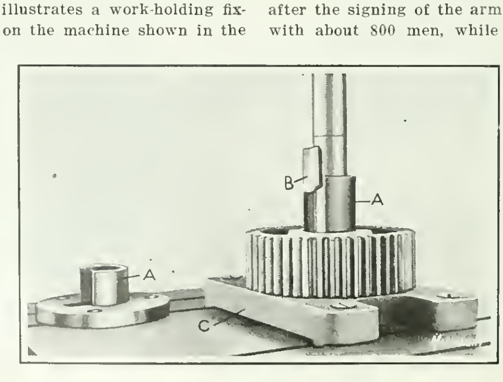


Fig. 12. Details of Work-holding Fixture and Arbor of the Type used on the Keyseating Machine shown in Fig. 11

CANADIAN METAL-WORKING INDUSTRIES

The Bureau of Statistics of the Dominion of Canada has recently published a preliminary report on the foundry and machine shop industry in Canada during 1919. From this report it appears that there are 731 individual foundries and machine shops in Canada, 418 of these being in Ontario and 134 in Quebec. The total capital invested amounts to over $100,000,000, and the value of the output in 1919 was $82,000,000. The industry employed 25,000 workers, and paid in salaries and wages about $30,000,000. The raw materials used were valued at $26,300,000. The greatest volume of business came under the heading of foundries. The value of different classes of machinery and tools made in Canada was as follows: Boilers and engines, $3,900,000; all other kinds of machinery, $12,600,000; contract work and repairs, $8,700,000; and tools of all kinds, $1,600,000.

* * *

According to a recent Commerce Report, the first locomotive built by the Armstrong-Whitworth Co., England, was delivered a little over a year and a half ago, and since that period, over 120 locomotives have been built. Immediately after the signing of the armistice, the company began work with about 800 men, while it now employs 3000 and can complete an engine in about sixteen days. It is stated that orders have been received for locomotives from the Belgian Government, Indian State Railways, Bombay Braoda Railway, Buenos Aires Western Railway, Trinidad and Java Roads, the Midland and Grand Western of Ireland, Northern Counties of Ireland, English Midland Railway, and others, including the Nigerian steam roads. The capacity of the plant is said to be limited only by the scarcity of materials—a difficulty rapidly being overcome.

Common Causes of Errors in Machine Design

Changes in Design—Lack of Concentration—Reasoning from Slight Knowledge—Comparison of Different Designs—Eighth Installment

By R. H. McMINN

ONE great cause of error in a finished product is lack of care in making changes in design and in correcting the drawings to correspond. A change in one or more details may be proposed to remedy a defect at some point in a machine without making a careful analysis as to whether the alteration will incidentally introduce effects not foreseen. Because the change is apparently a minor one the work may be entrusted to a draftsman who is not very familiar with the design of the complete machine, and yet he may be expected to proceed to carry out instructions without making a study of its design and operation. However, the proposed change in a detail may necessitate other changes in the same detail or associated details due to the need for increased strength or additional clearance, or because of some principle which has determined the original design of the part to be changed. No one is entirely competent to judge, in making an alteration, as to whether a single change necessitates other changes, unless he is thoroughly familiar with the basic principles underlying the existing design. Even if the change should be entrusted to the original designer of the machine, he should again familiarize himself with its design, if necessary, and in making any alteration should give full consideration to all incidental effects of the change.

A clear vision of all geometrical relationships involved when making any change from the original or standard drawings must be sought. No change of a detail should be made without a drawing of the assembly and associated details at hand. Making a separate lay-out of parts connecting with or in close proximity to a detail to be altered assists greatly in avoiding errors. One should design nothing for, change nothing on, or add nothing to a machine already installed without a clear knowledge of the machine, as well as the objects surrounding it.

When a change is made in any part or view while making an original design, all obvious changes which are necessitated thereby in previously drawn parts or views should immediately be indicated in some manner on drawings, so they will not be overlooked. When, while checking, a dimension is changed on one part or view, all related dimensions on all parts, views, and drawings should be changed at once to agree, if they have already been checked. All last minute changes in design should be watched carefully. Such changes may upset all previously carefully considered principles and clearances.

Too Great Dependence on Memory

Too great a dependence on memory in engineering work is the cause of many errors. It is absolutely necessary that one's memory be able to retain impressions for a certain length of time. The mere transferring of figures from one place to another involves their retention in the mind during this operation. Those figures and facts which are often used can no doubt be retained by one having a reasonably good memory with a sufficient degree of accuracy to use them without further verification; but length of time elapsing between the noting and using of a fact or figure affects the accuracy of its retention. One set of facts and figures becomes intermingled with other sets. It can be recalled that a part was made approximately a certain way and size but the exact way and size cannot be recalled with certainty. Even though one may correctly remember that a certain part had a certain dimension which is to be duplicated, it may take reference to recent drawings to determine whether such part has been changed and will affect the dimension in the new design. Therefore, as a general thing, memory should not be relied upon as a final check. Even if exact duplication of a part is not necessary, reference to a drawing of a part somewhat similar to the one being drawn may suggest valuable points in design.

Fundamental principles and basic facts not subject to change can be remembered over long periods with sufficient accuracy to base design upon. Likewise, memory can be developed as a great aid in suggesting where to look for certain facts and figures. The combined memory of the members of an organization regarding its particular business is one of the greatest assets of the concern, but an endeavor should be made to conserve mental energy and not burden the mind in trying to remember details that may be recorded for reference.

Lack of Concentration

Many mistakes are due to intermittent concentration on the work at hand, for eternal vigilance is part of the price of accuracy. The mind should not be burdened by thinking of outside matters during work in the drafting-room. There are many chances for considering and selecting the best alternatives as to how the work can be done even in tracing, and this attention helps to form a habit of concentration. Habitual concentration on a single task is less fatiguing than the mental effort necessary to constantly drag a wandering attention back to one's work.

Drawings or specifications should be read intently and not casually. They should not be read faster than one can determine the full significance of the parts read. Numbers should not be read so fast that the figures are interchanged and 1269 is read 2169. This error seems to be due to the tendency to see first the figures most easily seen, unless concentration directs the eye to reading in a certain order. When copying a number it should be read slowly and intently enough so that it is not possible to gain inaccuracy by a second reading. This concentration must be maintained in transferring the figures to any other drawing. The full significance of each figure or word must be kept in mind when writing even when there is an inclination to write somewhat automatically.

A mere glance will not comprehend all the relationships of a machine part to the whole. The entire outline must be consciously observed, the reasons for its being so understood, before a draftsman can intelligently use dimensions from the part. Do not allow the mind to be deceived by first impressions. If, when checking, a dimension of 3 inches is seen in the general locality where the checker knows there should be such a dimension, he is inclined to assume that the dimension line and arrow-heads are so located as to properly denote the dimension of the part intended; but this assumption must be verified by close observation.

In all operations, the hand and brain should be held as close to simultaneous action as possible. The mind should not be allowed to run too far ahead of the hand, or the hand may skip a figure or a word or introduce one erroneously. An attempt should be made to keep the mind off some feature of the work which must be considered at a later time before the job is complete. If questions arise or solutions of problems occur that do not bear directly on the work of the moment, written notes of them should be made to clear the mind. In starting on a train of figures or thought, an attempt should be made to carry it through to a logical stopping place. One should try, at all times, to maintain the same care when nearing the completiou of a job as was used in the beginning.

Reasoning Too Far from Slight Knowledge

One great cause of error is in reasoning too far from slight experience or knowledge. There are several ways by which a designer ventures to predict what the action of any particular elements in a new machine will be:

1. He judges from the action of the same elements in the same kind of machine he is designing, either from acquaintance with an actual machine or from a treatise on the design of that kind of machine.
2. He is instructed by a superior to introduce certain elements with the superior's word that they will work as expected.
3. From his general knowledge of machinery he devises a combination of elements which appears practicable but which he recognizes to be somewhat experimental, because he does not know of the exact combination having been used before.
4. He reasons from the action of the same elements in some machine other than the kind he is designing.
5. He obtains the principles involved in designing an element or a combination from some treatise which includes the design of those elements but does not pertain to their application in the particular kind of machine he is designing or the exact conditions to which he wishes to adapt them.

Comparison of Different Designs

The designer is reasonably safe in predicting results in the first instance cited. In accepting the word of a superior he must, of course, analyze the circumstances himself to see if there is any apparent reason why the combination will not work. If the combination is new and simple, it may not need previous experimentation before incorporating it in a machine, but if complicated its proper working should be verified by experiment. When a designer predicts the operation of certain elements by comparison with an entirely different kind of machine or from a treatise on the design of such elements which does not cover the exact conditions in which he must use them, he must be especially careful.

Too great a departure from the proportions of the elements with which one is making a comparison or the conditions under which they work may introduce effects which the designer may not suspect if he is relying chiefly on his past experience and does not know all of the laws affecting the design of the elements. A radical change in the distribution of metal in a certain type of casting may introduce shrinkage strains which existed to a much less extent in the original casting. A large cast-iron gear on a certain machine may have had the rim, spokes, and hub especially proportioned to reduce such strains. Unless a designer knows the tendency of such castings to crack by unequal cooling, he may use a gear approximately the same except with a specially large thick hub with special bosses on it, which will radically increase shrinkage strains.

The designer may recall from his past experience where an unbalanced cast-iron wheel rotates satisfactorily at a thousand feet per minute peripheral speed. He may not even know of the comparatively slight strains in the metal that were produced by centrifugal force, and the effect of lack of balance may not have been evidenced. The wheel may have been fitted to a shaft that rotated in cast-iron bearings lubricated merely from an oil-hole, which properly served the purpose at slow speed. However, if this wheel were rotated at a peripheral speed of five or six thousand feet per minute the action of centrifugal force in producing internal strains and unbalanced effects would have to be considered as well as the desirability of changing the material of the bearing, its length, the method of lubrication, and the size of shaft. Therefore if one who is ignorant of the laws affecting the rotation of such a wheel should use at high speed exactly the same design for wheel and bearings that had been used at low speed, thinking that the only change was one in speed, in all probability he would get into trouble.

All substances are affected by changes in temperature. If the temperature to which certain parts will be exposed in a new machine differs greatly from that in which they were known to have been used satisfactorily in another machine their durability or operation in the new machine may be affected. This is especially true of non-metals like cloth, rubber, leather, hemp, or manila rope and wood, because these materials are damaged by heat at relatively low temperatures. Combinations using water as one element must be considered in reference to operating temperature, because of the comparatively limited range in temperature between which water freezes and boils. The strength of metals used in machine construction starts to decline at temperatures ranging from 200 to 700 degrees F.

Reference to Treatises on Design

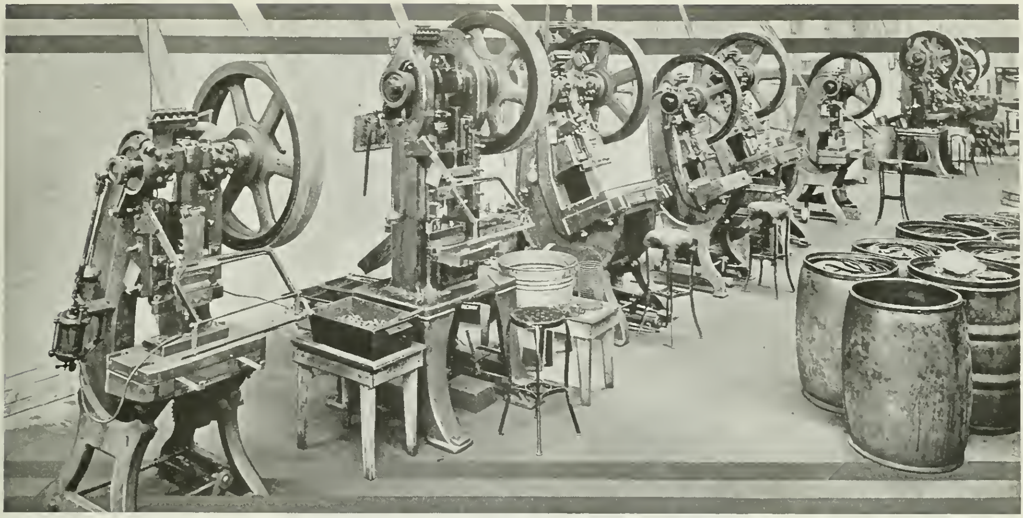
When a designer consults a treatise which covers the principles involved in the design of a certain kind of part, he is liable to fall into error if the authority he uses does not give all of the principles which he should know for his particular condition. Books on machine design generally cover the bursting strain produced by centrifugal force on the rim of a rapidly revolving wheel, but many do not call attention to the unbalancing effect of a single mass, as a boss, which is off center on such a wheel. Some elementary books on strength of materials go into the strength of various sections in bending, usually including the I-beam, and base its strength on section modulus only. They do not state that the effective strength of an I-beam when subjected to bending may be considerably reduced unless it has lateral support to reduce the strains in the compression flange, nor that under certain conditions stiffeners must be provided to prevent crippling of the web. Therefore, if a designer is working with elements with which he is not entirely familiar, the selection of the authorities to consult regarding their design is important. He should endeavor to select for reference a treatise which is sufficiently comprehensive so that his reasoning may be based upon all of the principles involved.

Relation of Other Machines or Equipment

A designer should not proceed with insufficient dimensions or information. One frequent source of error is in the lack of knowledge of the characteristics of machines which may have to be purchased to go with the machine one is designing, such as engines, pumps, fans, motors or other electrical material. The machine being designed may depend partly upon the characteristics, or some special feature or size of one of these machines, and he must therefore become sufficiently familiar with the type to be used to avoid errors in his design.

He must also know the exact shape and size of any other special material to be ordered for the machine, such as ball and roller bearings, clutches, chain, valves, bolts, screws, as well as lumber (the sizes of which when dressed are less than nominal sizes). He must not only know the characteristics and sizes of all equipment and material to be purchased, but must so definitely specify and describe such items on bills of material that no one can misinterpret what is required.

The concluding installment of this series of article will appear in September MACHINERY.



The Use of Inclinable Power Presses

Distinctive Features and Class of Work Advantageously Performed

By N. T. THURSTON, The Acklin Stamping Co., Toledo, Ohio

THE field of inclinable power presses is comparatively small work which can be produced from sheet metal, fed laterally past the punch and die from rolls, the force of gravity being utilized for carrying the completed part off the press into a suitable receptacle. However, the stock may also be fed in long strips and, generally, transversely through the machine. Although inclinable presses are limited to manufacturing small parts, this is not because the type of press limits the size of work that can be handled, but because the class of work limits the size of press on which the necessary operations can best be performed.

The advantages of feeding the stock in strips, or from a roll, and of utilizing the force of gravity for disposing of the finished parts are applicable only to small work, and so presses of the type being considered are of limited size, the largest having an over-all height of about 9 feet and a weight of approximately 9600 pounds, while the smallest is about 3 feet in height and weighs about 300 pounds. The smaller presses are not equipped with legs, as they are intended for bench use. Most of the presses in use are well within the limits mentioned, in size and weight.

The feeding of stock across the front of the press is made possible by a gap between the table and the portion of the frame supporting the ram. This construction will be apparent by reference to the illustrations in which presses are depicted. The same construction is found in many types of punching presses. The utilization of the force of gravity to carry the completed part away from the die is accomplished by tipping the frame backward so that the ram is positioned at an angle from the vertical. As will be seen in Fig. 1, the frame of an inclinable press is circular on the bottom to permit it to be placed at different angles of inclination. Advantage need not necessarily be taken of this means of removing work from the press, and so presses of this type are frequently used with the ram positioned vertically.

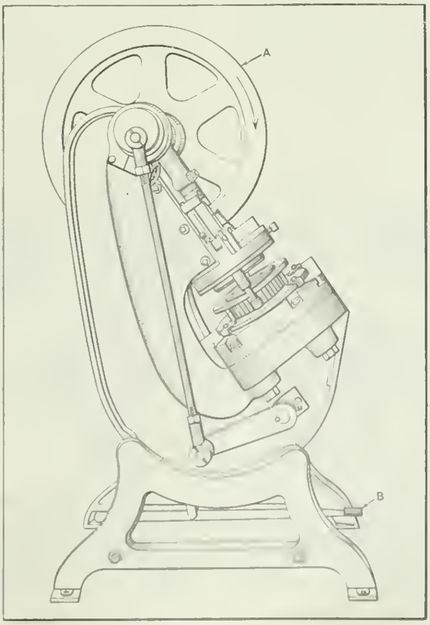


Fig. 1 Inclinable Power Press

Inclination of Presses

The inclination of presses is regulated by various mechanical devices on different machines. Some presses are provided with a set of gears actuated by a crank for the purpose, while others are swiveled by turning a handwheel attached to a vertical screw, the handwheel being located between the legs of the press. The machine illustrated in Fig. 1 is of the ungeared type and is driven by a belt connected to the flywheel pulley A. An opening in the back of the frame allows the feeding of strips of stock through the machine in addition to the lateral feed. Most inclinable presses are equipped with a pin-type clutch for transmitting motion from the flywheel to the crankshaft, this clutch being capable of quick engagement and disengagement. The clutch is engaged by depressing the foot-lever *B*. While there are several designs of inclinable presses, the one illustrated is representative of the general principles incorporated in all presses of this class.

The degree of inclination depends upon the work and the type of die being used. For example, in Fig. 2 a combination blanking and drawing die is employed for the production of brass cups used as face-powder containers. These cups are light in weight, and so a considerable inclination of the press is required to cause them to slide away from the die rapidly enough so as not to interfere with the continually descending and ascending punch. The cups are made from brass stock placed in rolls at the right of the machine and fed across the die. An inclinable press is particularly suited for this work.

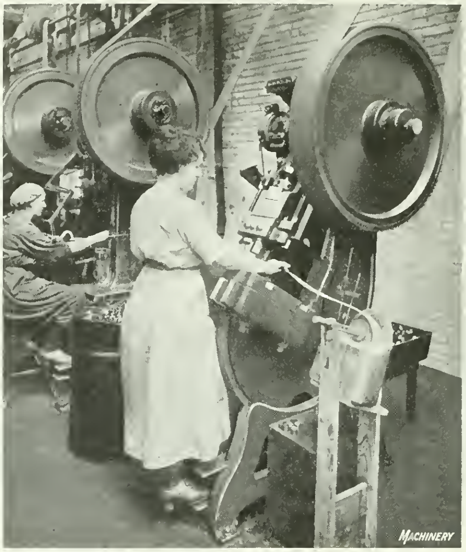


Fig. 2. Producing Small Brass Cups from Stock fed from a Roll, on an Inclinable Power Press

Classes of Work Readily Performed on Inclinable Presses

The part produced by the machine shown in Fig. 2 is illustrated at *I*, Fig. 3. This illustration shows a number of parts typical of the classes which can be successfully produced on inclinable presses. Those shown at *A*, *B*, *C*, and *J* are blanked and pierced, the operations being performed by follow-dies as the stock is fed across the machine while the latter runs constantly. This continuous operation of the press, which is possible because of the rapid removal of completed parts from the die, permits high rates of production. At *L* is shown a small tinware part used in the base of a vacuum bottle. This part is made complete in one stroke of the press, that is, it is blanked, drawn, and stamped. It is fed from narrow sheet metal in rolls, and slides from the die into a pan at the rear of the machine at the rate of about 15,000 parts per ten-hour day. The appearance of a valve-spring retainer at the end of a blanking, piercing and drawing operation is shown at *H*. The parts *H*, *I*, and *L* are drawn to some degree, and it is on work of this nature that an inclinable press is limited to a certain depth of drawing. The quick-action characteristic of ungeared inclinable presses does not permit the forming or drawing of even small parts to any great depth. This is true for the reason that in drawing metal opportunity must be given to permit the metal to flow under the pressure of the die parts. A quick sharp impact will not give the metal this opportunity, and so causes it to crack and tear.

All the work so far considered has been produced in one operation with either a single die or a follow-die. Although one-operation work is best suited for manufacture on inclinable presses, other parts which require subsequent press operations can also be produced if the dies are constructed so as to eject the part at the conclusion of each operation and allow it to slide away by gravity. Those parts illustrated at *D*, *E*, *F*, *G*, *K*, *M*, and *N* represent work of this sort. These parts are first blanked from long strips of stock on an inclinable press, and then finished in following operations on presses of the same type. The subsequent operations do not allow as rapid a production as the blanking operation, due to the inability of feeding the pieces as quickly. Nevertheless, no work on the part of the operator is necessary to remove the piece from the press, and this feature alone permits greatly increased rates of production. There is a great variety of mechanisms for the purpose of rapidly and automatically feeding parts to the die, such as disk feeders, hopper feeders, etc., but as the work is generally of the nature shown in Fig. 3, the force of gravity alone is relied upon to remove it from the die. All photographs here reproduced were taken in the shops of the Acklin Stamping Co., Toledo, Ohio.

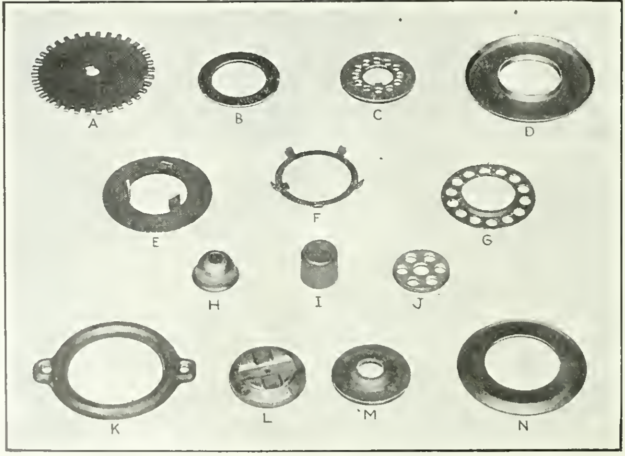


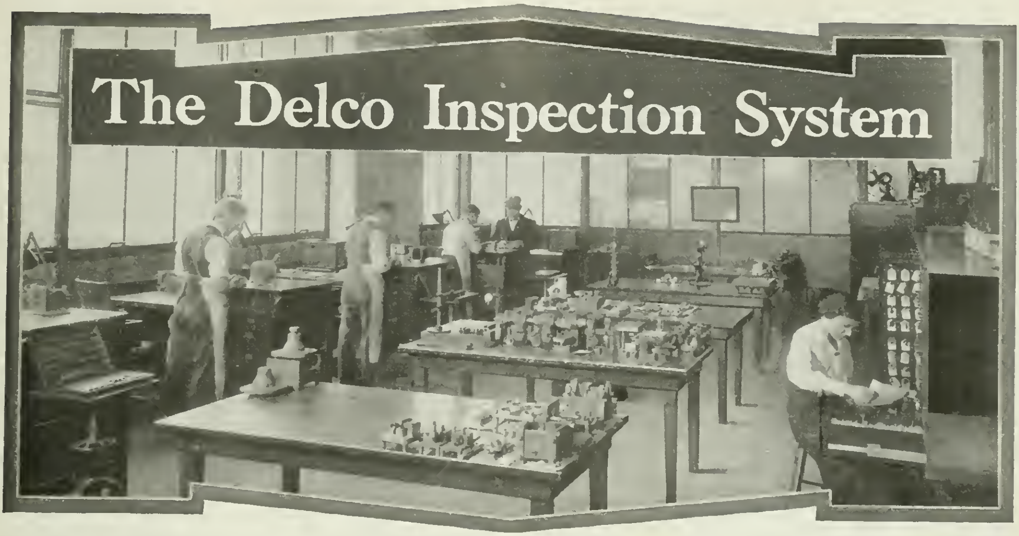
Fig. 3. Specimens of Work of the Sort for which Inclinable Presses are Most Suitable

* * *

TRAINING WORKMEN IN SAFE PRACTICES

It is estimated that 90 per cent of the shop and factory accidents of this country are caused by inattention, carelessness, or lack of skill or judgment. For this reason the training of workmen in safe practices should be given at least as much attention as the installation of machine guards. The training of workmen along these lines should be so thorough that they will be constantly on the alert to detect and avoid dangerous working conditions, as well as to correct "chance-taking" habits. It is claimed that a reduction of from 25 to 75 per cent in accidents has resulted from the establishment of safety organizations in certain plants, and that this decrease in accidents has been accompanied by greater output, product of better quality, and a decrease in the labor turnover.

The Delco Inspection System



Typical Examples of Gaging Fixtures Used by the Dayton Engineering Laboratories Co. in the Manufacture and Inspection of the Company's Product—First of Two Articles

By ERIK OBERG

IN the articles published in the May, June, and July numbers of MACHINERY, the principles of inspection, the inspection system used by the Dayton Engineering Laboratories Co., Dayton, Ohio, and the general tool and gaging system employed by the company, were described with special reference to the main features of the system. The present articles will describe specific gaging and inspection fixtures that are typical of those used in the company's plant. The examples that have been selected for illustration will give a comprehensive idea of the extensive use that is made of special gaging fixtures in this plant, and will indicate the methods that are employed in designing these, to obtain accuracy of inspection as well as simplicity and rapidity in handling the work. This article will be continued in September MACHINERY, completing the series.

Concentricity Gages

One of the important classifications of gages used in practically all lines of manufacture, and especially in the manufacture of apparatus in which armatures or other cylindrical parts rotate, is concentricity gages. These may be designed in various ways, but the method generally followed is to provide a base with an upright on which the part to be gaged is placed so that one of the cylindrical surfaces to be tested for concentricity fits over some part of the upright. The upright has a hole or bushing in it, concentric with the surface mentioned, which is intended to receive a plug, the latter, in turn, being provided with some kind of ring or swinging gaging member which will fit over some other surface, the concentricity of which is to be gaged.

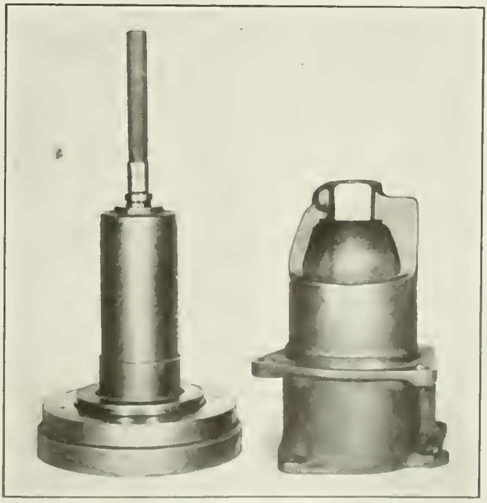


Fig. 1. Concentricity Gage

A simple example of a gage of this type is shown in Fig. 1. The work to be gaged is shown at the right, and the gage itself at the left. A hole in the lower part of the casting to be gaged fits over the cylindrical portion at the lower end of the upright of the gage. The plug gage shown has a pilot which fits into a bushing in the upper part of the upright, and the concentricity of the hole in the upper part of the casting is gaged by the protruding shoulder on the plug gage fitting into this hole as it is pushed into position. A somewhat similar concentricity gage is shown in Fig. 2. Here the work is represented by the dot-and-dash lines *A*. The bushing *B* locates the work on the fixture, the object of which is to test the concentricity of the bore *C* and hub *F* with *B*. After the work is placed in position, bore *C* is tested by simply pushing down the plug gage *D*. After the plug gage is in place, bushing *E*, mounted on it, is pushed down over hub *F*, thus testing the relative concentricity of the cylindrical surfaces at *B*, *C*, and *F*.

Concentricity Gage for Pole Pieces

A concentricity gage intended for gaging the concentricity of pole pieces after the poles and field coils are assembled in the frame is shown in Fig. 3. The dot-and-dash lines show the frame and poles in place on the gage, the frame being located by surfaces *A*. The base of the gage is provided with a collared stud *C* on which bushing *B* is a good sliding fit. Bushing *D*, in turn, is

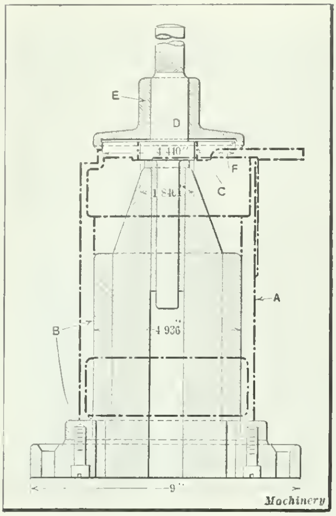


Fig. 2. Gage for inspecting Concentricity of a Bore with a Hub

mounted on bushing *B* with a press fit, the two bushings resting on the collar of stud *C*. Gaging member *E*, which is a hardened tool-steel part, is let into a slot or keyway in bushing *D*, and held in position by screws as shown. When the work is mounted on the fixture, part *E* should be able to revolve entirely around without touching the pole pieces *F*. The diameter of the hole through the pole pieces has previously been tested by limit plug gages, and the gage shown is intended only for testing the concentricity of the pole piece with the cylindrical surface *A*. The knurled handle at the upper end is pinned to bushing *B* to permit revolving the gage portion when using the fixture.

Concentricity Gages for Bearing Plates

Fig. 4 shows a series of gages used for inspecting the concentricity of various holes and hubs in the bearing plate shown by the dot-and-dash lines. The gaging fixture at the left is used for gaging the concentricity of the hole *D* with the hub *E*. This is done by simply pulling plug *A* upward after the work has been placed in position in the fixture. Plug *B*, shown at the left of the fixture, is used for testing concentricity in the same way as plug *A*, except that it is used after a bushing has been assembled in place in hole *D*, this being done in a subsequent operation.

The fixture in the center of Fig. 4 is employed for gaging the concentricity of hole *F* with the surface *J* in the same way that hole *D* is gaged in the fixture to the left, and the plug *G* is used for testing the hole after the bushing is in place, in the same manner that plug *B* is used.

The fixture to the right is used for testing the center distance between the two holes *D* and *F*. The work to be gaged is slipped over bushing *H* mounted on a stud inserted in the fixture, and plug gage *I* is then pulled upward, thereby testing the center distance between the two holes.

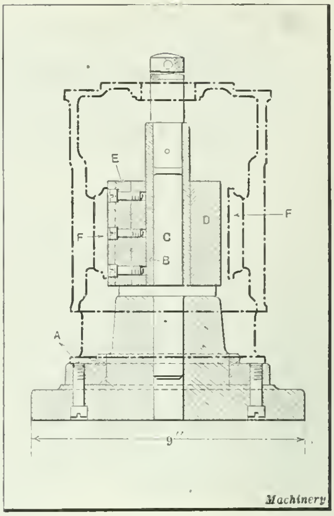


Fig. 3. Gage for inspecting Concentricity of Pole Pieces after Assembly

Inspection Gage for Motor Generator Frame

A box type inspection gage, used in inspecting the frame of a motor generator for a starting and lighting set, is shown in Figs. 5 and 6. The frame is shown at the left in Fig. 5, and consists of two malleable castings bolted together. This frame is inserted in the box gage for testing the location and concentricity of various holes and surfaces; its position in the gage is shown by dot-and-dash lines in Fig. 6. The object of the gage is to test the location of the bore *A* (the same reference letters are used to designate the same parts in both illustrations), with relation to the three dowel holes *B* on one side of the frame and the three dowel holes *C* on the other side. It also tests the relation

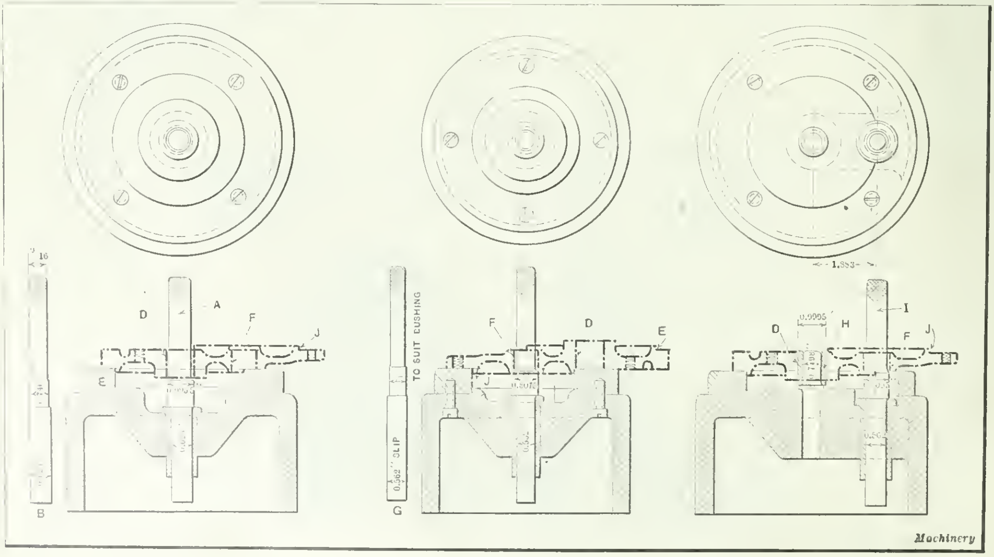


Fig. 4. Series of Concentricity Gages used for inspecting the Relation between Various Surfaces of a Bearing Plate

of the surfaces *D*, *E*, and *F* with relation to the bore *A*, and enables the location of the two holes *G* and the dimension *H* to be checked.

As will be seen by an inspection of Fig. 6, the work is located by being placed over three dowels in the bottom of the fixture, located to correspond with holes *B*. The location of the dowel-pin holes *C* on the opposite side is then tested by plungers *P*, which are carried in the cover of the fixture and are provided with bayonet locks so that they can be kept out of the way when the work is put in place. The location of surface *D* is tested by two feeler gages or plungers *I*, while the location of surfaces *E* and *F* is determined by the use of a limit plug gage passed between these surfaces and the hardened gaging blocks *K*. The location of the holes *G* is tested by the plungers *L*, and the length *H* is determined by the feeler gages *M*. The concentricity and the location of the bore *A* is determined by the use of plunger *J* provided with a handle *N* at the top for convenient manipulation.

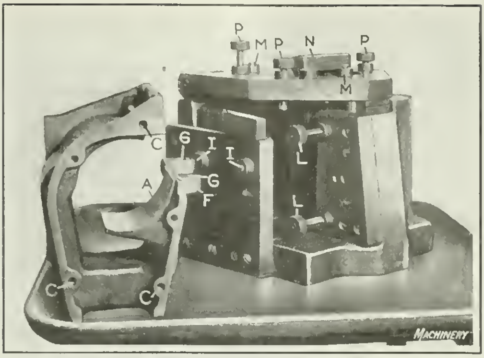


Fig. 5. Box Type Gaging Fixture for Motor Generator Frame

Inspection Gage for Distributor

Fig. 7 illustrates an inspection gage used for the final mechanical test on the assembled distributor for a well-known automobile. A similar gage is shown in detail in Fig. 8, with the position of the work indicated by dot-and-dash lines. The object of the gage is to test the location of the tapered end of the shaft *A* with reference to the holes into which threaded plugs *C* enter, and also to determine the vertical location of the center of *A*.

The work is located on the gage by the threaded plugs *C* screwed into the holes in the distributor. The base of the distributor rests upon the hardened pad *D*. Disk *E* is slipped over the tapered stud *A* before the piece is placed in the fixture. After the work is located, plunger *F* is slipped into place and by having a "Go" and "Not Go" step at its inner end, the checking of the radial distance 0.997 inch will test the vertical location of the tapered shaft *A*. A "Go" and "Not Go" plunger *G* is used to test the lateral position of shaft *A* with reference to face *B* of the disk, thereby also testing the location of the taper with reference to the threaded plugs *C*. Finally the concentricity of the tapered shaft *A* is gaged by revolving disk *E* while in contact with the plunger of an Ames indicator *H*.

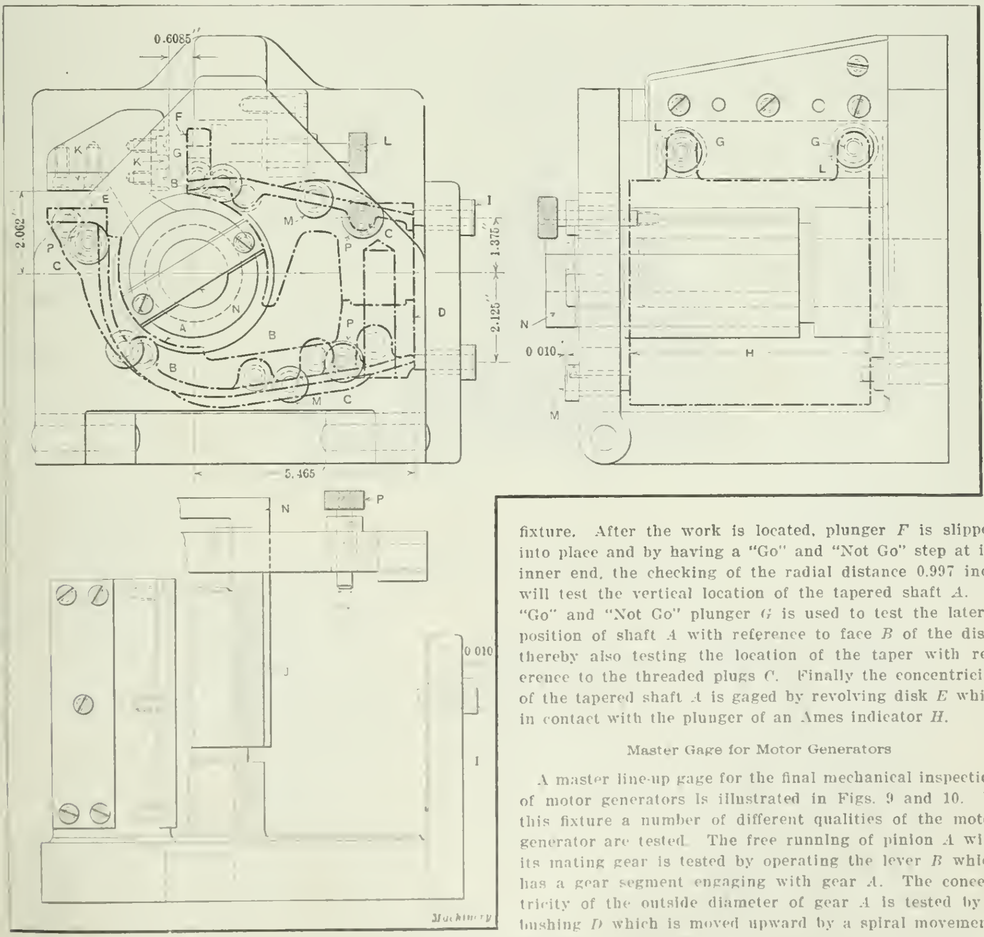


Fig. 6. Detailed View of the Gage shown in Fig. 5 with the Position of the Work and the Relation of the Gaging Points indicated

Master Gage for Motor Generators

A master line-up gage for the final mechanical inspection of motor generators is illustrated in Figs. 9 and 10. In this fixture a number of different qualities of the motor generator are tested. The free running of pinion *A* with its mating gear is tested by operating the lever *B* which has a gear segment engaging with gear *A*. The concentricity of the outside diameter of gear *A* is tested by a bushing *D* which is moved upward by a spiral movement, actuated by handle *F*. The dimension *L*, which determines the location of gear *A*, is tested by a "Go" and "Not Go" plug gage. This actually determines the length of dimension *M*, which is the important dimension in this case. The flat surface *G*, the cylindrical surface *H*, and the dowel-pin *I*, are the means by which the motor generator is located in the inspection fixture.

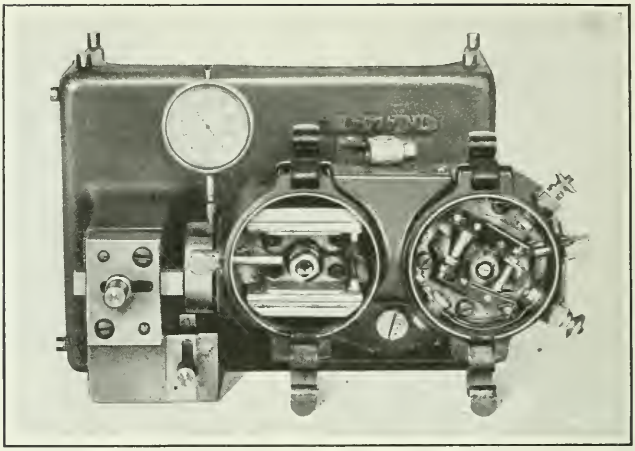


Fig. 7. Fixture on which Ignition Distributors are inspected

The fixture is also used in checking the action of the motor brushes on the commutator. The starting or cranking mechanism of the generator is set in motion to start the automobile engine by depressing a foot-pedal. The depression of this pedal not only brings the motor brushes into contact with the motor commutator but also brings the starting gears into mesh. In order to insure quiet meshing of the gears, the contacting of the motor brushes with the commutator and the meshing of the gears must be properly timed. Referring to the illustrations, lever *J* corresponds to the starter foot-pedal of the automobile, and pin *E* is a duplicate of the motor-brush actuating pin used in the assembled unit. As lever *J* and pin *E* are pinned to the same shaft, the motor brushes can be brought into contact with the commutator by moving lever *J*. The point of contact or timing of the brushes is clearly shown by having an electric lamp connected in circuit with the commutator brushes and by providing a series of graduations at *K*, Fig. 9. If lever *J* reaches a certain predetermined graduation mark when the electric lamp is lighted, due to closing the circuit, it shows that the timing of the contact between the motor brushes and the commutator is accurate.

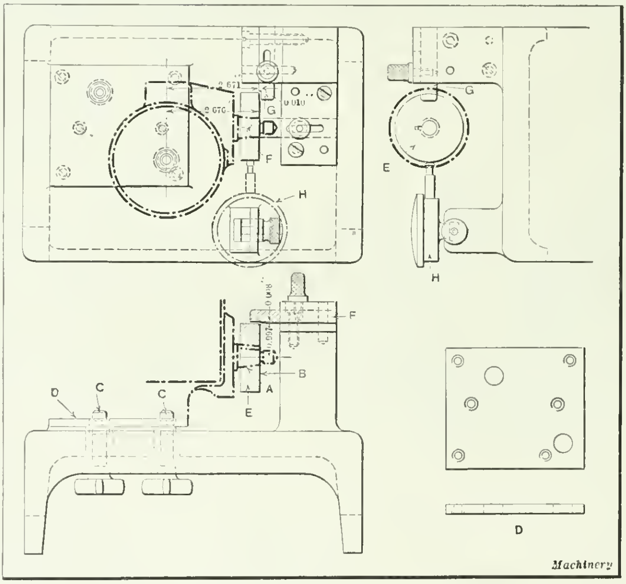


Fig. 8. Detailed View of Gaging Fixture for Ignition Distributors

Recess Gage for Clutch Shells

Figs. 11 and 12 illustrate a gage used for inspecting the recess at the edge of the clutch shell shown at the left in Fig. 11. The width of the recess is gaged by placing the shell over the gaging points at *A* and *B*, in the position indicated. It will be seen that the work is seated against the pins *C*. The gaging point at *B* is at the end of a lever, the other end of which actuates an Ames dial indicator, by means of which it is easily determined whether the actual tolerance on the depth of recess is maintained. A snap gage is placed over the gaging points for the purpose of setting the indicator, so that it will read zero when the gaging point *B* is in the proper relation to the gaging point *A*. The gage does not indicate whether the error is in the depth or the width of the groove, but whenever the work will seat on pins *C* and the indicator does not show the right reading, the groove is either too narrow, or its depth is incorrect, or both.

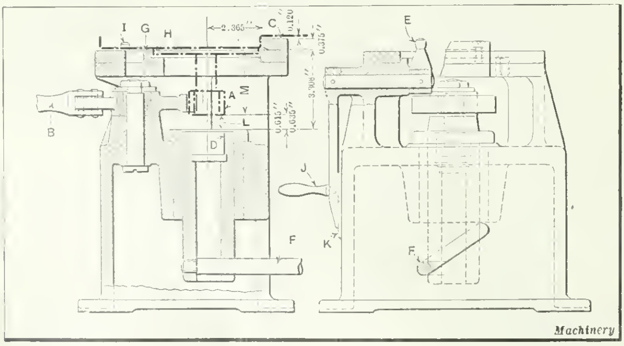


Fig. 9. Sectional View of the Motor Generator Testing Device shown in Fig. 10

In September MACHINERY a number of additional testing fixtures and gages will be described, including a spring testing fixture, a gage for testing installation conditions of motor generators, amplifying gages, device for testing the spacing of ignition cams, plate gages for the automatic screw machine department, gear-testing devices, limit gages for rollers, etc.

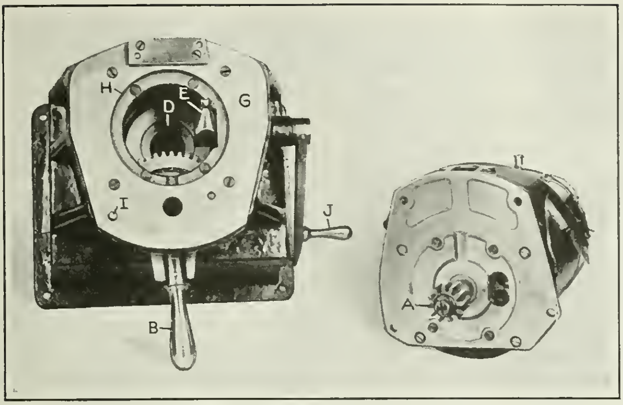


Fig. 10. Functional Gage used in Final Inspection of Motor Generators

INDUSTRIAL INDEX NUMBERS

The Department of Commerce has undertaken to issue monthly index numbers showing the relative changes taking place in a number of financial and industrial activities, which will give an idea of the general industrial activity and the price situation. Instead of giving the statistics in total figures of dollars, tons, etc., comparative index numbers have been prepared which makes it much easier to make instant comparisons. As far as possible the relative numbers have been arrived at by using the average of 1913 as a base number equal to 100: but in many instances the basic data do not go back to the pre-war years, and in such cases the average for 1919 has been used as a base.

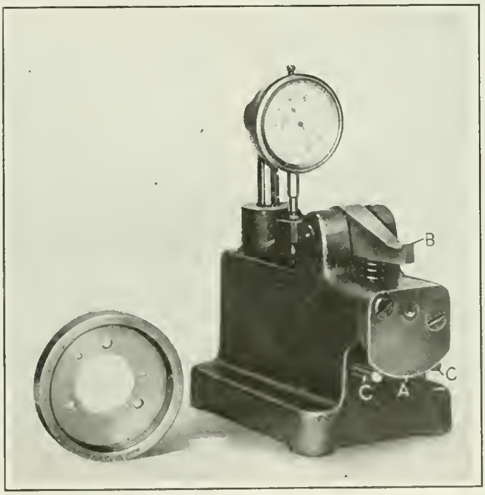


Fig. 11. Gage for checking an Internal Recess

The data that have been published by the Department of Commerce include information relating to banking and financial operations, price index numbers, transportation, foreign trade, farm products and foodstuffs, metals and metal products textiles, fuels and power, paper, and rubber. A study of these index numbers is very illuminating.

In the price index, for example, comparing with 1913 as 100, it will be seen that the peak for metal and metal products was reached in April, 1920, when prices for these products were 195, while in May, 1921, they were 138. Of the various commodities listed, only the wholesale prices of food and farm products show at present a lower price index number than metals and metal products.

As regards transportation, comparison is made with the 1919 average, because figures for 1913 are not available. These figures show that in May, 1921, the average freight movement was 93 as compared with 100 in 1919. The peak in freight movement was reached in October, 1920, when it was 124. The lowest figure recorded is for January and February, 1921, when it was 85. This shows what a comparatively small margin there is between a feast and a famine for the railroads. With 24 per cent above the 1919 average, the railroads were unable to cope with the traffic. With even 7 per cent below, as in May, they find it impossible to meet their expenses because of the reduced revenues.

The figures for exports and imports show that the exports in May, 1921, were 161 as compared with 100 in 1913, the imports being 139; but in May, 1920, the same figures were 363 and 289, respectively.

The production in the metal and metal products field is well indicated by these index figures. Placing the 1913 average as 100, the pig iron production in October, 1920—the peak month—was 129, falling to 48 in May, 1921; the steel ingot production, which was 131 in March, 1920, fell to 50 in May, 1921. The iron and steel exports reached their peak in January, 1921, at 235, falling to 70 in April, 1921. These index numbers will be published from month to month.

* * *

In a recent Commerce Report it is stated that the Department of Overseas Trade in Great Britain is steadily extending its trade commission service in all of the principal markets, and is keeping exporters well advised of German methods and of trade openings available for British exporters. British wholesale prices are being drastically cut, and the fact is being made wider known by a new scheme of cooperative advertising in the leading newspapers of Australia, France, Japan, India, South Africa, South America, Belgium, Holland, Cuba, Scandinavia, Spain, China, Dutch East Indies, Mexico, and Switzerland. In some cases the advertisements are run parallel with German manufacturers' announcements so that a comparison of prices and of quality can be studied by foreign buyers. Films showing the methods of British manufacture are a notable feature of the new drive that is being made for increased trade.

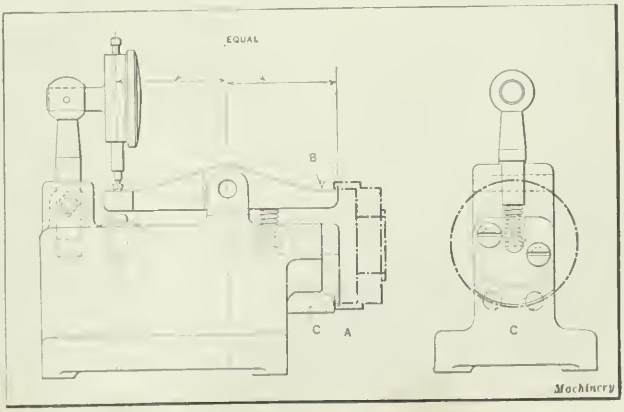


Fig. 12. Position of the Work when inspected with the Gaging Fixture shown in Fig. 11

MILLING A 99-TOOTH SPIRAL GEAR

By GEORGE WARMINGTON

Proper spacing of the teeth in cutting a 99-tooth spiral gear in a milling machine could not be accomplished by simple indexing, and compound and differential indexing were, of course, impossible due to the index-head being connected to the table feed-screw in order to rotate the work to suit the lead of the teeth. The difficulty was overcome by the use of a special templet in connection with a 33-hole circle on an ordinary index-plate. This templet is illustrated in Fig. 1. Thirty-three equally spaced teeth were first cut around the work, then the position of the index-head crank relative to the work was altered by means of the templet, and thirty-three more teeth were cut, after which the crank position was again shifted and the final thirty-three teeth were milled.

In order to space correctly each tooth in the first set milled, the index-head crank was rotated an amount equal to the ratio of the index-head divided by the number of spaces desired. As $40 \div 33 = 1\ 7/33$, the crank was turned one complete revolution plus 7 holes, or a total of 40 holes, on the 33-hole circle. After having cut the first set of teeth, in order to mill a tooth one third of the distance between any two, it was necessary to move the crank 1/3 of 40 or 13 1/3 holes. As this was impossible by means of the index-plate alone, the templet previously referred to was employed. The distance between the centers of holes *A* and *B* on this templet is equal to the length of the chord between the centers of any two adjacent holes on the 33-hole circle, and the center of hole *C* is one-third the distance between the centers of holes *A* and *B* when measured along an arc corresponding to that of the 33-hole circle.

After the first set of teeth had been cut, holes *A* and *B* of the templet were placed over the thirteenth and fourteenth holes, respectively, from the one on the index-plate in which the spring plunger of the crank was inserted while cutting the last preceding tooth. Pins were then inserted through holes *A* and *B* into those of the index-plate in order to secure the templet to the latter. The crank was next turned and its plunger inserted in hole *C* of the templet, thus moving the crank the desired 13 1/3 spaces, after which the two clamping screws on the crank were loosened, the templet removed, and the crank turned to the thirteenth hole, the work, of course, remaining stationary. After the clamping screws of the crank had been retightened, the indexing movements necessary for correctly spacing the next set of teeth were made in the same manner as during the milling of the first set. When the machining of the second set of teeth was completed, the position of the crank relative to the work was again altered in the manner previously described, to permit the final set of teeth to be correctly spaced.

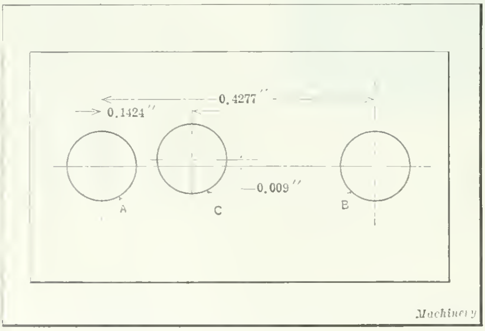


Fig. 1. Templet used with Index-plate for spacing the Teeth in a 99-tooth Spiral Gear

The determination of the various dimensions shown in the templet required trigonometric calculations, as explained in the following, use being made of the diagram illustrated in Fig. 2. The radius of the 33-hole circle of the index-plate was 2.250 inches. It is evident that,

$$COE = \frac{360 \text{ deg.}}{33} = 10 \text{ degrees } 54 \text{ minutes } 33 \text{ seconds}$$

and

$$COD = \frac{COE}{3} = 3 \text{ degrees } 38 \text{ minutes } 11 \text{ seconds}$$

As *OK* is perpendicular to *CE*,

$$KOC = \frac{COE}{2} = 5 \text{ degrees } 27 \text{ minutes } 16 \text{ seconds}$$

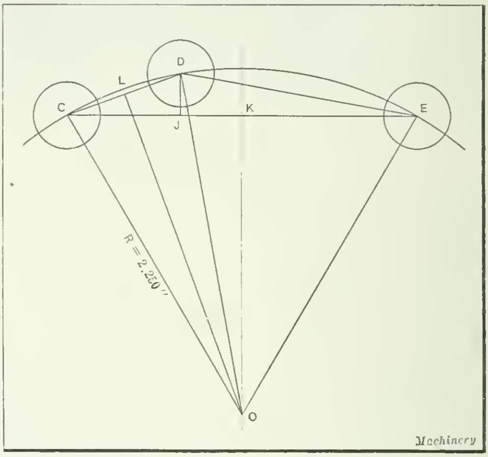


Fig. 2. Diagram used in calculating Dimensions in Fig. 1

Also, as *LO* is perpendicular to *CD*,

$$COL = \frac{COD}{2} = 1 \text{ degree } 49 \text{ minutes } 5 \text{ seconds}$$

Finally, *DJ* is perpendicular to *CE*. According to geometry,

$$DCJ = COD = 3 \text{ degrees } 38 \text{ minutes } 11 \text{ seconds}$$

Having now determined the magnitude of the various angles involved, the lengths *CE*, *CD*, *DJ*, and *CJ* can readily be calculated.

$CE = 2R \sin KOC = 2 \times 2.25 \times 0.09506 = 0.4277$ inch
$CD = 2R \sin COL = 2 \times 2.25 \times 0.03172 = 0.1427$ inch
$DJ = CD \sin DCJ = 0.1427 \times 0.06342 = 0.009$ inch
$CJ = CD \cos DCJ = 0.1427 \times 0.99799 = 0.1424$ inch

* * *

PROTECTION OF AMERICAN PATENTS ABROAD

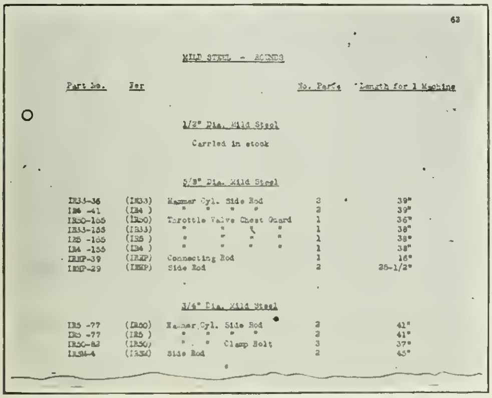
In accordance with the Nolan patent act, foreigners who failed or were unable to protect their inventions by patents in the United States during the war may now do so, provided their governments grant reciprocal privileges to American citizens. The countries which have granted such privileges to American citizens, and in which it is now possible to secure patent protection even after the United States patent has been issued and the inventions publicly used or manufactured or even sold abroad, are Austria, Belgium, Canada, France, Italy, Norway, Sweden, Czecho-Slovakia, Mexico, Spain, and Portugal. American manufacturers are urged to take out foreign patents on their inventions made during the war if they have not already done so in these countries, and if protection there is of value to them. It is expected that legislation to meet the Nolan act will also be passed in Germany, Switzerland, Denmark, Holland, and possibly in Great Britain.

Record of Materials Used in Machine Construction

By HYMAN LEVINE

To secure greater cooperation between its various departments, a certain western plant has developed a commodity book that should be of interest to all firms manufacturing more than one kind of machine. This book contains a list of materials and standard parts used in the construction of its products, and has proved of substantial value, saving much time and expense to the shop, purchasing, cost, and engineering departments, and assisting materially in reducing production costs and overhead expense.

Items are so listed and arranged as to be of the greatest service to all who use the book; and include such raw materials as steel, wrought iron, pipes, brake lining, packing, rubber hose, leather, wool, felt, and paper, and such standard purchasable parts as bolts, screws, nuts, pipe fittings, ball bearings, lubricators, cotter-pins, washers, and rivets. So far as possible, commodities are classified alphabetically, and an index has been added to make the finding of any desired material a comparatively easy matter.

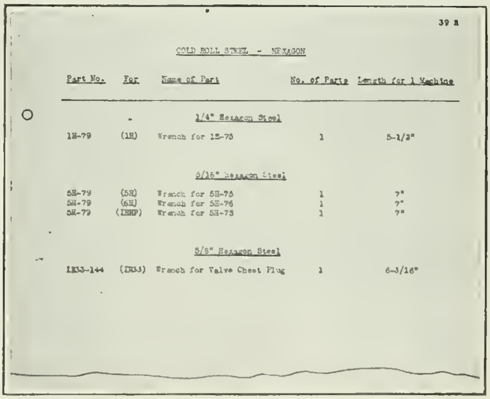


63

MILD STEEL - ROUNDS

Part No.	For		No. Parts	Length for 1 Machine
		1/2" Dia. Mild Steel		
		Carried in stock		
		5/8" Dia. Mild Steel		
IR33-36	(IR33)	Hammer Cyl. Side Rod	2	39"
IR4 -41	(IR4)	" " " "	2	39"
IR50-165	(IR50)	Throttle Valve Chest Guard	1	36"
IR33-165	(IR33)	" " " "	1	38"
IR5 -165	(IR5)	" " " "	1	38"
IR4 -155	(IR4)	" " " "	1	38"
IRHP-39	(IRHP)	Connecting Rod	1	16"
IRHP-29	(IRHP)	Side Rod	2	25-1/2"
		3/4" Dia. Mild Steel		
IR5 -77	(IR50)	Hammer Cyl. Side Rod	2	41"
IR5 -77	(IR5)	" " " "	2	41"
IR50-82	(IR50)	" " Clamp Bolt	3	37"
IR34-4	(IR34)	Side Rod	2	45"

Fig. 1. A Page from the Commodity Book showing List of Parts made from Round Steel Bars



39 a

COLD ROLL STEEL - HEXAGON

Part No.	For	Name of Part	No. of Parts	Length for 1 Machine
		1/4" Hexagon Steel		
1H-79	(1H)	Wrench for 1H-75	1	5-1/2"
		5/16" Hexagon Steel		
5H-79	(5H)	Wrench for 5H-75	1	7"
5H-79	(6H)	Wrench for 5H-76	1	7"
5H-79	(IRHP)	Wrench for 5H-75	1	7"
		5/8" Hexagon Steel		
IR33-144	(IR33)	Wrench for Valve Chest Plug	1	6-3/16"

Fig. 2. Another Page from the Book giving Information regarding Hexagon Cold-rolled Bars

In Fig. 1 is shown page 62 of this book, which lists three sizes of round mild steel ordinarily carried in stock. In the first column is given the part number of the article on which the material is used; in the second column is given, in parentheses, the symbol of the machine on which the part is used; in the third, the name of the part; in the fourth, the number of parts used on each complete machine; and in the fifth, the length of material used in the manufacture of one machine. Thus, the first listing under 5/8-inch diameter mild steel shows that part number IR33-36 is used on the No. IR33 machine as hammer cylinder side-rods, two such rods being required for each machine, and the cutting-off length of each being 19½ inches. The first listing under 3/4-inch diameter mild steel shows that the two hammer cylinder side-rods for the No. IR50 machine are made of 3/4-inch diameter steel; are cut off 20½ inches long, and bear part number IR5-77. The second listing under 3/4-inch diameter mild steel shows that the same rods are also used on the No. IR5 machine. It will be observed on this sheet that although ½-inch diameter mild steel is not used in the manufacture of any machine parts, it is carried in stock for general purposes; and that 5/8-inch diameter mild steel is used for eight different parts, and 3/4-inch diameter mild steel for only three. Different sizes, shapes, and characters of steel are similarly listed on other sheets, one of which is shown in Fig. 2.

Standard parts such as bolts, nuts, screws, washers, etc., are not cut to length, but are usually purchased in quantity, and in the listing of these, the last column becomes unnecessary, and may therefore be omitted. Fig. 3 shows page 8 of the book, on which several sizes of hexagon-head cap-screws are recorded. The fifth size given shows 5/8-inch diameter screws, 3¼ inches long, having eleven threads per inch. These are used as cylinder head cap-screws on the 5H and 6H machines, and as clamp bolts on the IRHP machine.

A list of cast-iron castings, arranged in a slightly different manner, is shown in Fig. 4. The usual part numbers, machine symbols, and part names are here given; but there have been added, at the request of the shop and purchasing departments, two blank columns, in which may be written from time to time, the quantity of castings on hand and on order. On other sheets are shown malleable castings, steel castings, brass castings, die castings, and drop-forgings.

When the book was first prepared only four copies were required, and the pages which are of regular 8½ by 11 inch letter page size, were therefore typewritten in quadruplicate. Its usefulness, however, became rapidly apparent, and the demand increased to eight copies. The book is now constructed in a slightly different manner.

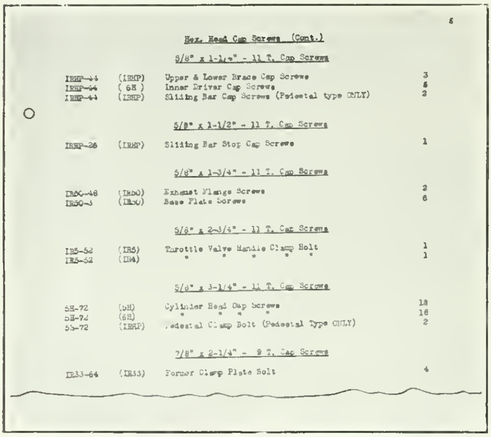
The individual pages are typewritten on thin onion-skin paper, a sheet of carbon paper with its face touching the back of the page being inserted in the typewriter so that the impression of the letters appears on both sides of the paper. The pages are then soaked in gasoline to make them more transparent, and two holes are punched at the left of each page for binding, a margin having been left so that these holes will not interfere with the inscriptions.

Eight blueprints are then made of each sheet. The prints are punched at the same points as the original sheets, and are fastened in numerical order under a heavy manilla cover bearing the name of the owner, thus providing a flexible and easily handled book, and a means of ready identification. Index sheets are placed at the beginning of the book, and small marked tabs are pasted on the sheets listing the commodities most frequently referred to, thus greatly facilitating the finding of any desired article. The items referred to by the tabs in the engineering department's book are as follows: Square-head bolts, cap-screws, fillister-head screws, set-screws, nuts, pipes and fittings, cold-rolled steel, carbon steel, mild steel, cotter-pins, and washers; but these may be varied to suit the requirements of each department.

How Changes are Made

The continual improvement in product that is sought by all progressive plants frequently necessitates changes in dimensions of parts, the addition of new parts, and the scrapping of old ones. To keep the commodity book up to date, it is therefore necessary to make promptly all corrections to conform with changes in design or shop practice; and to simplify this work was one of the reasons for adopting the loose-leaf blueprint form of book.

When a part becomes obsolete, it is only necessary for the office clerk to collect the books from the various departments, and to cross out the items with a blue pencil; or if a new part is added, it is written in with either white or black ink, making the same change on the original typewritten sheet. When the number of changes becomes too great for this procedure, a new sheet is typewritten, and the prints are inserted in the book. Fig. 2 shows such a sheet. There was originally listed on it only 11/16-inch hexagon steel which was used for making index bars for double-bored gaging blocks, the other parts having been made of mild steel. When it was found that the mild steel did not come close enough to the required dimensions to make the parts suitable for other uses, it was decided to use cold-rolled steel instead. The items were crossed off the sheets listing hexagon mild steel, and a new sheet made out as shown, numbered 39A, and inserted after sheet 39 in the book. A similar illustration is shown in Fig. 4. The castings were not originally included in the book; but when it was decided to insert them, it was only necessary to add a letter after the proper sheet number. Changes, additions, and eliminations are thus made without disarranging the index or the general order of the book.



6

Hex. Head Cap Screws (Cont.)

5/8" x 1-1/4" - 11 T. Cap Screws

IRHP-44	(IRHP)	Upper & Lower Brace Cap Screws	3
IRHP-44	(6H)	Inner Driver Cap Screws	6
IRHP-44	(IRHP)	Sliding Bar Cap Screws (Pedestal type ONLY)	2

5/8" x 1-1/2" - 11 T. Cap Screws

IRHP-26	(IRHP)	Sliding Bar Stop Cap Screws	1

5/8" x 1-3/4" - 11 T. Cap Screws

IR50-48	(IR50)	Exhaust Flange Screws	2
IR50-5	(IR50)	Base Plate Screws	6

5/8" x 2-3/4" - 11 T. Cap Screws

IR5-52	(IR5)	Throttle Valve Handle Clamp Bolt	1
IR5-52	(IR4)	" " " " "	1

5/8" x 3-1/4" - 11 T. Cap Screws

5H-72	(5H)	Cylinder Head Cap Screws	18
5H-72	(6H)	" " " "	16
5H-72	(IRHP)	Pedestal Clamp Bolt (Pedestal Type ONLY)	2

7/8" x 2-1/4" - 9 T. Cap Screws

IR33-64	(IR33)	Former Clamp Plate Bolt	4

Fig. 3. Page for Standard Sizes of Cap-screws, showing Various Machines on which Each is used

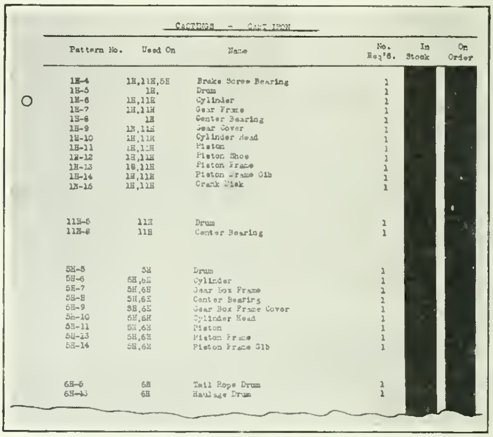
Use of the Book

The use to which the book is put necessarily varies with each department and with the character of the work in progress through the plant; but as occasions arise new uses are found, so that it is now available for many more purposes than was originally intended.

In computing production costs, the charge for material is always an important item. The cost department uses this book to estimate the weights and quantities of materials used in the construction of the various products. Thus, in obtaining the cost of the hammer cylinder side-rods for the No. IR33 machine (Fig. 1), it will be found that 39 inches of ⅝-inch diameter mild steel are used for each machine. The value of this material added to the labor charge and the overhead expense gives the total cost of the parts. On the same machine there are used four ⅞-inch cap-screws, each 2¼ inches long, shown as No. IR33-64, Fig. 3. Being standard purchased parts, and requiring no factory labor, the price of these may be taken from the books direct.

Usefulness of Commodity Book in the Shop

The shop superintendent uses this book for entirely different purposes. Production in the plant being on a schedule basis, it is of vital importance that an ample supply of raw materials be maintained at all times. The items in the commodity book are checked monthly with the quantity on hand and the quantity required by the production schedule; thus the possibility of a serious and unexpected shortage is averted.



CASTINGS - CAST IRON

Pattern No.	Used On	Name	No. Req'd.	In Stock	On Order
1H-4	1H,11H,5H	Brake Screw Bearing	1		
1H-5	1H,	Drum	1		
1H-6	1H,11H	Cylinder	1		
1H-7	1H,11H	Gear Frame	1		
1H-8	1H	Center Bearing	1		
1H-9	1H,11H	Gear Cover	1		
1H-10	1H,11H	Cylinder Head	1		
1H-11	1H,11H	Piston	1		
1H-12	1H,11H	Piston Shoe	1		
1H-13	1H,11H	Piston Frame	1		
1H-14	1H,11H	Piston Frame Gib	1		
1H-16	1H,11H	Crank Disk	1		
11H-5	11H	Drum	1		
11H-8	11H	Center Bearing	1		
5H-5	5H	Drum	1		
5H-6	5H,6H	Cylinder	1		
5H-7	5H,6H	Gear Box Frame	1		
5H-8	5H,6H	Center Bearing	1		
5H-9	5H,6H	Gear Box Frame Cover	1		
5H-10	5H,6H	Cylinder Head	1		
5H-11	5H,6H	Piston	1		
5H-13	5H,6H	Piston Frame	1		
5H-14	5H,6H	Piston Frame Gib	1		
6H-6	6H	Tail Rope Drum	1		
6H-13	6H	Haulage Drum	1		

Fig. 4. Record of Castings, Space being provided also for entering Quantities required for a Machine and kept in Stock

Should a shortage occur, however, for one reason or another, reference to the commodity book immediately informs the shop what other materials may be used as substitutes. If, for instance, the supply of ⅝- by 1½-inch cap-screws should become exhausted the sheet shown in Fig. 3 would indicate that there is a quantity of cap-screws only ¼-inch longer that is immediately available. If, however, the supply of ⅞- by 2¼-inch cap-screws should become exhausted, the same page would show that there are no cap-screws of near enough size that could be utilized, though possibly, on another sheet, some square-head bolts might be found that would serve the purpose almost as well.

Working drawings usually give only the finished dimensions of the parts, the selection of the stock from which the products are made being left to the shop. By reference to the commodity book, a clerk in the superintendent's office can readily determine what size of material the engineering department intended to have used. The hammer cylinder side-rods No. IR33-36, Fig. 1, are ⅝ inch in diameter when finished, and being made of ⅝-inch diameter steel, require no turning operation to reduce to size.

The book is also of assistance in the utilization of obsolete stock. It happens, occasionally, in the changes of design that are made to meet requirements of working conditions, or for other causes, that certain materials carried in stock can no longer be used for the production of the parts for which they were intended, due to the changes in these parts. Reference to the commodity book shows the shop office at a glance what other parts there are on which the materials could be used. Thus, if the ⅝- by 1½-inch cap-screws, shown in Fig. 3, should become obsolete, the page shows that they might possibly be used on the No. IRHP machine and the No. 6H machine, where ⅝- by 1¼-inch screws are required.

Advantage of the Book to the Purchasing Agent

The purchasing department is interested in the quantity of supplies on hand and the condition of the market for new supplies. A constant record is kept in the purchasing departments commodity book of all materials on hand and on order, so that it is possible for the purchasing agent to tell, after a moment's inquiry, whether the stock is such that it would pay to wait for a better market before ordering, or whether it is such that new supplies must be bought regardless of price. Large sums of money may occasionally be saved by having available all the facts on the supply at hand, the estimated future demand, and the condition of the market. In these days of fluctuating prices, this is no small item.

A good purchasing agent does not depend entirely on the shop for requisitions on materials. It is quite common for the shop foremen to put off asking for required supplies until the last possible moment; they do not always realize that it takes some time for an order to go through the office, and a much longer time for the order to be filled. If a shortage should occur, the person blamed would be the purchasing agent, and the one to suffer most would be the company. By reference to the figures giving stock on hand, entered in his commodity book, and to the production schedule, the purchasing agent can order the necessary quantities at the proper time, and insure that an ample supply will always be on hand. By the same means he can keep the stock down to a working minimum and save the interest on an unnecessary investment in surplus supplies.

Value to the Engineering Department

The most frequent and perhaps the most advantageous use of this book is made by the engineering department. In any plant that manufactures more than one type and one size of machine, it is of great importance that the same parts be utilized on as many different machines as possible. Such practice saves money in the drawing and designing of parts, in reducing the different sizes of materials that must be carried in stock, and in cutting down the number of machines that are tied up in the production of the parts. Adapting the part for use on a number of machines also saves in the time required to machine each part, due to a better utilization of jigs and fixtures, and in various other ways incident to quantity production.

In designing new machinery, or redesigning old, the engineering department makes constant use of the book for the purpose just mentioned; namely, saving through standardization of parts. Where possible, the identical part is used; and where this object cannot be attained an effort is made to utilize some size of material already carried in stock, rather than using a new size. The illustrations show to what extent this has succeeded.

In Fig. 1 we find that 9/16-inch and 11/16-inch diameter steel has been entirely eliminated from stock. The ⅝-inch diameter steel, it will be seen, is used for eight different parts, and part No. IR5–77 on two sizes of machines. Fig. 2 shows that part No. 5H–79 is used on three different machines; and Fig. 3 indicates that ⅝- by 1¼-inch cap-screws are used in two machines, in three different capacities. Further reference to this illustration shows other similar instances where the same practice has been followed. Fig. 4 shows a similar condition in castings. Brake screw bearing No. 1H–4 is used on three different sizes of machines: Nos. 1H, 11H and 5H; and another machine is now being designed to use the same part. Similar instances in great quantity may be found on nearly every page of the book, and in every design handled by the engineering department.

In the design of tools which are to be built at the plant it is also desirable to use, so far as possible, only those materials and standard parts that are actually carried in stock. It is obviously poor policy to instruct the tool-room to use a ⅞- by 2½-inch set-screw, which it would have to either buy or make, when a ¾- by 2⅜-inch or a 1- by 2⅝-inch screw is carried in stock and would serve the purpose just as well. Neither is there any advantage or economy in specifying a 7/16- by 2⅛-inch steel plate, 3 inches long which would have to be machined to size, when a ½- by 2¼-inch plate, 3 inches long, which is carried in stock and used on a regular machine, would be quite as useful and would require no machining other than cutting from the bar. The commodity book makes it possible for the tool designer to watch these points; and it is in giving careful attention to such items that economies are effected which considerably reduce the investment in tools.

Every growing plant has a certain amount of experimental work and special jobs in process. It is possible by intelligent use of the book to design the parts of such sizes and to use such standard supplies as to reduce the cost of the experimentation materially.

Summary

This commodity book, developed by long experience, and used by many different people, thus adds to the convenience of the force and saves money for the company. Particular credit for its preparation and perfection is due to the chief engineer of the plant and his assistant. As has been indicated, some of the economies obtained are: (1) Reducing the investment in materials carried; (2) cutting the labor required on many parts; (3) producing certain parts in larger quantities; (4) assisting in taking advantage of market conditions thereby making more economical buying possible; (5) eliminating the losses due to shortage of materials; and (6) reducing tool and experimental costs. There are undoubtedly other ways in which the commodity book is and can be used to the advantage of every department and to the entire plant. But enough has been shown to indicate that any firm manufacturing more than one product, that will adopt and use the book, with such changes and modifications as may be necessary to suit local conditions, will be materially benefited thereby. It should be remembered, however, that, to be really valuable, the book must be kept up to date, and free from error.

* * *

HARDENING HIGH-SPEED STEEL WITHOUT PITTING

By WILLIAM C. BETZ

The following method of hardening will be found satisfactory for such tools as milling cutters, forming tools for automatics, and other tools of a similar nature made from high-speed steel, that are required to have smooth unpitted surfaces. First preheat the work in a low-temperature furnace to from 1500 to 1550 degrees F., raising the temperature slowly. Remove to a high-temperature furnace which is heated to from 1950 to 2250 degrees F., according to the hardening heat recommended by the makers of steel, and heat quickly to the hardening temperature. When the hardening temperature is reached, remove the work immediately and quench in a salt bath, heated to from 1200 to 1300 degrees F., consisting of the following ingredients: Calcium chloride, 40 per cent; sodium chloride, 40 per cent; and ferro-cyanide of potassium, 20 per cent. Leave the work in the bath until the steel assumes the temperature stated, then remove and cool in oil at from 350 to 400 degrees F. When removed from this bath, the work should be washed in boiling soda to remove the salt. High-speed steel, heated and treated in this way, will be found to give excellent service, and it will come from the bath clean and unpitted.

DRILL JIG AND TOOL EQUIPMENT FOR MOTOR HOUSING

By H. MIKKELSEN
Tooling Engineer, Bell & Howell Co., Chicago, Ill.

The drill jig and tool equipment here illustrated are employed in the plant of the Bell & Howell Co., Chicago, Ill., in the production of housings for the motor and governor of what is known to the motion picture camera trade as a "cinemotor." The cinemotor parts are manufactured on the interchangeable plan and require an unusually high degree of workmanship and accuracy, the tolerances in some cases being as close as plus or minus 0.0001 inch.

Although the jig and tools shown in Fig. 1 are used only in the production of the cinemotor housing shown at *A*, they should nevertheless prove of general interest to those who are engaged in the manufacture of small interchangeable parts requiring a high degree of accuracy as regards the relative location, and the drilling, reaming, and tapping of holes on different sides of the work. The tool equipment mounted in block *J* is used in machining the holes, and the jig *B* serves to locate the holes in their proper positions, the depths of the holes, counterbores, and threaded sections being governed by the stops mounted in plate *K*.

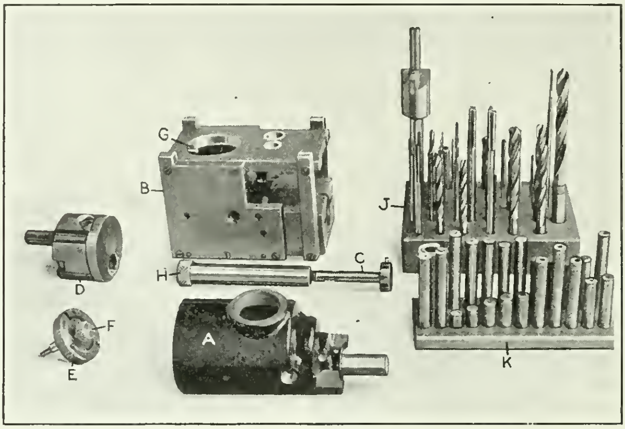


Fig. 1. (A) Cinemotor Housing; (B) Drill Jig for Part A; (J) Block for holding Tools; (K) Plate for holding Depth Stops

Locating and Clamping Work in Fixture

From an inspection of the housing shown at *A*, Fig. 1, it will be evident that the provision of adequate means for locating and clamping the work in the drill jig presents a rather difficult problem, especially when the lightness of the casting and the accuracy required are taken into consideration. The method employed to overcome the difficulties encountered will be more easily understood if an explanation of the procedure followed in loading the jig is given.

The work *A* is inserted at the left-hand end of jig *B*. Fig. 2 shows work *A* in the position that it occupies when clamped in place ready for the various drilling operations which are performed on five of its sides. The right-hand end of the jig is shown in Fig. 3. After the work is placed in the jig as described, draw-screw *C* is inserted at the right-hand end of the jig, and pushed in until the three pins projecting from its head are slid into corresponding slots in the end of the jig as indicated in Fig. 3. The locating plug *D*, Fig. 1, is next inserted loosely in the open end of the work so that it occupies approximately the position indicated in Fig. 2. Locating plug *E* which fits into the large bored hole on the upper side of work *A*, is then inserted in the top plate of the fixture as shown in Figs. 2 and 3. Center screw *F* which projects into a threaded hole in locating plug *D* is next tightened slightly. Pin *G*, Fig. 1, lines up plug *E* and prevents it from turning while screw *F* is being tightened. It should be mentioned that plug *D* is provided with drill bushings for locating four holes inside casting *A*, while plug *E* is equipped with bushings for locating three equally spaced holes in the flange on the upper side of part *A*.

The hole in the top plate of the jig (through which plug *E* is inserted in the work) is elongated, and while it allows plug *E* and the work to be moved a limited distance in a longitudinal direction, or in a direction parallel to the axis of the large bore of the work, it prevents the work from turning or rotating in the jig. Draw-up nut *H* is next inserted through the clearance hole in *D* and tightened on screw *C*, to clamp the work in position. The locating and clamping of the work is completed by tightening screw *F*.

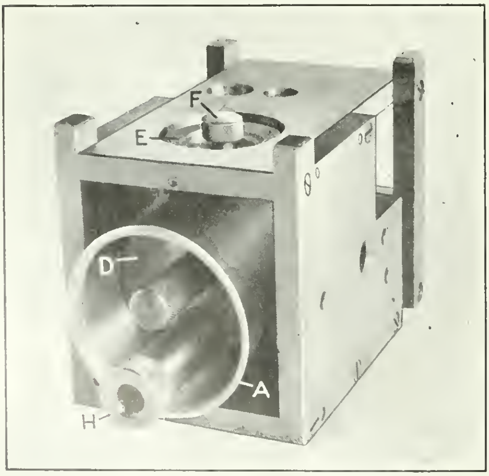


Fig. 2. View showing Open End of Jig with Work in Place

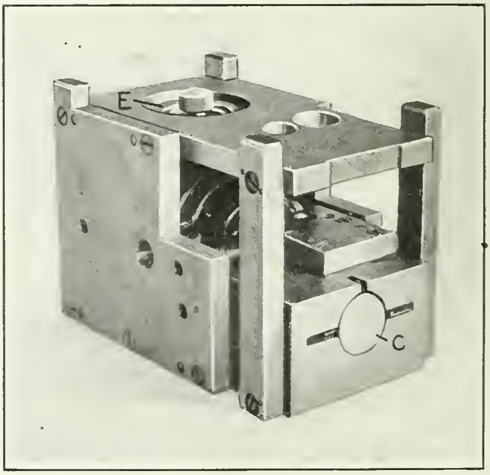


Fig. 3. View showing Closed End of Jig with Work in Place

Tools Used with Fixture

All the tools used in the drilling, reaming, tapping, and counterboring operations are mounted in the order of use in a wooden block as shown in the upper right-hand corner of Fig. 1. In some cases, several tools are used in machining one hole. For holes of this kind several positive stops or tool-setting blocks are required. The limited amount of space on the jig led to the mounting of the stops on a separate steel plate as shown in the lower right-hand corner of Fig. 1. A letter is stamped opposite the drill bushing of each hole requiring the use of a stop or stops in setting the tools. Thus if a bushing marked "A," for instance, is employed to locate a hole in which drilling, tapping, and counterboring operations are required, there will be a corresponding stop for each tool on the gage-plate under the corresponding letter, which in this case would be "A." On each stop is marked the size of the tool with which it is intended to be used, in order to eliminate errors in the selection of tools or stops. The lengths of the stops are determined by adding together the distance from the center of work to the bottom of the hole or counterbore and the distance from the surface plate upon which the jig rests to the center of the work.

* * *

POWER FROM THE TIDES

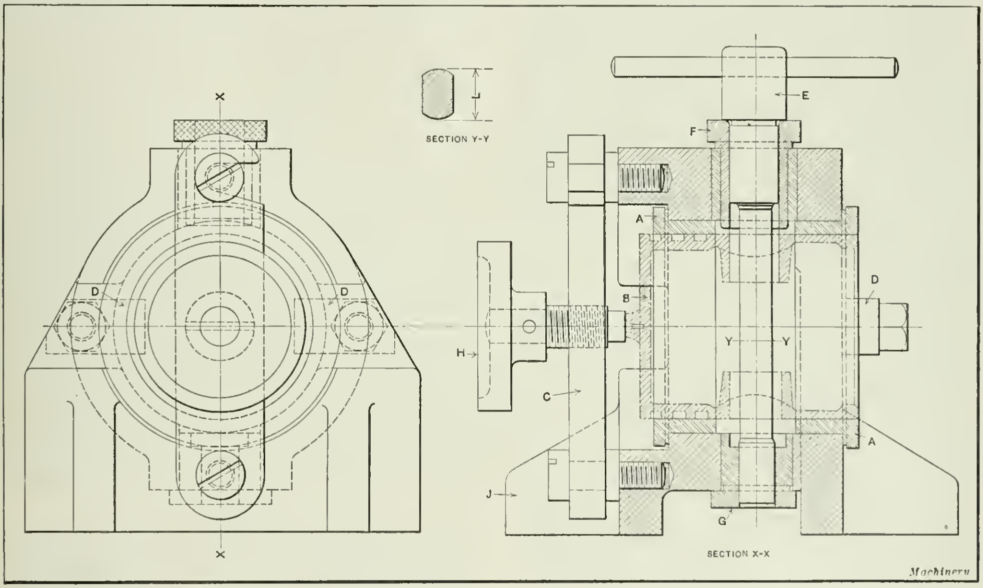
Although the idea of utilizing the rise and fall of the tides for power purposes has long been discussed, no tidal power station of any magnitude has yet been developed in any part of the world. The lack of data based on operating conditions and on constructional costs renders it difficult to form any definite conclusions as to the economic aspects of such a scheme. Much interest is, however, being shown in this question by government committees in Great Britain and in France. It is reported that experiments are to be carried out in the latter country, and it is probable that definite data will be available in the near future. The only practicable methods of developing tidal power on any large scale are based on the use of one or more tidal basins, separated from the sea by dams or barrages, and of hydraulic turbines through which the water flows on its way between the basin and the sea, or between one basin and another.

FIXTURE FOR LINE-REAMING WRIST-PIN HOLES IN PISTONS

By WILLIAM OWEN

In the production of automobile engine pistons it is necessary that the wrist-pin holes be accurately reamed to size and that they also be accurately centered and lined up at right angles with the sides of the piston. The fixture shown in the accompanying illustration is designed for use in performing this reaming operation. It is provided with a set of interchangeable work-holding bushings *A* which are a press fit in the fixture. This construction permits pistons of standard size as well as over-size pistons to be reamed in the fixture by simply changing the bushings. The pistons must, of course, be ground or finished accurately to size so that they will be a good fit in bushings *A*, before the wrist-pin holes are reamed.

In loading the fixture, clamp *C* is first swung aside and the piston inserted so that the skirt or open end comes in contact with stops *D* attached to the end of the fixture. The locating pin *E* is next inserted and passed through the guide bushing *F* and the drilled wrist-pin holes of the piston until the small pilot at the end enters bushing *G*, thus locating the wrist-pin hole in the correct position for reaming. Clamp *C* is then swung into place, and the end of the screw *H* brought against the head of the piston *B* to hold it in position while reaming; locating pin *E* is next removed and the reamer inserted and run through the work.



Line-reaming Fixture for reaming Wrist-pin Holes in Pistons

The body *J* of the jig is of cast iron and is provided with legs set wide apart to insure accuracy. The locating pin is made a snug fit in the upper and lower guide bushings, but in the center where it passes through the wrist-pin holes it is flattened on the sides as shown in section Y-Y, dimension *L* being made a good fit in the drilled wrist-pin hole. This style of pin allows the work to be located or clamped against the open or skirt end, yet it locates the wrist-pin hole in the correct vertical and central position. The reamer employed is of the two- or four-blade built-up type having a pilot at the lower end which runs in guide bushing *G* and a body which runs in the upper guide bushing *F*. The driving end of the reamer is made with a taper shank but it can, of course, be made to fit the collet of a quick-change drill chuck.

Working Sheet Aluminum

By A. EYLES, Foreman Sheet Metal Worker, Lancashire & Yorkshire Railway Co., Manchester, England

MUCH has been written recently about the physical characteristics of aluminum, but comparatively little has been published from the mechanic's point of view, notwithstanding the fact that this metal is now being increasingly used and has become an essential material in many industries. The present article, therefore, being written by one who has been engaged in the art of working sheet aluminum for a number of years, should contain something of practical value and general interest.

Comparatively speaking, the art of working aluminum is in its infancy. The fundamental advantage obtained by the use of aluminum is naturally that of lightness, since in cast form it has a specific gravity of only 2.56 or about one-third that of iron or steel. The strength and weight of some of the more common metals used in the manufacture of sheet metal ware are given in the accompanying table.

Aluminum is one of the most malleable of all industrial metals, being surpassed only by gold and silver. As regards ductility, it is sixth in order, being preceded by gold, silver, platinum, copper, and iron. The malleability and ductility of the metal are such that it can be rolled into sheets less than six ten-thousandths inch in thickness and then beaten into leaves twenty-five millionths inch thick, provided of course, that the working of the metal is accompanied by frequent annealings. Soft aluminum sheets can be spun and formed by various methods into all shapes. In fact, it may be safely stated that aluminum can be drawn deeper and with less annealing than the other commercial metals, if the proper grade is used with a suitable lubricant. For drawing aluminum, a cheap grade of vaseline is used as a lubricant, and for drawing deep shells, lard oil is commonly applied. Kerosene is recommended as a lubricant for performing stamping operations or for shallow draw-press work.

COMPARISON OF STRENGTH AND WEIGHT OF METALS USED IN SHEET-METAL WARE

Metal	Specific Gravity	Weight in Pounds		Ultimate Tensile Strength, Tons per Square Inch
		Per Cubic Inch	Per Cubic Foot	
Aluminum (Cast)	2.56	0.092	159	5.25
Aluminum (Sheet)	2.70	0.097	168	7.50
Zinc (Sheet)	7.20	0.259	448	7.00
Copper (Sheet)	8.80	0.318	549	13.50
Iron (Sheet)	7.70	0.278	480	23.00
Steel (Sheet)	7.80	0.282	486	28.00

Machinery

Care in Selecting the Proper Grade of Sheet Metal

When ordering aluminum sheets, it is necessary, if the requirements of the job are at all exacting, to specify the temper desired, because the sheets can be obtained in various grades of hardness, ranging from dead soft to dead hard. Care should also be exercised to specify the sizes best adapted to the purpose for which they are to be used. The degree of hardness of metal sheet, depends, of course, on the amount of rolling that it receives at the mill, and also upon the number of annealings it receives during the rolling process. If worked too long without annealing, aluminum will become so hard that it will be brittle.

For convenience in ordering, three grades of hardness are usually specified: (1) dead soft, which has been annealed and which is suitable for much forming and working; (2) half hard, which has been annealed during the rolling and which is suitable for plain stamping and a limited amount of working; (3) dead hard, which is not annealed and which is suitable for bending and straight work that does not require working. The difficulty now being encountered in obtaining certain kinds of wood for motor and railway coach construction, and the comparative ease with which aluminum sheets of large size and without blemish can be obtained, is leading to the more general use of aluminum in the motor and railway shops. As an illustration of the sizes which may be obtained, the writer has recently worked on aluminum sheets having a surface area of 77 square feet, being 14 feet long by 5 feet 6 inches wide, and having a thickness of 3/32 inch. This large sheet was used in the construction of all-metal railway vehicles.

Care in Handling the Metal

In the various operations by means of which the sheet aluminum is fabricated into numerous shapes, over-working or over-straining of the metal should be avoided. This condition is often due to working the metal excessively without exercising suitable judgment with regard to the annealing operations. Working sheet aluminum to a cracking or splitting point indicates lack of annealing and injudicious workmanship. It is always advisable to anneal the metal often rather than risk fracturing it before the shaping operation has been completed. It should be remembered that during the forming operation the structure of the metal is entirely disarranged, as is graphically illustrated when a perforated spherical cup which has been worked up from the flat, is examined. Some of the perforations, it will be seen, are enlarged while others are contracted, according to the flow of metal. Deep shells requiring a number of drawing operations, should be annealed during the process as soon as the metal shows a certain degree of hardness. In such a case, two or more annealings are often required.

Hollowing, raising, or other forming operations are accomplished in different ways and with different results by the metal-worker and by the power-press operator. The sheet-metal worker easily hammers a sheet of aluminum or copper into the desired shape and produces a shell without seams or joints. The same shell may be produced on the power press and the finished product will contain perhaps a number of joints, but in this case the amount of hollowing or "dishing" required on the aluminum sheet is considerably less. Also it may appear as though it would be easy to hollow or raise a sheet of metal to any extent if the operation is performed with the metal hot, but such is not the case, especially with brass and copper. Iron can be worked much better when hot, and sometimes sheet aluminum can be more easily manipulated when heated to about 200 degrees F.

In all cases where aluminum is subjected to severe treatment, accompanied by displacement of its fibers, careful annealing is necessary in order to insure the equal flow of the metal and minimize the possibility of cracking. There is no exception to this rule, either for thin or thick sheets.

Determining Sizes for Drawn Shells

To lay out accurately a pattern to be cut from aluminum sheet metal, that is subsequently to be drawn to shape, particularly if the surface has a spherical or compound curvature, is an operation requiring something more than guesswork. In practice, however, very good approximations can nearly always be found. One method commonly employed in finding the blank size for a drawn cylindrical sheet aluminum shell is to multiply the circumference of the cylindrical article by its height and add the area of the bottom. This formula gives the diameter of a circle of equal area, and does not allow for flange; consequently the proper allowances should be made. In calculating the blank diameter for a spherical or hemispherical shell, it is assumed in the formulas used that the area of the circular piece of metal is equal to the curved surface of a hemisphere. This assumption is practically correct, and would be strictly so if the metal of the finished articles were exactly the same gage as the sheet from which the blank is cut. To maintain the same thickness of metal is extremely difficult in practice; but what is lost in area by contraction is compensated for usually by what is gained in expansion while working it to shape. The following formula may be used to find the area of the blank of a hemispherical shell. Since the area of a hemispherical surface is equal to $\frac{1}{2} \times \pi D^2$, the radius R of the circular blank corresponding to this area may be written thus:

$$R^2\pi = \frac{D^2\pi}{2}; \text{ or } R^2 = \frac{D^2}{2}$$

and

$$R = \frac{D}{1.4}$$

It will thus be seen that the radius R of the blank can be found by simply dividing the diameter D of the sphere having the same radius as the hemisphere, by 1.4.

Another well-known and simple method of finding the blank size, when a sample article is available, is by weight. The sample is first weighed, and in determining the size care should be exercised to use the same thickness of metal. If, for example, the article weighs exactly one pound and is made from sheet aluminum 0.064 inch thick, the first step will be to find the weight of a square foot of metal from the value given in the accompanying table. It will be found that 1 square foot (or 144 square inches) weighs 0.894 pound; consequently the area which will weigh one pound can be found by dividing 144 by 0.894, which gives 161.14 square inches, or a blank diameter of nearly 14⅜ inches.

Annealing Methods

Correct annealing is dependent upon two factors, time and temperature. Oftentimes the varying of the annealing period has a more important bearing on the mechanical properties of the metals than has the temperature. Although aluminum is distinctly a malleable metal, it frequently is necessary to anneal it two or three times during the forming of an intricate piece. The procedure is to work the piece to a certain stage, anneal it, and repeat the process until the desired shape is obtained.

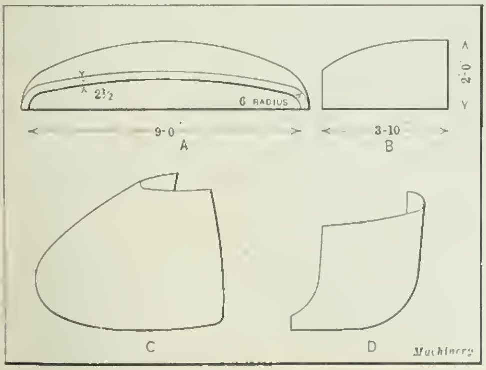


Fig. 1. Examples of Sheet Aluminum Working

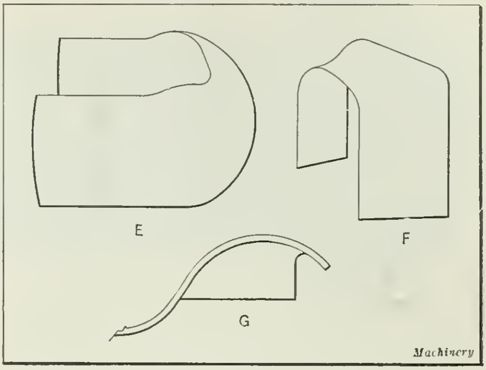


Fig. 2. Additional Aluminum Parts for Automobile Construction

Sheet aluminum can be most efficiently annealed in a muffle furnace, where the heat can be obtained by radiation. If such a furnace is not available, the work may be annealed quite satisfactorily in an open fire of clean coke, over a brazier's gas hearth, or over the flame of the benzoline or gasoline blow-torch. Owing to the relatively low melting point of aluminum, which is approximately 1210 degrees F., great care must be taken during annealing to prevent the metal from melting. The correct temperature varies from 700 to 900 degrees F., depending on the thickness of the metal and the length of time that it is subjected to the heat. Cold-rolled sheet aluminum is often annealed by prolonged exposure at various temperatures; for example, an anneal will be obtained by a twenty-four-hour exposure at 698 degrees F. for a certain grade of metal. On the other hand, perfect malleability of the metal is often restored on cold-rolled aluminum sheets by exposing them for three minutes at the annealing temperature of 887 degrees F. Tests have shown that short exposures in the annealing temperature, ranging from three to thirty minutes, confer workable properties on the metal. The following three simple methods may be used for annealing sheet aluminum:

1. Prepare a mixture of ordinary whiting and oil, mixed to the consistency of thick paste. Coat the metal on both sides with this preparation, and place it on a clean fire or in a furnace, allowing it to remain until the oil in the paste becomes ignited. When this occurs withdraw the work from the furnace and allow it to cool gradually. The coating of whiting should then be removed from the surface of the metal by washing it and brushing.

2. Heat the metal to a dull red color, perceptible in the dark and cool slowly. With this method care must be exercised to get an equal annealing temperature distributed over the entire surface of the work.

3. Heat the sheet aluminum until pine wood sawdust just glows when sprinkled on it, which indicates a temperature of about 750 degrees F. At this temperature a dry match-stick will just char when rubbed on the metal.

With any annealing, it should be emphasized that it is of the utmost importance to see that every part of the work reaches the necessary temperature; otherwise strains will exist in certain parts of the metal which will not be relieved by the annealing process. Sheet aluminum can be thoroughly annealed by cooling slowly in the atmosphere, or by cooling quickly by plunging into clean cold water. An advantage gained when the work is cooled quickly in water is that further stages of working the metal can be taken up without delay, instead of waiting for the metal to cool gradually, and the former method is preferred by some workmen.

Examples of Aluminum Sheet Working

Figs. 1 and 2 show examples of sheet-metal working, which have been recently handled by the writer. At *A* and *B*, Fig. 1, are shown two views of a canopy for all-metal railway cars. The thickness of metal is 0.080 inch, and the dimensions indicate clearly some unusual characteristics about the job which required careful manipulation of the metal in order to produce the first-class product which was essential. The metal was cut to the desired shape, which was determined by previously making a model. The size of sheet required was 11 feet 8 inches by 4 feet 9 inches. The metal was first shaped by hollowing or raising it on a concave wood block. The flange was worked over to a depth of 2½ inches, as the diagram at *A* shows. The flanging operation presented some difficulty, especially at the ends, where the 6-inch radius is shown, because here there was great danger of cracking or splitting the metal. To secure a smooth surface and to harden and stiffen the canopy, the work was finished off with a planishing hammer while laid on a smooth convex head.

The specimen of sheet aluminum work shown at *C* is a cowl for an airplane engine. In the manufacture of aircraft, the use of sheet aluminum for cowlings, etc., is of extreme value, owing to the ease with which the metal can be shaped and its lightness. The piece of work shown at *D*, which is a corner panel for a motor car, is a rather difficult part to handle, due to the compound curve.

The example of aluminum sheet working shown at *E*, Fig. 2, is that of the back panel of the motor car which extends from door to door in one piece. The desired contour was obtained by forming the metal with the hammer, from a single sheet of aluminum placed over a large concave block of wood. When the shape of these automobile backs is particularly bulbous, it may be made in halves and welded together by the use of the oxy-acetylene torch. By this method a joint can be made which is as strong as the rest of the material and which is practically invisible. At *F* there is shown an ogee cowl-dash for a motor car which is made by first cutting the metal to the required developed area and then working it by "raising-in" and "raising-out" methods to form the ogee, or compound curve design. The other specimen, shown at *G*, is a typical splash or mud guard with wing, used on motor cars.

Suggestions for Working Sheet Aluminum

In all the examples shown in these two illustrations, the shaping should start on a concave block or leather sand bag, working from the edge of the blank toward the center in a series of concentric circles and using a round-nosed wooden mallet. The shape of the work should not be developed too rapidly in any one section, for if the metal is stretched too much in one direction, it is very difficult to get it back again where it can be properly re-formed. It is advisable to work the metal by applying many light blows in preference to a few heavy ones. This procedure will result in the work being finished quicker than by the use of heavy blows. The shape of the article should be gradually developed at each stage of the hammering. As the metal hardens by working, a hollowing hammer should be used, working outward and removing the wrinkles or ridges that may have been produced.

It is good practice to test the work before the finished shape is fully reached by placing it on the car frame, which will immediately indicate whether or not alterations are necessary. As soon as it has been established that no alterations are required, the metal should be planished on a convex head, made of iron or steel, using a suitable hammer and working from the center to the outside edge. The final smoothing may be accomplished by using a hammer, the head of which has been covered with thin leather, but in delivering the blows they should be directed to fall between those previously delivered. This process should be continued until the surface of the metal is quite smooth.

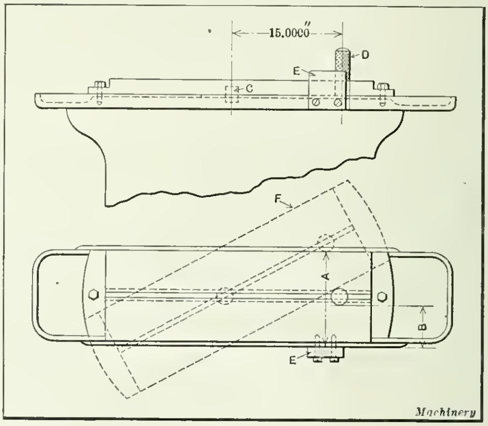
Hand planishing may be advantageously replaced by using a power-driven hammer, delivering hundreds of blows per minute. It is possible when working sheet aluminum to so finish the surface of the metal that no marks will be perceptible on the surface. A slight unevenness of the surface after planishing may be smoothed out by using a piece of emery cloth glued to a piece of wood. This also leaves the surface of the aluminum in a suitable condition for receiving the paint. Aluminum takes paint or enamel excellently, and such troubles as blistering or cracking are rarely encountered in sheet aluminum panels and similar formed parts.

* * *

SETTING TABLE FOR TAPER GRINDING BY SINE BAR METHOD

By W. E. WILSON

In grinding taper plug gages the writer has found it convenient to use the top half of the grinding machine table as a sine bar when setting the table to give the required taper per foot. The accompanying illustration shows how the grinding machine table is equipped for this method of setting. A 1⅛-inch hole is bored in the top half of the table at a distance of 15 inches from the center of pin *C*, about which the table pivots. A hardened and ground plug *D* is provided which fits into this hole. A hardened, ground, and lapped block *E* is also attached to the lower half of the table.



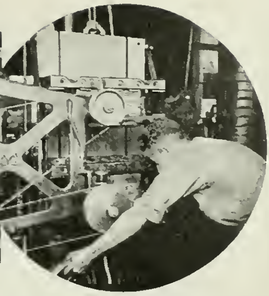
Grinding Machine Table used as Sine Bar

Now the distance from the center of pin *C* to the center of pin *D* is known, and the distance *B* between plug *D* and the lapped face of block *E* (when the table is set for straight cylindrical grinding) can be easily measured. With these measurements given, it is evident that standard size blocks can be employed to set the top half of the table at any desired angle, in much the same way as in setting a regular sine bar. The dotted lines at *F* in the lower view show the position of the top half of the table when set for grinding a steep taper. In setting the table in this position, standard size blocks would be placed between plate *E* and pin *D* to give the required distance *A*, which would be calculated by trigonometry in the usual way.

* * *

Manufacturers who are interested in the housing problem as it affects their employes should find the copy of an address delivered before the American Institute of Architects at Washington, and appearing in the Commerce Report of May 13 of special interest, as it outlines a method whereby the Department of Commerce can render cooperation in the national housing problem.

Design and Making of Drop-forging Dies



Methods Employed in Modern Drop-forging Plants—First of Two Articles

A DROP-FORGING die consists of two blocks of metal, usually steel, in the face of each of which the impression of one half the forging to be produced is cut. One of these members is attached to the ram of the drop-hammer by a dovetail shank *A*, Fig. 1, machined in its upper surface, and the other is similarly mounted and secured on the sow block or anvil cap. Matching surfaces *B* are provided for aligning the upper and lower dies, so that the impressions will match, and if this is not done accurately, the forging will be ruined, regardless of the accuracy with which the impressions have been made.

Material for Drop-forging Dies

The material from which drop-forging dies are made is usually either a high-grade open-hearth carbon steel or an electric alloy steel containing certain percentages of nickel and chromium, although other alloys are used in special cases. This special chrome-nickel steel has been found particularly suitable for producing drop-forgings from a higher grade of material than was formerly thought possible to drop-forge successfully. The development in this regard has been due primarily to the demands of the automobile industry, in which there are used a great variety of intricately shaped drop-forged parts made from dense fine-grained alloy steels of various compositions. Straight carbon steel, which is the material used extensively for certain types of drop-forging dies, has inherent advantages which make its use generally preferable to alloy steel for the smaller classes of work.

Cast-steel and Cast-iron Dies

Cast-steel dies are sometimes used, but care must be exercised in selecting the steel, to insure that the casting is sound and free from blowholes. The advantage of casting the die impressions over sinking them is in the saving of time in manufacture, and more especially in the possibility of producing more intricate shapes. Cast-steel die-blocks are not recommended, however, unless the design of the forging demands that the impressions be cast. On the lighter classes of drop-forgings, particularly if there are only a few to be made from one impression, cast-iron die-blocks have been used with fair success. The finest grain of cast iron should be used in making drop-forging dies, and the structure of the iron should be homogeneous.

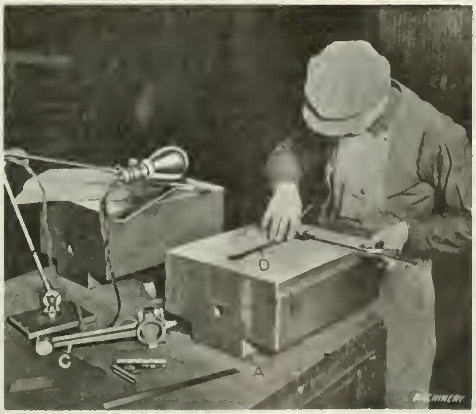


Fig. 1. Laying out Die Impression with Aid of Templet and Side Matching Surface

Comparison of Carbon and Alloy Steels for Drop-forging Dies

Although mention has been made of the use of cast-steel die-blocks and those made from cast iron, there are a great many shops in which neither of these is used. In fact, when one speaks of die-blocks, forged steel is usually understood to be the material used. Forged steel die-blocks are made from large ingots in the steel mills and have usually been annealed and frequently heat-treated, according to the requirements of the user, when received in the drop-forge plant.

In one shop where both carbon and alloy steel blocks are used, the practice is to use carbon steel blocks in the annealed state, and after sinking the impression, to harden them according to the specifications furnished by the steel manufacturer. The alloy steel blocks are received in a heat-treated state, and register a scleroscope hardness of about 50. These blocks receive no heat-treatment after they come to the drop-forging plant, but are machined direct and put into immediate service. The scleroscope hardness which these alloy blocks have been drawn to is the maximum for machineability, but the service to which these particular dies are put does not require a high degree of hardness so much as it does toughness, so that alloy steel of the hardness mentioned is suitable in this case. It is doubtful, however, whether anything is gained by receiving the blocks at the drop-forging plant in a heat-treated state, for the most satisfactory procedure seems to be to work the steel blocks, whether they are carbon or alloy, while they are soft, and to heat-treat them after the impressions have been sunk.

Desirable Qualities for Die Steels

The desired qualities for die steels are sufficient hardness to prevent spreading from the wedging of the hot metal in the impression, and enough toughness to withstand the destructive effect produced by the hammer blows. Obviously, deep-impression dies are the ones which will cause trouble by spreading, unless the proper grade of steel is used. Steel with the desired physical properties usually contains carbon, manganese, nickel, and chromium. For special uses, alloy steels containing vanadium, cobalt, tungsten, and molybdenum are also suitable. A straight carbon steel is not wholly suitable; neither is a low-carbon steel, high in manganese, although both are often used.

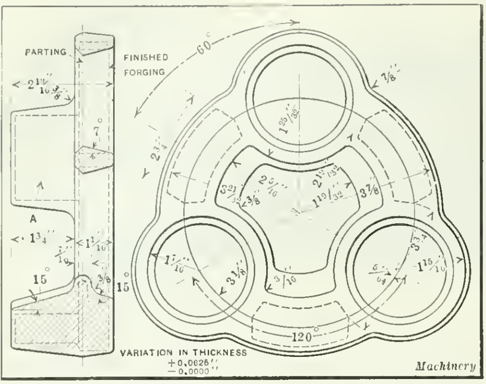


Fig. 2. Forge-size Drawing with Draft, Finish, and Shrinkage Allowances

Selecting the Proper Kind of Die Steel

Too much care cannot be exercised in the selection of the die steel. It should be made by either the electric process or by the acid open-hearth method. A very satisfactory carbon steel, and one which is quite generally used where the tougher alloy steel is not required, contains 0.60 per cent carbon and 0.70 per cent manganese, with small quantities of sulphur and phosphorus. This gives the proper degree of toughness, and is generally suitable since it does not spread perceptibly under the hammer. A chrome-nickel alloy steel which, after much experimentation by steel manufacturers, has proved to be excellent for drop-forging dies, has the following composition: Carbon, 0.55; manganese, 0.70; nickel, 1.5; and chromium, 0.50 per cent, with about 0.04 per cent, each, phosphorus and sulphur.

The selection of the steel to use for a particular drop-forging die requires the exercise of sound judgment based on long experience. Although a number of rules have been formulated, any general rule which might be stated, cannot be implicitly followed. It is known that alloy steel dies will not check as readily as those made from carbon steel; it is also known that carbon steel wears longer on small forgings of thin section than does an alloy steel die. Checks, or small cracks appearing in the impression produced by the heat of the forging, gradually become larger and more pronounced as the dies are used, and these form corresponding projecting fins on the work. These fins are objectionable, not only because they give the piece a rough appearance, but also because they make it difficult to locate the forging in a jig or fixture for machining.

If the forging is of such design that there is considerably more metal in any one part than in the rest of the piece, as for example, in the hub of a gear or a projecting boss, especially if the die impressions are deep, alloy steel is the material to use in making the dies. When the forgings are of thin section, carbon steel blocks are invariably used, on account of their being fully suitable in service and more thoroughly understood by the hardener. Carbon steel is also cheaper than alloy steel.

The size of the die-block is another consideration which is of great importance. If large quantities of drop-forgings are to be made, it would appear that carbon steel, on account of its better wearing qualities, would be more suitable, but if the design of the drop-forging is such that the metal must be broken down and shaped quickly in one operation and without a great number of blows being struck (even if the piece is comparatively small), alloy steel dies will withstand the severe blows of the hammer better than dies made from carbon steel. This, of course, requires a more substantial block and should be considered before work of making the die impressions is started.

Ordinary low-carbon steel, made either by the Bessemer, open-hearth or crucible process, fills the die impressions and crevices readily and is an excellent forging material, but due to later developments in automotive industries and in the fabrication of airplane engine parts, the denser alloy steels are being commonly used. Chrome-nickel steel is one of the most difficult of these alloys to forge, and in designing the dies for forgings made of this material, the impressions should contain no sharp corners and crevices, but these parts should be well rounded and filleted.

Importance of Adequate Draft, Shrinkage, and Machining Allowances

After the proper size and composition of die-block has been decided on, the method of laying out the impression and sinking it is a comparatively simple matter. Before this can be done, however, the consideration of draft allowance, shrinkage, and allowance for machining, must be made. The usual draft allowance is 7 degrees, but this is sometimes increased to 10 or even 15 degrees if the depth of the impression and the general design should require it. In deep, narrow, die impressions or where the metal must be "shot up," that is, forced into the impression in the upper die, an increase in draft allowance is necessary.

Another instance in which increased draft must be allowed is where there are holes or openings in a forging, especially if the walls are of rather thin section. Holes are produced by plugs in the matched dies, and these plugs are of such a height that there is a thin, horizontal wall left in the forging at the parting line within the hole, which is subsequently punched out. The draft on these plugs is often as great as 15 degrees, the reason being that on account of the thin-section walls the metal shrinks rapidly during the process of forging, and so is likely to contract sufficiently to "freeze" to the die plugs. In drop-forging a part of the design referred to, the draft on the outside of the impression would not need to be more than the standard 7 degrees, or just enough to permit the forging to be readily withdrawn from the impression.

On smaller work the draft is sometimes as small as 3 degrees, and it is also as small as this on large work if the section is thin and the impression shallow. The failure to provide sufficient draft will result in the die deteriorating more rapidly, and consequently in extra work being involved in resinking the impressions. Production will be decreased proportionately with the amount of difficulty experienced in removing the drop-forging from the impression. Insufficient draft for dies having deep impressions will also increase the probability of breakage.

In laying out the die impressions from a drawing or sample, when they are not to be sunk on an automatic engraving machine of the profiling type, the allowance for

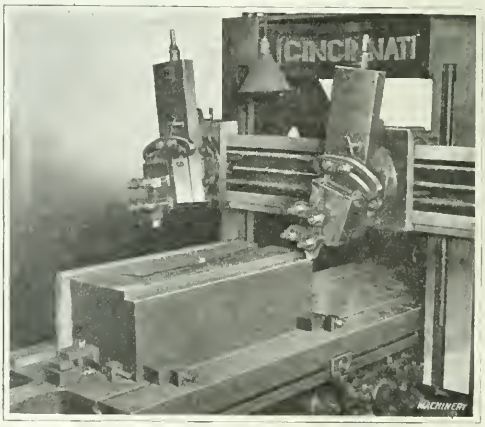


Fig. 3. Planing off the Face of a Used Die

shrinkage is taken care of by using standard shrink rules, ⅛ and 3/16 inch to the foot, as determined by the shape and size of the forging and its material. (If a mechanical engraving machine is employed to sink the impression, all necessary allowances are taken care of when making the pattern or model used on machines of this type.) On a long slender part, a greater shrinkage allowance should be made on the length than would be necessary if the forging were nearer average proportions. If the forging is to be trimmed cold, it will shrink more before trimming than a hot-trimmed forging, and so the allowance for shrinkage on the second-operation or finishing dies should be made accordingly.

The allowance which must be made in the designing of a die to provide additional metal for machining purposes is of vital importance. The amount of material left for finishing varies according to the practice in different drop-forge plants. It is the custom in many shops to allow at least 1/32 inch, even on small pieces where a machining cut is to be taken, and on the larger forgings an allowance of 1/16 inch is made. On parts such as crankshafts, from 3/32 to ⅛ inch or even more may be allowed, depending on the nature of the forging design. All finish allowances are additional to the allowance for draft.

One company handling a large business follows a practice of making a forging-size drawing of the part, on which the allowance for machining, draft, etc., is shown, and the outline of the part as it will appear after machining is indicated by dotted lines, as Fig. 2 shows. Two blueprints of these drawings are sent to the customer so that he may approve it and be informed as to just what he will receive and whether the allowances are sufficient for his purpose. After an approved blueprint has been returned to the drop-forge plant, the dies may be safely made. This is good practice, though not general, it usually being considered sufficient to pour a lead casting in the dies and send it to the customer to be checked and approved by him. This cannot be as readily done by the customer as could the inspection of a drawing, which also leaves a permanent record for the contractor, and carries the approval of the customer before the expense of sinking the impression has been incurred. Of course, if a change in the impression were necessary after the lead casting had been made, the welding torch could be resorted to for building up the impression or for removing metal, but in either case the question of expense enters. This expense will not be encountered if a drawing of the forging is first made and submitted for the customer's approval.

Other Details in Die Design

The details shown in Fig. 2 bring out another point in die design besides that of allowances. This forging is a planet cage for a high-grade gas engine. The parting line is indicated on the drawing; the section to the right of the parting line is produced in the lower die, and the section in which lugs *A* are to be forged, in the upper die, advantage being taken of the tendency of hot metal to shoot up. It will be noticed that there is a regular 7-degree draft allowed for the hub in the lower die, but that a much greater draft is provided on the upper die than appears to be needed. This is necessary in order to make the two impressions meet at the parting line, where the flash formed in the drop-forging operation must be trimmed. It will be obvious that if these two draft surfaces were not made to meet at a common outline the forging could not be properly trimmed and consequently the forging would be spoiled.

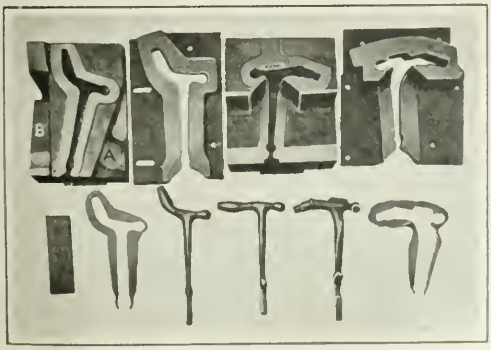


Fig. 4. Forging and Trimming Dies for Automobile Steering Arm

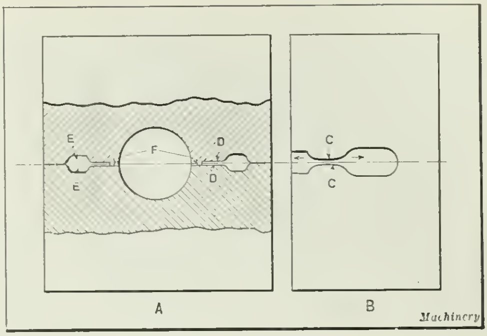


Fig. 5. (A) Section from Flash Recess. (B) Side View of Fuller

Before the impressions are laid out, or the machine model made, there is another point in design to be considered and that is the arranging of the impression so that the heavy end of the forging will be in the front part of the die-block. This facilitates handling the forging which, for larger work, is done by using tongs to grasp a projecting sprue or "tong-hold." If the heavy end is placed at the rear of the die-block, additional effort will be required to handle the forging. If the impression is deep and the forging correspondingly heavy, the channel in which the tong-hold is formed, should be large enough so that the weight of the forging will not cause the sprue to bend when the part is being handled while it is yet hot. If the forgings are of a small size, they will probably be hammered from the bar, and the statements previously made regarding the position of the impression in the die-block will not apply. On account of the increasing demand for large drop-forgings, however, the point is a valuable one, because the steel from which these forgings are made is first cut into blanks of the proper size and handled from one end, as previously mentioned, by tongs.

Laying out the Die Impressions

The die-block is first faced and squared up on two adjacent sides to a depth of two or three inches, as indicated in Fig. 1. This is done by planing, and the dovetail shank *A* on the opposite side of the die-block is also planed. In planing the shank, it should be remembered that it must be absolutely parallel with the sides of the die-block and accurately located, because it is by means of the shank that the die is aligned with the center of the hammer ram. If the shank is not accurately machined, it may result in the dies gaping so that the blows struck by the hammer may ultimately ruin the die and at best produce forgings of only questionable quality. After the impressions have been worn so that the dies are no longer serviceable, the faces are planed off as shown in Fig. 3, and the impressions resunk

Modern developments in the method of sinking the impression in a drop-forging die have resulted in obviating, in large measure, the amount of hand work required in finishing the die impression, and have also, by the use of ingenious automatic machines, eliminated the need of laying out the die impression on the face of the block. There are a great many drop-forging plants, however, engaged in the manufacture of their own dies, where the method is still followed of first laying out the impression and then sinking it with the most convenient type of machine tool available in the die-room.

In the actual laying out of the die impressions, a metal templet is commonly employed, which is made from the drawing of the part. The templet is laid out to a shrinkage scale, and suitable additions (such as already described in detail) made for finishing and for draft. The laying out of this templet is usually entrusted to one man who has had experience in the reading of drawings and who is familiar with this branch of the work. The templet is first laid on the face of the block (see Fig. 1) which has previously been coppered, and is so arranged that the impression will be about central and in no case too near the edge of the die-block. The die shown being laid out is for the connecting-rod *C*, the templet for which may be seen lying on the block at *D*. For medium size and large work, the block should be large enough so that the impression will not be closer than 2 inches from the edge at any point. The outline is then scribed and gone around with a prick-punch.

It will be noticed that in laying out the die, the squared side is used as a straightedge, in connection with a combination square and other ordinary instruments. The squared sides assure that the impressions in mating dies will be accurately located from the same surface. These matching sides are located on the right-hand side of mating dies, as seen from the front of the hammer, and are the means by which it is possible to set up the job in the hammer so that the impressions will match perfectly.

The work necessary on the face of the die, if the forging is of simple design and contains no offsets so that it can lie in one plane, is simply that of sinking the impression and milling a shallow space around it in which the flash can flow. Sometimes this shallow recess *D*, Fig. 5, is, in turn, surrounded by a deeper gutter *E*, so that if the flash is excessive, it can be prevented from spreading farther than the confines of the flash impression. The impression in the upper die is surrounded by a ridge *F*, which is not found on the lower die. The function of the ridge is to force the hot metal to flow into the flash recess. The forging design is seldom such as to occupy only one plane, and frequently it becomes necessary to provide a fuller, such as at *A*, Fig. 4, on one side of the block, and an edger *B* (sometimes called a "buster") which is usually located on the opposite side of the dies from the matching edges.

The Fuller and the Edger

The purpose of the fuller is to draw out the stock to approximately the desired length, and its design is of greater importance than might at first be thought. If it is made too narrow, it is likely to produce cold shuts; if it is too short the stock will be gouged into, which will result in an irregular surface and an inferior structure in the forging. It should not be attempted to design the fuller so that the end of the stock can be drawn in one "bite" of the dies. The diagram *B*, Fig. 5, conveys an idea of the proper design. The impressions in mating dies should be necked as at *C*, with the shallow impression of the neck running into a deeper impression that accommodates the end of the stock. The surface of this neck should be rounded or crowned, so that when the first blow is struck the crowned impressions of the neck will force the stock to flow in both directions; then the blank or bar may be moved in or out and hammered until the proper reduction in section has been obtained.

The purpose of the edger is, as may be inferred by inspecting the breakdown die at the left in Fig. 4, to form the blank into the approximate shape of the forging so that it may then be laid in the impression and reproduced. The templet used in laying out the impression for the die may be here again put to good usage by laying it on the side of the two matched die-blocks and scribing the outline so that the anvil, or lower-die edger section, will support the edged blank and locate it so as to be convenient for the hammerman. Convenience in handling the forging seems to be the main consideration in laying out the edger.

The fuller, which is not likely to be deep, is located on the matching or right-hand side, if the die contains an edger; if not, it is placed on the left side, opposite the matching sides, so that these will not be cut into. The edger often cuts into the side of the die to such a depth that if it were placed on the right-hand side it would cut away entirely the matching surfaces. Where more than one operation is required in making a drop-forging, the fuller and the edger are necessary only on the first, or what is termed the breakdown die, as will be understood from the illustration, Fig. 4. The die shown at the left is the lower breakdown die for an automobile steering arm and is provided with both a fuller *A* and an edger *B*. The other dies shown in this illustration are, from left to right, the rough trimmer, the finishing die, and the finish trimmer, all of which are lower dies. The various steps in the evolution of the steering arm are shown in the lower part of the illustration, these being the blank, the flash produced in the breakdown dies, the first-operation forging before and after bending the end, the finished forging with sprue attached, and the flash.

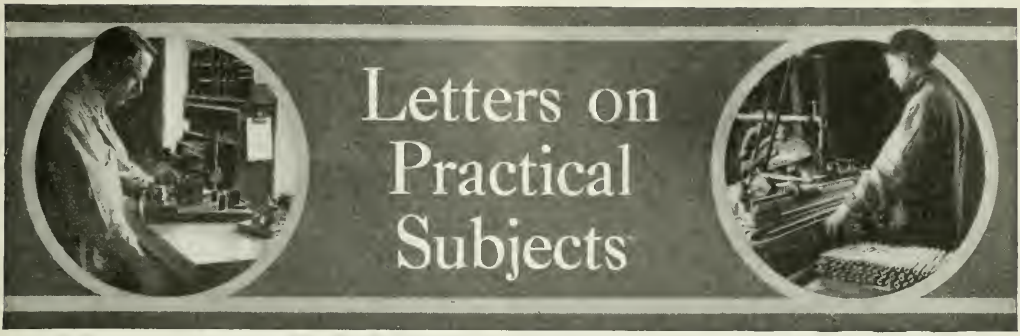
MACHINERY is indebted to the Union Switch & Signal Co., Swissvale, Pa., and J. H. Williams & Co., Brooklyn, N. Y., for much of the information contained in the foregoing. The second article on this subject, which will appear in the September number of MACHINERY, will describe in detail the methods by which die impressions are sunk, and will give complete information on the design, construction, and provision for shear on trimming dies, including formulas for calculating pressure in pounds required to force a forging through the die opening.

* * *

TRADE BETWEEN SWEDEN AND RUSSIA

Swedish newspapers report that a number of leading manufacturing concerns in Sweden have formed a trading syndicate for the purpose of doing business with Russia. The capital represented by these concerns exceeds $250,000,000, and two prominent men have been selected to go to Russia with a view to making the necessary trade arrangements. It is recognized that all of the trading cannot be done on a basis of gold payments, but that some of it will have to be done by barter or exchange. This makes it necessary that the firms that are members of the syndicate represent varied groups of industry so that some of them may be able to use, or at least dispose of, the raw materials that may have to be taken in payment for the finished goods sold by other members of the syndicate. The Soviet Government has placed orders for 1000 locomotives in Sweden and also for 800 cylinders for repairing old locomotives.

It has been reported by the New York *Times* that nineteen tons of Russian gold were melted and reissued as Swedish currency in 1920 in addition to seventy tons of Russian gold which arrived at Stockholm, representing a value of approximately 71,000,000,000 gold rubles. There were deposits of Russian gold in Swedish banks amounting to $160,000,000, of which $50,000,000 was later transferred to other European countries, while $50,000,000 has been deposited as securities for commercial orders placed by the Soviet Government in Sweden. The remainder is being held for future disposal as orders are being placed. It is stated that an appreciable amount of Soviet gold has passed through Sweden to America, as the United States is not transacting direct business with Russia, but uses Sweden as an intermediary. Most of the American firms who are doing business with Russia maintain agents in Sweden or other Baltic ports.



Letters on Practical Subjects

UNIVERSAL JIG FOR DRILLING COTTER-PIN HOLES

A universal jig for use in drilling cotter-pin holes in pins and screws such as shown in Fig. 2 is illustrated in Fig. 1. While this jig was primarily designed for use in drilling cotter-pin holes in pins such as those shown at *A*, Fig. 2, it has also proved useful in drilling holes for cotter-pins and dowels in studs and screws like those shown at *B*. This tool can be used in drilling holes of various sizes in pins or screws from 1/8 to 3/8 inch in diameter. Means of adjustment is also provided for locating the holes at any required distance from the end or shoulder of the work. When two holes are to be drilled in a pin, the required distance between them can be obtained by adjusting the members that carry the drill bushings.

A cast-iron base *A* is employed in the construction of the jig. To this base is fastened a machine-steel block *D*. In block *D* there is a milled slot that guides a hardened steel V-block *E* in which the pins to be drilled are placed. A hardened steel wedge *F*, operated by screw *G* having a left-hand thread, causes block *E* to be raised when knob *J* is turned, thus clamping the pins to be drilled against bushing-holders *H*, so that the work will be prevented from shifting while the drilling operation is being performed. A quarter turn of knob *J* will lower or raise V-block *E* a sufficient amount to permit the pins for which the jig is set, to be freely entered or removed. By operating the hand-knob, V-block *E* may be adjusted so that pins of any diameter within the range of the jig can be held in place.

Plates *K* and *L* are fastened to block *D* and serve to guide the V-block. It will be noticed that openings are cut in these plates to allow wedge *F* to pass through. On plate *L* is a movable stop *M* which locates the pins endwise in the V-block, and is operated by lever *N*. When lever *N* is pressed down, stop *M* is withdrawn from in front of the vee so that the drilled pin will be pushed through and dropped on guard *O* by the new piece which is inserted from the opposite end. Guard *O* protects the threads of screw *G* from the chips and also serves as a chute for conveying the drilled pins to a box or other receptacle under the front end of the guard. When drilling large quantities of pins, the jig may be attached to the drilling machine table by means of a plate provided with a T-slot. When two holes are to be

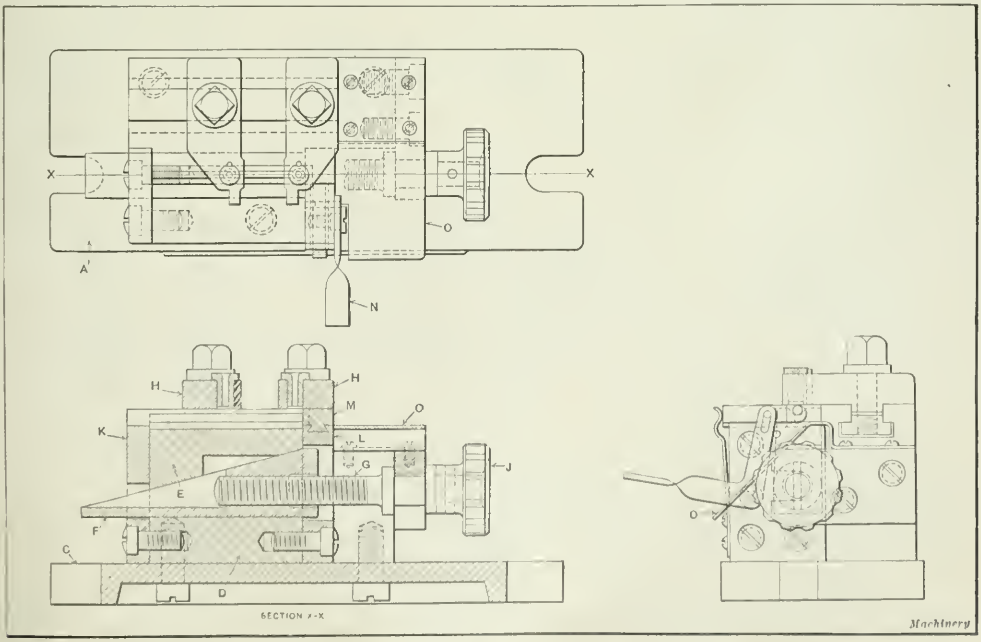


Fig. 1. Jig for drilling Cotter-pin Holes in Pins of Various Kinds and Sizes

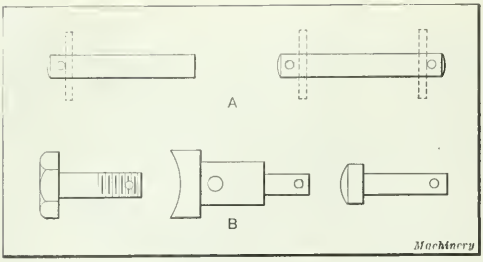


Fig. 2. Types of Work drilled by Use of Jig shown in Fig. 1

drilled in each pin, a multiple drilling head attachment can sometimes be used, thus enabling both holes to be drilled at the same time. This tool has proved to be very useful in a plant where various kinds of special machines of light weight are constructed in large as well as small quantities.

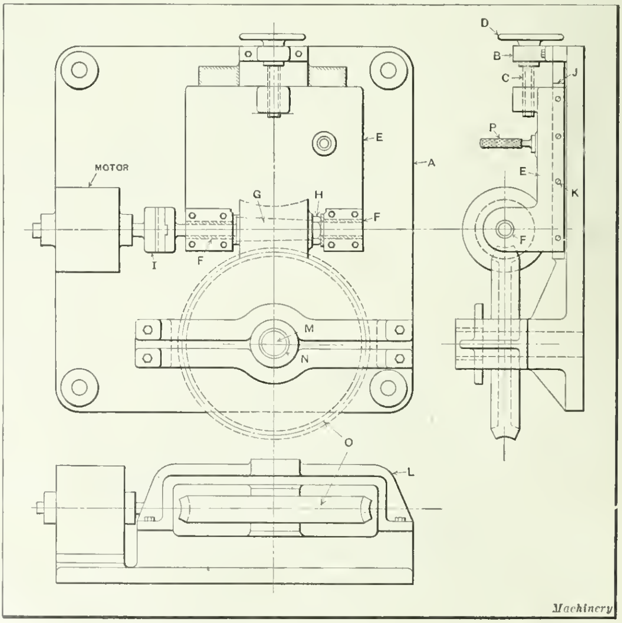
Cleveland, Ohio A. J. Cayouette

FIXTURE FOR GRINDING-IN WORMS AND WORM-WHEELS

The fixture shown in the accompanying illustration was designed for grinding-in worms and worm-wheels used in the construction of automobiles, but it is also adaptable for use in other cases where worm drives are employed to a considerable extent. With a slight modification of the design it could also be used to grind-in helical gears. The fixture simply provides a means of rotating a worm and worm-wheel in mesh, the grinding or lapping being accomplished by a mixture of oil and an abrasive applied to the contact surfaces. It will be noted that the electric motor which drives the parts to be ground-in, is located on base *A*, thus making the fixture self-contained so that it can be easily set up in any part of the shop or moved from place to place. If desired, the fixture could be arranged for belt drive by providing a tight and loose pulley, so that the rotating members could be stopped to permit the removal and insertion of work.

The pad on which the motor is mounted, and the dovetail section which carries slide *E*, are cast integral with the base. It will be noted that a separate bracket *B*, which carries screw *C*, is bolted to the base. Screw *C* is operated by handwheel *D* to obtain the proper adjustment of slide *E*. Slide *E* is made of cast iron, and has two bearings *F* which carry the worm-arbor *G*. This arbor is made of hardened steel and is accurately ground to size and provided with a lock-nut *H*. It is necessary to have a joint of the kind shown at *I* to enable slide *E* to be adjusted. With a belt drive this joint would not be required, as the belt could be provided with a compensating pulley that would permit the necessary movement. The slide has a gib *J* which can be adjusted by screws *K*, to take up any looseness that might result from wear.

The cast-iron bridge *L* forms a top support for the worm-wheel spindle *M*. Spindle *M* rotates in hardened steel bushings *N*, and carries the worm-wheel *O* which is keyed to it. A hardened steel plug *P*, located in a hardened steel bushing in the slide, serves to determine the proper depth to which the worm and worm-wheel should mesh when properly ground-in. When this point has been reached, the plug can be slipped through into a bushing in the base.



Fixture for grinding-in Worms and Worm-wheels

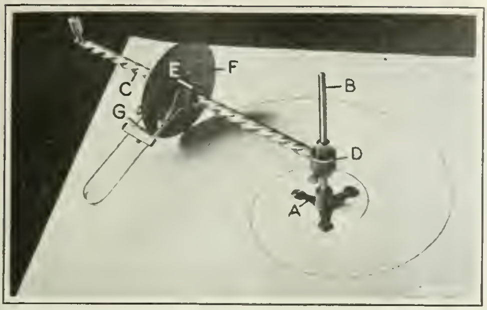
When grinding-in a worm-wheel a hardened steel worm corresponding to the one that is to be used with the worm-wheel is mounted on arbor *G* and locked in position by nut *H*. This arbor is then set into place between the bearings on slide *E*, care being taken to see that the center plate of joint *I* is in the proper position to slide into place. The bearing caps are then bolted down, after which slide *E* is drawn back by turning handwheel *D*, so that the worm will clear the worm-wheel while the latter is being put in place. The worm-wheel is mounted on spindle *M*, after which it is placed in the fixture and held there by bolting down supporting bridge *L*.

When the fixture is in operation, a solution of engine oil and fine carborundum or some other abrasive mixture is fed slowly to the hardened steel worm as it rotates; at the same time the worm is fed gradually into the worm-wheel until it reaches the full depth as determined by stop-plug *P*. If it is necessary to feed it in a little deeper to provide more clearance, the plug is removed and the worm fed in the required amount. To grind-in a worm it will, of course, be necessary to have a hardened steel worm-wheel which can be used in a similar manner to grind-in the mating part. This fixture was designed by the writer and has been used successfully by a large manufacturing company in England for a number of years.

Cleveland, Ohio C. F. George

INSTRUMENT FOR DRAWING LOGARITHMIC SPIRALS

While there are several instruments that can be used to develop a logarithmic spiral—a curve extensively used in connection with the design of milling cutters and circular saws—they are all more or less complicated and therefore expensive. A simple and inexpensive instrument for drawing these curves, which can be made by a skilled mechanic, is shown in the accompanying illustration. This instrument consists primarily of a stand *A*, which supports a vertical shaft *B*; a screw *C*, provided with a sleeve *D* which is a sliding fit on the vertical shaft; a nut *E*; and a sharp-



Instrument for drawing Logarithmic Spirals

edged marking disk *F*, which draws the spiral on the paper. An inking pad *G* can be attached as shown.

If screw *C* is turned around the fixed vertical shaft, the disk describes on the paper a curved line which is a logarithmic spiral. The length of the arc of this curve depends upon and is proportional to the developed length of the disk and increases simultaneously with the increase of the radius. Only the logarithmic spiral has these characteristics, and it is evident that logarithmic spirals of different pitches can be described by changing either the lead of screw *C* or the diameter of disk *F*. It will be found best to design the nut on the screw so that it will be possible to attach disks of different diameters. This instrument can also be used to advantage in designing spiral frames for turbines and turbine pumps.

Elmhurst, L. I. PAUL SCHWEITZER

FIXTURE AND TOOL EQUIPMENT FOR FACING MOTOR HOUSING

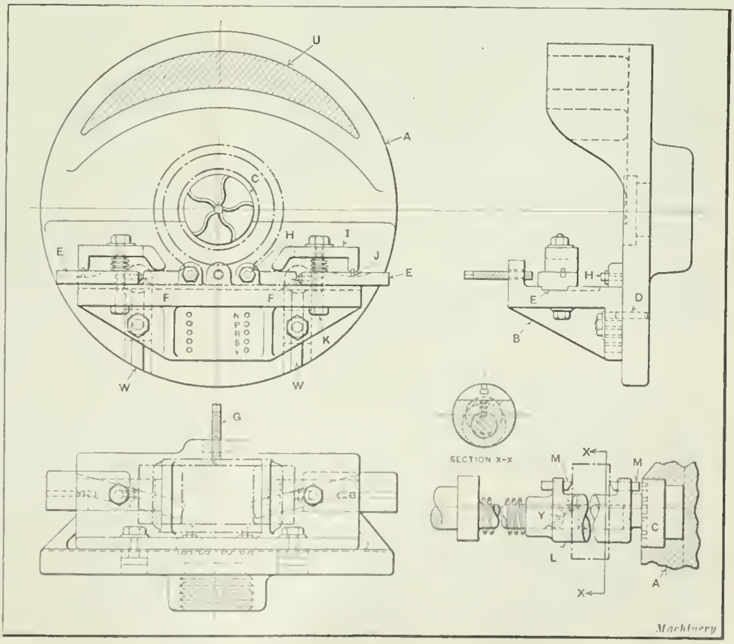
A novel facing tool and fixture used in machining both faces of a motor housing in one set-up on a turret lathe are shown in the accompanying illustration. The principle on which the tool operates should find ready application to various lathe and boring mill jobs. The tool and fixture effected quite a saving of time in that it made it possible to perform all the boring and facing operations on the motor housing in one set-up. The fixture can be adjusted to accommodate several different sizes of housings. It is threaded to fit the spindle of the machine, and takes the place of the regular faceplate. The facing tool, which is shown in the lower right-hand corner of the illustration, is not adaptable to different sizes a separate tool being required for machining each size of housing.

The body of the fixture *A* is an iron casting, part of the face being finished to permit the attachment of angle-plate *B*. On the side opposite *B* are two ribs so constructed as to form a recess *U* which is filled with babbitt to counterbalance angle-plate *B*. Driven into the center of faceplate *A* is a hardened bushing *C*, which takes the thrust of the facing tool, as will be explained later. Two dowel-pins *D* driven into faceplate *A* serve to locate angle-plate *B* in the proper positions for the various sizes of housings, a pair of holes being provided for each size of housing which the fixture is made to accommodate. Each set of holes is stamped with the letter corresponding to the size of housing for which it is intended, in order to facilitate setting up the fixture. Two T-slots *W* in faceplate *A* accommodate bolts for clamping angle-plate *B* in place after it has been located by the dowel-pins.

Angle-plate *B* is an iron casting, and is ribbed to provide rigidity. The top surface is finished, and two oblique keyways are milled on this surface to receive the bosses which project from the bottoms of blocks *E*. These keyways are cut at an oblique angle so that as blocks *E* are adjusted in or out, locating screws *F* will always retain their central positions relative to the housing. Location of the work is accomplished by nesting it between screws *F*, where it is clamped in place by screw *G*, which forces it against locating pins *H*, and clamps *I* which are lifted off the work by springs when the nut is released; these clamps can be pushed back out of the way for loading. Pin *J*, by riding in a keyway in block *E*, keeps clamp *I* from turning. Block *E* is tapped to receive bolt *K* which holds it in place. This bolt is likewise utilized for tightening clamp *I*.

The facing tool, shown in the lower right-hand corner of the illustration, consists primarily of a body, having two shanks which are eccentric, and a bushing *L*, the bore and outside diameter of which are turned eccentric the same amount as the body. A spiral keyway *Y* is milled in the shank, which receives a pin held in the bushing. The tool is so assembled that when it is in the relaxed position, the two eccentrics counteract each other, and the outside diameter of the bushing is central with the spindle of the machine.

When the facing tool is fed in, the face of bushing *L* abuts against the face of bushing *C* in the faceplate, and as the shank is fed in farther, it causes bushing *L* to turn thus forcing it off the true center and thereby producing an outward feeding movement of the tool bits *M*. Several S-shaped slots or grooves radiate from the center of bushing



Fixture and Tool used on Turret Lathe for facing Motor Housing

C and provide clearance for dirt and chips. These slots are important, and must not be omitted. The amount of eccentric offset of the shanks of the tool body must be equal to a little more than half the width of the face to be machined.

Brooklyn, N. Y. LESTER FERENCI

MILLING INTERMITTENT GEARS ON AN AUTOMATIC

On page 753 of the April, 1920, number of MACHINERY a method of milling intermittent gears on a Brown & Sharpe automatic screw machine was described. Another good method of doing this work is here presented, which does not require the stopping of the spindle and permits using greater feeds and speeds.

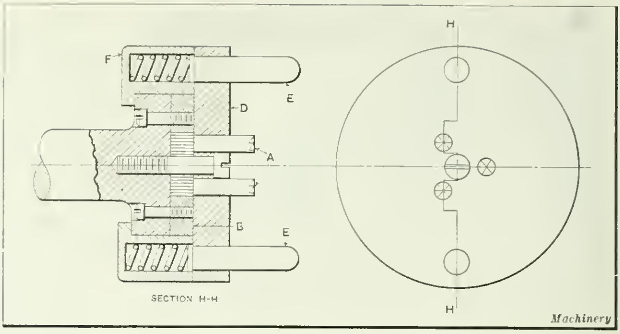


Fig. 1. Tool for milling Intermittent Gears

The end-mills *A*, Fig. 1, have small gear teeth cut on their rear ends which mesh with teeth of the internal gear *B* and are held in the proper relation to the internal gear by plate *D*. The internal gear *B* is fastened to the shank by screws, the shank being held stationary in the turret. As the tool is brought forward to the work by means of the lead cam, the driving pins *E*, which are also held by plate *D*, enter the pin wrench holes in the spindle cap thus rotating the body which, in turn, revolves the end-mills.

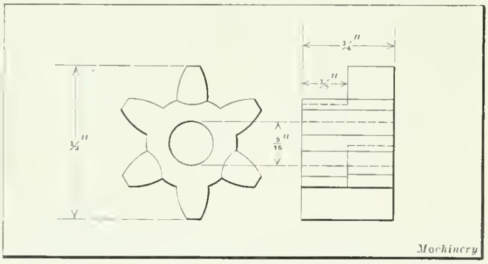


Fig. 2. Intermittent Gear machined by Tool shown in Fig. 1

The collet is keyed to the spindle in proper alignment with the pin wrench holes in the spindle cap so that the end-mills will be properly located in relation to the work The driving pins *E* are backed by springs in collar *F* so that when the tool first comes into contact with the spindle cap the pins will act as a friction clutch, not being able to enter the pin wrench holes in the spindle cap until the revolving body has attained the same speed as that of the spindle.

The collar *F* is held to plate *D* by four screws (not shown). The order of operations for making the intermittent or skip gear shown in Fig. 2 from extruded brass bars on a No. 0 Brown & Sharpe automatic screw machine, using spindle speeds of 810 and 1800 revolutions per minute is given in the accompanying table.

ORDER OF OPERATIONS FOR MAKING INTERMITTENT GEAR ON BROWN & SHARPE AUTOMATIC SCREW MACHINE

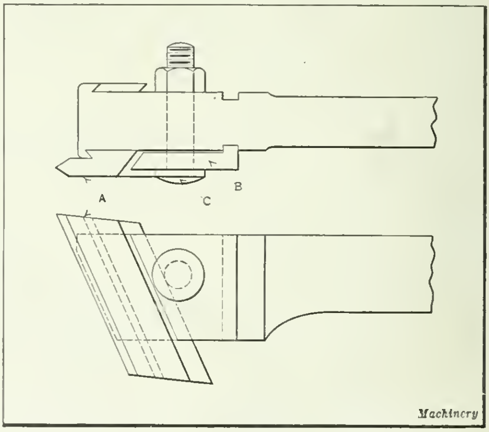
Speed	Operations	No. of Rev's.	Cam Rise	Feed per Rev.
High	Feed stock	16	.....	.....
High	Revolve turret	19	.....	.....
High	Center	8	0.040	0.005
High	Revolve turret	19	.....	.....
High	Drill	32	0.320	0.010
High	Revolve turret	19	.....	.....
High	Ream	19	0.270	0.014
Slow	Revolve turret	19	.....	.....
Slow	Mill teeth	19	0.125	0.007
High	Clear mill	5	.....	.....
High	Cut off	92	0.180	0.002
High	Clear stock	3	.....	.....
	Total	270 = 9 seconds per piece		

Machinery

Chicago, Ill. J. B. AMSTUTZ

THREADING TOOL AND TOOL-HOLDER

The threading tool and tool-holder shown in the accompanying illustration is intended primarily for use in performing threading operations in the engine lathe, although it can also be used in the turret lathe and screw machines. It is especially well adapted for threading brass work, such as valves and pipe fittings. The holder is so designed that the threading tool can be held either on the left-hand or right-hand side as desired. Two clamps, one of which is shown at *B*, are required, one being designed for use in holding the cutter on the right-hand side and the other for holding the cutter on the left-hand side of the holder.



Tool-holder for holding Threading and Forming Tools

For tool-room use, a threading tool having one cutting tooth or point like that shown at *A* in the tool-holder is employed. This type of tool is well adapted for cutting threads in steel, but for brass work it is usually preferable to have the cutter made with two teeth instead of one. The tool-holder can also be used to advantage for holding forming tools for form-turning operations on brass work, such as required in finishing valves and other pipe fittings. For operations of this kind performed in a forming lathe, one tool-holder can be held at the front of the work, one at the rear, and one in the operating bar.

Chemnitz, Germany T. R. WAGNER

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, July 15

THE outlook in trade generally is now distinctly brighter than for many months past. The long stoppage of work in the coal mines has been brought to an end, and the threatened trouble in the engineering trades has been avoided. The miners' strike ruthlessly aggravated a condition of trade that was already deplorable, and the only satisfaction to be gained from the dispute is the fact that for the first time in a large industry as a whole a profit-sharing scheme has been accepted by both owners and workers. This is generally considered to be a step that will have an excellent effect on the attitude of labor, provided a long enough trial is given to the project.

In the machine tool trade there were signs of improvement even previous to the ending of the coal dispute; but it may be some little time before an improvement is felt on the production side, as there are so many firms who have been accumulating stocks in preference to shutting down their works.

Ground Bars and Precision Gages

The production of ground steel bars is developing rapidly; at present most of these are exported to France, where the advantages of bars in this form appear to have been quickly appreciated. The first cost appears to be against precision ground bars; but as they can be ground to within 0.0005 inch on the diameter, a great many uses have been found for them, not only in machine tool building but in many other classes of work. Their use eliminates many operations when used for pins, feed-shafts, twist drills, reamers, and similar work.

The production of precision reference gages in this country is being watched with considerable interest. Several sets of standard gages made by an English firm have been tested at the National Physical Laboratory, and have been found to be within the limits required for certification. The limits allowed are plus two hundred-thousandths and minus one hundred-thousandth inch for gages under 2 inches, while larger gages are allowed more or less proportionate tolerances.

The laboratory has recently completed a very important piece of work, comprising the production of standard end gages with flat parallel end faces strictly perpendicular to the gage axis. A lapping jig similar to that used for finishing precision gages is used, and the resulting end faces have been tested and found to be flat and parallel to within five-millionths of an inch. The gages are made from carbon steel, hardened at the ends only.

Overseas Trade in Machine Tools

The official returns giving figures on the import and export trade in machine tools for May are remarkable in many ways. Exports fell during the month, but to a figure only a little lower than that of twelve months ago when trade in general was immeasurably better. Imports were maintained at the low figure—about 250 tons—they have shown for the last three months. For more than a year, up till last March, the value per ton of imported machine tools had been high, ranging from £225 to £275. In April this figure fell, and the fall continued in May, reaching only a little over £150 per ton, a figure around which the value per ton of exported machine tools has remained very steadily for more than a year. The tonnage imported per month is so small that any variation in the type of the tools would make a considerable difference in the value per ton, but at the same time there is other evidence that foreign makers have been accepting lower prices for their machines, while a smaller proportion of the more costly and elaborate machine tools have been imported.

Among the machine tools exported during May were 138 lathes. The majority of these were of the heavier type, and the same remark applies to the 174 drilling machines exported. In both these classes of machines, and also in milling machines, the imports were insignificant by comparison, but grinding machines and power presses were imported and exported in more or less equal numbers.

New Machine Tools on the Market

Despite the recent poor trade prospects, the faith of makers in the immediate future of the machine tool industry is shown by the continual appearance of new and improved designs in machine tools of all classes. Smith & Coventry, Ltd., of Manchester, have brought out some new Bateman planing machines, 10-foot stroke and 5 feet square. They are driven by 18-horsepower motors and have two cross-slide tool-heads and two side tool-heads to which rapid power traverse is applied. The table cutting speeds may be varied from 30 to 60 feet per minute in three changes, while the return stroke is constant at 120 feet per minute. Another new product of the firm is a brass finisher's lathe with automatic dead stops for both lengths and diameters; the control arrangements of this lathe are very well carried out.

The spiral bevel gear generator shown by Smith & Coventry at Olympia last year is proving very satisfactory under extended trials; a 51-tooth by 5-pitch steel motor back axle gear can be cut from a rough gashed blank in one hour, while the corresponding pinion with 15 teeth takes twenty minutes.

Another new planer, with a 3- by 3- by 8-foot stroke, is built by the White Machine Tool Co., Burnley Road, Halifax. These are essentially heavy-duty machines, the housings being exceptionally rigid, while all driving pinions and feed-gears are 0.4 carbon hammered steel.

Prices of Materials

The month of June saw further reductions in the prices of materials. Round steel bars fell from £15 10s to £13 10s per ton, while steel plates dropped from £19 15s to £15 15s per ton, and boiler plates that stood at £31 in January have now fallen to £21 per ton. Other metals do not show such decisive drops in prices, but the tendency is consistently downward.

* * *

THE PROVISION FOR MACHINE TOOLS IN NEW TARIFF BILL

The metal schedule of the permanent tariff bill, as passed by the House of Representatives, provides, in regard to machine tools, as follows:

> Machine tools and parts of machine tools . . . and all other machines and parts thereof, finished or unfinished, not especially provided for, 35 per cent ad valorem: Provided that machine tools, as used in this paragraph, shall be held to mean any machine operating other than by man power which employs a tool for work on metals.

This provision is made in Paragraph 372 of Schedule 3 of the new tariff bill. Schedule 3 includes metals and manufactures of metals.

NEW METHOD OF MANUFACTURING WORMS

The production of multiple-threaded worms in the lathe or by the thread-milling process necessitates intermittent indexing motions which often result in inaccuracies. The hobbing method, with its inherent advantage of progressive and continuous indexing, eliminates this objectionable feature. The Gould & Eberhardt Co., Newark, N. J., has recently developed a method of hobbing worms, one of the features of which is the special form of helicoidal cutter or hob employed. The design of these hobs permits worms to be hobbed which have a shoulder on either or both ends. The type of hob employed is illustrated in Fig. 1. The teeth are arranged helically as in regular gear hobs. There are about fourteen roughing and three finishing teeth. It will be noticed that there are only about one and one-half or two convolutions of teeth, thus making the hob much shorter than gear hobs, the length being about twice the normal linear pitch of the worm to be cut.

Action of Hob

The action of the hob is in the nature of a progressive roughing and finishing cut. The tops and sides of the roughing teeth are increased in regular increments. The first roughing tooth is made high enough to reach into the worm to half the depth of the thread, each succeeding tooth removing a little more metal, until the finishing teeth complete the worm tooth shape. The arrangement of teeth just described makes this hob analogous in its cutting action to that of a broach coiled around a cylinder. The removal of metal is accomplished progressively, and the cutting action is distributed over all the teeth. If the hob is made in the ordinary manner, it will be found that the "following" side of the hob teeth will cut away part of the worm thread from the pitch line to the outside diameter of the worm, unless suitable corrections in the form of the hob teeth are made. This condition necessitates a different lead of helix on opposite sides of the teeth, the "leading" side being made to the basic lead calculated from the normal linear pitch, and the "following" side recut to a shorter lead sufficient to clear the theoretical contour of the worm thread section. In setting up the machine, the middle of the three finishing teeth is centered with the axis of the worm. The amount of feed of the cutter-head relative to the axis of the worm depends on the helix angle of the worm thread; the greater the angle, the less the axial feed and vice versa. The fixture for holding the worm blank should be of a very rigid design and be provided with powerful means for driving, since the strains produced by the hobbing process are severe.

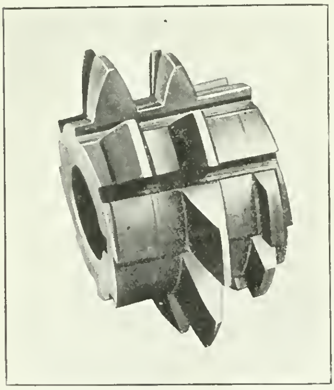


Fig. 1. Type of Hob used in cutting Worms

Production and Accuracy Attainable

The outstanding features of any thread-cutting process are the rate of production and the degree of accuracy attainable, and it is these features by which the merits of any process should be judged. The production possible with the hobbing method of manufacturing worms is much greater than can be obtained with the lathe or rotary milling cutter methods. This advantage is especially noticeable in the case of multiple-threaded worms, because the machine is geared for the number of threads, just as in hobbing helical gears. This obviates the necessity of indexing by hand and taking a fresh cut through the worm threads. In Fig. 2 is shown the set-up of one of these special hobs mounted in a gear generating machine for finish-threading low-carbon steel single-threaded worms. These worms have a 3⅛-inch outside diameter, 0.667-inch linear pitch, and are 4½ inches long. The axial feed of the cutter was 0.007 inch per revolution of the blank, and the speed of the cutter 51 R.P.M. The worms were finished with one cut, the production time, floor to floor, being seventeen minutes each.

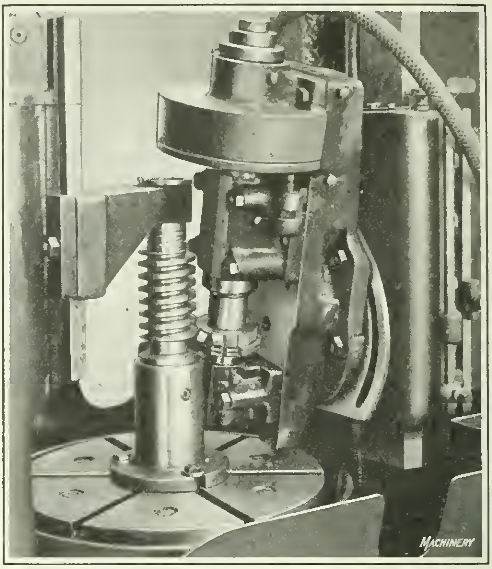


Fig. 2. Single-threaded Worm and Set-up for hobbing the Threads

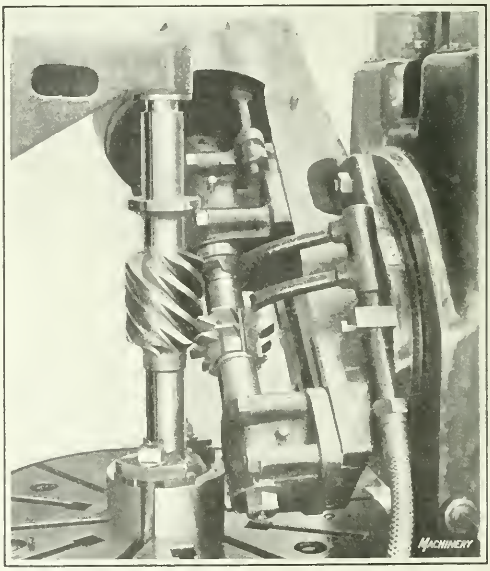


Fig. 3. Multiple-threaded Worm being hobbed with Hob of Special Design

The hobbing method is also adaptable for roughing worm threads that are to be subsequently heat-treated and then ground to correct errors due to distortion. In roughing with this method, the spacing of the teeth on the worms is very accurate, and permits a high degree of precision in the final grinding operation. Fig. 3 shows the rough-threading operation on an alloy steel seven-threaded worm, the outside diameter of which is 4.10 inches; width of face, 4½ inches; and linear pitch, 1.37 inches. The time required to thread this worm was sixty minutes, floor to floor. The threads are, of course, subsequently finished by grinding.

Another example illustrating the rate of production obtainable by this method is the threading of an alloy steel quadruple-threaded worm, having a 2.8-inch outside diameter; a 4½-inch face; and a 1.06-inch linear pitch. Worms of this type were produced at the rate of eight minutes each, floor to floor. The worm hobbing process has proved very successful in the threading of multiple-threaded automobile steering worms. These worms are produced with a very accurate linear pitch and excellent finish. A double-threaded steering arm for a well-known motor car is 2.09 inches outside diameter, 1⅝ inches face width, and has a linear pitch of 0.52 inch; quantities of these parts were produced by hobbing at the rate of fifteen minutes each, floor to floor.

The accuracy of worms produced by the hobbing method as outlined is due to the nature of the cutting action which is progressive and continuous and which produces multiple-threaded worms of accurate lead—an essential feature in worm drives.

* * *

MACHINING MOTOR PISTONS

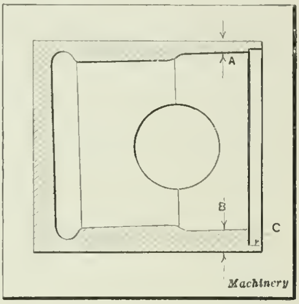
By ALBERT A. DOWD

The writer read with considerable interest the description of the process of machining motor pistons which appeared on page 878 in May Machinery. Some of the machining operations described in this article, however, are not carried out in accordance with the practice generally found most satisfactory by the writer, who has handled a great number of automobile pistons of various kinds in the last few years. The following suggestions relative to improved methods of machining automobile pistons are based on the facts obtained in developing methods for machining various types of pistons. It should be borne in mind that the design of a piston and the accuracy of the piston castings are factors to be taken into consideration, and it often happens that a method that proves entirely satisfactory for one kind of piston will be unsatisfactory for another. The practice of holding the piston by the outside diameter and facing the end and boring the inner surface in the first machining operation, as described in the article in May Machinery, while in use by some manufacturers, is not generally successful on account of the difficulty of preserving the required uniform thickness of walls.

An exaggerated example of the results often obtained in chucking the work from the outside for the first machining operation is shown in the accompanying illustration. It will be seen that while the bored and reamed open end of the piston at *C* is concentric with the outside of the rough casting, it is by no means true with the inside or cored section. Therefore, if the finished part of the open end is used as a locating point for any succeeding operations, the distribution of metal in the piston wall will be very uneven. For instance, the wall may be too thin at *A* and too thick on the opposite side at *B*; consequently, a number of pistons machined in this way when completed would vary appreciably in weight, and would be difficult to assemble in such a way as to balance the motor properly. However, if the work is held for the first machining operation by the inside cored surface, and the outside surface is rough-turned at this time, the outside and inside surfaces will be concentric and the walls of uniform thickness.

After the piston has been rough-turned, it can be held on the outside by means of soft jaws, while boring and reaming the open end. As the core of a piston is quite heavy, and as it has no support at one end, it is difficult to keep it properly located in the central position, and as a matter of fact, it is more than likely to be out of line when the casting is made. For this reason, most manufacturers of pistons agree that the proper method of holding a piston for the first machining operation is by the inside cored surface, using some type of expanding pin chuck for the work. It is possible, however, to locate a piston from the inside by a special device placed on the turret of a turret lathe. By using a device of this kind in connection with a special floating jaw chuck on the machine spindle, the work can be gripped by the outside in the floating jaws of the chuck so that it will be held in the proper relation with the cored inner surface. The locating device can then be withdrawn and the boring and reaming of the open end accomplished with the assurance that it will be true with the cored section.

In regard to the drilling of the wrist-pin hole, it is usually considered better to drill this hole from each side, and some manufacturers use a special drilling machine for this purpose which drills from both sides simultaneously. If this is done, there is less likelihood of the drill running out of line and producing a hole which is not square with the outside of the piston. The writer's objection to the method described in the article previously referred to is that the drill is unsupported for a considerable distance beyond the drill jig bushing at the time it comes in contact with the wrist-pin boss at the lower side of the piston.



Piston having Core out of Line with Outside Surface

* * *

NEW BOOK ON DIE-CASTING.

DIE-CASTING. 108 pages, 6 by 9 inches; 70 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

The die-casting industry, like most other industries, has been developed gradually through a period of many years, although the commercial application of this process for producing various kinds of castings is comparatively recent. The result is that developments and changes occur quite rapidly, and work formerly considered impracticable for production by the die-casting process is now handled successfully. It is likely that even greater advancements in the development of this method of producing castings may occur within the next few years. Whatever the future developments may be, the industry has made enormous strides since the introduction of the first machines designed for die-casting on a commercial basis. Semi-automatic and automatic machines have replaced many of the early hand-operated types; great progress has been made in the use of different alloys; plants devoted entirely to the manufacture of die-castings have been established; and an industry of great value in certain lines of manufacture has been created. This treatise (compiled mainly from articles written for Machinery by E. F. Lake and Chester L. Lucas) deals with the origin, development, and advantages of the die-casting process, the different machines and alloys now used in the production of die-castings, the construction of die-casting dies, and the commercial application of this efficient and accurate method of producing castings.

The German Machine Tool Industry

From MACHINERY'S Special Correspondent

Berlin, July 8

REPORTS relating to the German machine tool industry indicate that the supply of raw materials has been adequate to meet the demand during the last few months, but the supply of coal is still a limiting factor in industrial work. The orders on hand in the machine tool industry are comparatively few, and many plants are closed for from one to three days a week. There have been practically no labor troubles, and there is an increasing willingness on the part of the workers to perform their duties. In fact, in cases where orders are of an urgent nature, the men have declared themselves ready to work over-time.

Foreign business is now almost nil for several reasons: First, the uncertainty about the plans of the German Government after the acceptance of the London ultimatum prevented the German exporter from making plans with any degree of security. Second, the position of foreign business is entirely unsatisfactory, mainly because of protective legislation in many foreign countries. A great many of the countries have increased their tariff duties, and some have even introduced a special duty on imports from countries having a low exchange rate. Finally, Germany suffers the same as most industrial nations in consequence of the crises in the world's markets, where prices have been rapidly reduced and where other nations are becoming stronger competitors of German manufacturers. To export to the countries which have a special import duty becomes impossible.

Prices have fallen considerably, and in many cases manufacturers are selling at a loss. They prefer to do that rather than to have their plants entirely idle. The outlook for the German machine tool manufacturers is very dark at present. There can be no expectation of an increase in domestic orders for some time to come, and the uncertainty as to the amount of new taxation makes it impossible to lay any plans, business men preferring to quietly await developments. The heavy taxes that must be levied and the export duties that will be required will also reduce the competitive strength of German industry.

According to the official census covering exports and imports of machine tools during the first eight months of 1920, just issued, it appears that 58,500 tons of machine tools were exported as compared with 55,400 tons in 1913. The imports amounted to only 820 tons.

German Association of Machine Tool Builders

The report of the German Association of Machine Tool Builders for the business year 1920 calls attention to the disappointment of those who thought that the recovery of Germany would be rapid. The tremendous increase in production facilities caused by the war brought about overproduction in machine tools; while on the other hand, a great number of second-hand machine tools were placed on the market. At the end of 1920 there was a marked decrease in the prices of materials, but any advantage from this source was lost through the continuous rise in wages in the meantime. In 1920 there was a fair export business facilitated by the low exchange value of the mark, even though the domestic business was small.

The formation of groups within the association, which was started last year, has made further progress. The fundamental object of the groups is to facilitate price agreements and cooperation in regard to manufacturing programs. This plan can be successful only where the group includes makers of machines of the same kind. The idea has proved very valuable; meetings within the smaller groups take place frequently, and by these conferences plans for manufacturing programs have been effectively promoted. Of course, larger meetings are held whenever the interests common to all groups need to be considered.

Machine Tool Exhibitions

Another subject dealt with by the association is that of machine tool exhibitions. The experience with the fair at Leipzig has proved this to be a satisfactory means for advertising the German machine tool industry. At the fair last spring there were 145,000 visitors, among them many thousand foreigners. In 1922, sixteen thousand square feet of space will be taken at the exhibition, and the association will also take part in the 1923 fair, at which time it will be determined whether this fair will become a permanent institution or not. The exhibitors report that they obtained many good prospects as a result of the fair, but direct sales were made only in a moderate degree and restricted mainly to well-known makes of machines. The duration of the fair has been limited to two weeks for the future.

Organization of German Trade Associations

The German Precision Tool Association and the German Twist Drill Association have each engaged a business manager of their own; and secretaries have been appointed for the twenty-seven groups of the German Machine Tool Builders' Association. Altogether, in all the offices of the association, ninety-nine persons were employed at the end of 1920. Of these, three were engaged in connection with the exhibition, thirty-four on import and export trade, eleven on consolidations, and nine in connection with research work. The association has acquired an office building of its own. For the problems and the work of reconstruction a new department has been opened, which has a chief with five assistants.

The association now has 392 members, exclusive of the German Precision Tool Association, which has 121 members, and the German Twist Drill Association, which has 23 members. The Association for the German Works for Abrasives has 34 members, and the Research Society, 76.

Present Prices of Machine Tools

It is reported that the German machine tool industry will have to be ready to face very keen competition from France, as the French machine tool industry has been highly developed and is placing machinery and tools of good quality on the market at low prices.

Notwithstanding the depression in the industry, there appears to be no likelihood of a reduction in prices among the German manufacturers. The dealers show a readiness to sell at reduced figures, frequently lower than those quoted by the makers. As examples, it may be mentioned that a 40-inch vertical boring and turning mill sells for 37,000 marks ($518, present exchange); a 48-inch lathe, 19,000 marks ($266, present exchange); and a hand-feed milling machine, 4100 marks ($57, present exchange.)

A Berlin agency of the Soviet Government in Russia has been created for the metal-working and mining industries. This agency has power to make all purchases in Germany for the metal-working and mining industries in Russia.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool Descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Stevenson Multiple-tool Gear Shaper. Stevenson Gear Co., Indianapolis, Ind. 1153
Poliakoff Milling Machine Dynamometer. Cincinnati Milling Machine Co., Cincinnati, Ohio....1156
Knight One-hand Electric Drill. Knight Engineering & Sales Co., Los Angeles, Cal....1156
Alfred Herbert Hardness Testing Machines. Alfred Herbert, Ltd., 50 Church St., New York City....1157
General Electric Arc Welding Sets. General Electric Co., Schenectady, N. Y....1158
Myers Combination Work-bench. Myers Machine Tool Corporation, Columbia, Pa....1159
Lehmann Double Back-geared Engine Lathes. Lehmann Machine Co., Chouteau Ave., at Grand, St. Louis, Mo....1159
Gorton Graduating Fixture. George Gorton Machine Co., Racine, Wis. 1159
Johnson Die Milling Machine. Johnson Tool Co., 201 Eddy St., Providence, R. I....1160
Pratt & Whitney Rotary Surface Grinding Machine. Pratt & Whitney Co., Hartford, Conn....1160
General Electric Heating Unit. General Electric Co., Schenectady, N. Y. 1161
Fitchburg Poppet Valve Grinding Machine. Fitchburg Grinding Machine Co., 76 Winter St., Fitchburg, Mass....1161
Jones Vertical Boring and Turning Mill. Jones Machine Tool Works, Philadelphia, Pa. 1162
Niagara Shear Gage. Niagara Machine & Tool Works, Buffalo, N. Y....1162
Fretter Tube-cutting Machine. Nathan F. Fretter, 9113 Columbia Ave., Cleveland, Ohio....1163
Alfred Herbert Four-jawed Independent Chucks. Alfred Herbert, Ltd., 50 Church St., New York City....1163
Pieuvre Belting. J. L. de Rabot, 191 Greenwich St., New York City 1163
Whiting Short-turn Trolley System. Whiting Corporation, Harvey, Ill. 1164
Lathe Attachments. Star Machine & Tool Co., 433 Champlain Ave., Cleveland, Ohio....1164
Arrow Pump Packing Gland. Arrow Pump Co., Room 54, Buhl Bldg., Detroit, Mich....1164
Rickert-Shafer Adjustable Boring Head. Rickert-Shafer Co., 612 W. 12th St., Erie, Pa....1165
McCrosky Floating Holders. McCrosky Tool Corporation, Meadville, Pa. 1165
Woodward & Wolf Press Guard. Woodward & Wolf, 213 Rosemont Ave., Trenton, N. J....1165
Milwaukee 9-inch Shaper. Milwaukee Shaper Co., 1023-1029 Cold Spring Ave., Milwaukee, Wis....1166
Simmons Method Gear Hobs. Simmons Method-Hob Co., 2nd St. and Duncannon Ave., Olney, Philadelphia, Pa....1166
Union Zinc-covered Tool Chests. Union Tool Chest Co., 83 Mill St., Rochester, N. Y....1166
Warner & Swasey Releasing Tap- and Die-holder. Warner & Swasey Co., Cleveland, Ohio....1167
Milling Machine Fixture. Supreme Machine & Tool Co., 1738 St. Clair Ave., Cleveland, Ohio....1167

Stevenson Multiple-tool Gear Shaper

A NEW type of gear-cutting machine, known as the Stevenson multiple-tool gear shaper, which differs from the usual types of gear-cutting machines in that it cuts simultaneously all or a number of teeth in a gear or similar product, as distinguished from cutting one tooth at a time, has been developed by the Stevenson Gear Co., Indianapolis, Ind. The distinctive member of this machine, which is shown in Fig. 1, is a special tool-head consisting primarily of a series of radially disposed tools, spaced about the circumference of the blank to be cut. The machine operates in the same manner as an ordinary vertical shaper, except that the tools are held in a stationary position, and the gear blank is reciprocated past them.

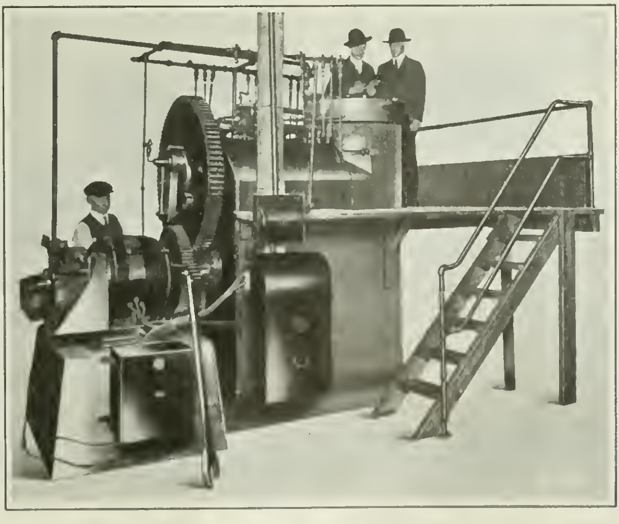


Fig. 1. Multiple-tool Gear Shaper built by the Stevenson Gear Co.

General Features of Construction

The frame of the machine is a casting of rectangular box section with a vertical cylindrical portion at one end. A ram that carries the work-arbor is mounted in the center of this cylindrical part, and the tool-head is mounted above the ram. A crankshaft which drives the ram has bearings near the top of the rectangular section, and is provided with an adjustable head at the end next to the ram; it is driven through back-gears by an individual electric motor. The work-arbor fits a socket in a spindle inside the ram, the spindle being free to rotate independently of the reciprocating motion imparted to it by the ram. An intermittent indexing movement is imparted to the spindle after each cutting stroke, the purpose of which will be described later.

Construction of the Tool-head

The top of the tool-head is shown in Fig. 2 and the bottom in Fig. 3, while in Fig. 4 the bottom is removed to expose the principal parts of the mechanism. The tool-head consists essentially of a flat steel disk, 3 feet in diameter, which is provided with a hole at the center and a number of radial grooves in its face in which the tool bits are held. Feeding movements are imparted to the tools by an annular sectional cam-ring, the tools being gradually fed inward between each traverse of the gear blank past them until the full depth of the tooth has been cut. At the completion of each stroke of the ram, the gear blank is indexed a space equal to one tooth, thereby presenting a different tool to each tooth from the one which made the previous cut.

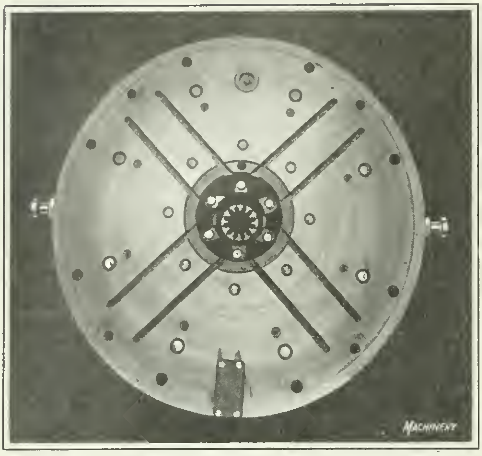


Fig. 2. Top of Tool-head as it appears when mounted on the Machine

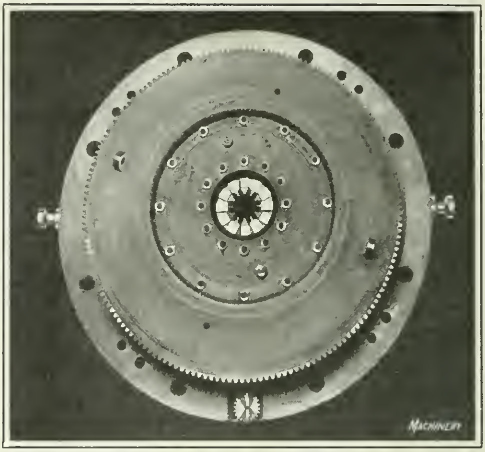


Fig. 3. Bottom of Tool-head showing Ring Gear used to clamp Tools

After the tools have been fed in to full depth, they are held in that position while the cutting process continues until the gear has been indexed one complete revolution, so that each tool takes one last cut on each tooth. This final complete indexing insures a uniformity of tooth spacing on the gear equal to that of the indexing mechanism. Uniformity of the tooth form is secured, even though the tools themselves may not be uniform, because if any tool is longer or wider than any other tool, even though it be only a thousandth of an inch, that portion of it which is longer or wider will take a last cut on the corresponding portion of each tooth in the gear, and thereby eliminate any variation which may have been caused by previous cuts.

When the tool-head is mounted on the machine, the only working parts to be seen are the points of the tool bits at the center and the small depth adjustment dial seen near the top in Fig. 2. The four pairs of T-slots on the face of the tool-head are useful for attaching a piloting device used on extremely long and slender arbors which need an outer support. Two tool-heads are provided for each machine, so that while one is in use on the machine, the tools of the other may be sharpened and reset, ready for use when the tools in operation become dull. The tool-head is held in place by eight studs and nuts in such a way that it can be readily removed and replaced. This arrangement permits a practically continuous operation of the machine. When a tool-head is taken off, it is turned bottom side up on trunnions. The clamping gear and plate are then removed in order to expose the tools and feeding mechanism, as illustrated in Fig. 4.

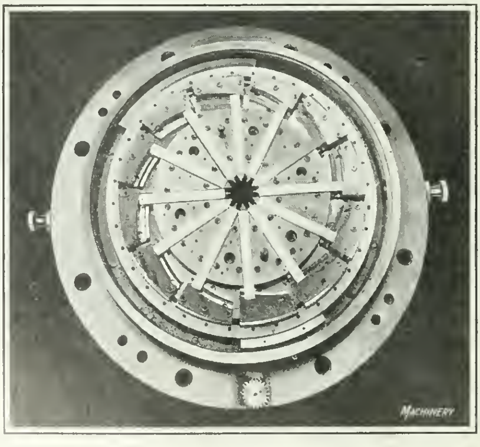


Fig. 4. Tool-head with Bottom removed to expose the Tool-actuating Mechanism

Tools and Actuating Cams

The tools are rectangular in section except for the lower side which is in the form of a vee. The gear tooth profile at the inner end of each tool is backed off to permit sharpening without changing the form. The outer end of each tool is ground to the radius of the cam surface against which it bears. A small pin near the back end fits in a groove of the cam and keeps the tool in close contact with the cam surface. The individual cam sections are mounted on a large ring, being attached by T-bolts that fit a circular slot in the ring. The tools are adjusted for depth independently by moving the cam sections individually along the T-slot relative to the cam-ring and each other. Feeding movement is imparted to the cam-ring through the two idler gears seen near the bottom of the tool-head in Fig. 4.

The final depth to which the tools are fed is determined by an adjustable stop that limits the rotary feeding movement of the cam-ring. As the feeding mechanism is spring-actuated, the position of the depth-controlling stop can be varied within reasonable limits without necessitating a resetting of the feeding mechanism. This is particularly desirable during the operation of the machine in cases where the tools may not have been set to exactly the right depth in the beginning, or in cases where the keen edges of the tools wear and they begin to cut uneven or over-size gears long before they are actually dull. The dial which controls this adjustment has been previously referred to.

Tool Feeding, Clamping and Indexing Mechanisms

In order to provide relief for the tools on the back stroke of the ram, a reverse feeding movement is imparted to the cam-ring. Then, before the beginning of the cutting stroke, the forward feeding movement of the cam is great enough to compensate for the slight reverse movement for relief and also to provide the necessary additional feed for the depth of the cut. The large gear and plate seen in Fig. 3 are used to clamp the tools intermittently for the cutting stroke. The gear member is free to rotate about the central plate, and a rotary reciprocating motion is imparted to it by a cam-operated segment so as to clamp the tools.

The feeding and clamping mechanism is shown in Fig. 5. Segment *A* which controls the feeding of the tools swings about a central stud as a fulcrum, and is moved directly by a cam. This cam is rotated intermittently by

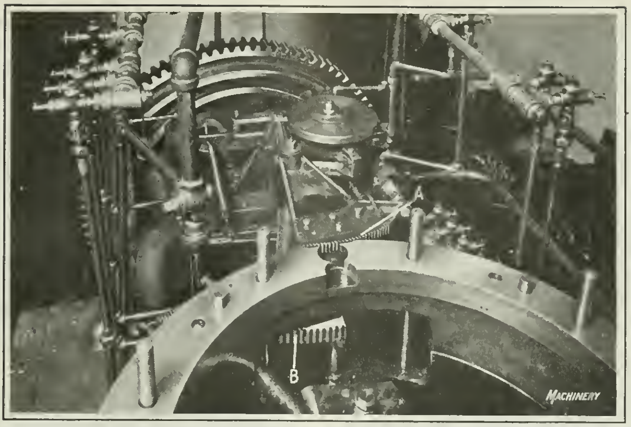


Fig. 5. View taken with Tool-head removed so that the Tool Feeding and Clamping Mechanism can be seen

a ratchet on which it is mounted, and can be adjusted to produce various feeding motions. The cam has a long gradual slope for the feeding movement and a sharp one for quickly returning the tools to their starting position at the completion of the cutting operation. The slight reverse movement for furnishing the tools with relief, previously referred to, is effected by mounting the fulcrum stud eccentrically on a shaft which is given a partial rotation by a face-cam on the large driving gear. Gear segment *B* is the one used in clamping the tools. It is actuated directly by a push-rod in contact with another face-cam on the large driving gear. The releasing movement is accomplished positively, but the clamping movement is effected by means of a spring in order to eliminate breaking some part, which might occur if the clamping mechanism were too tight.

The indexing mechanism is shown in Figs. 6 and 7. It consists of a split-bushing guide, one half of which is attached to the ram spindle, and the other half to a revolving drum on which is mounted a worm-gear driven by a worm and an intermittent gear train. The intermittent indexing movement is derived from a Geneva wheel, and is transmitted through a set of change-gears to the worm and worm-gear. By varying the ratio of the change-gears, indexing movements for any desired number of teeth may be obtained. Minute angular adjustments of the spindle position varying by one second of an arc, for locating keyways, the teeth of cluster gears, etc., are obtained by means of a differential clutch between the worm and worm-shaft.

The main crankshaft of the machine is connected to a large back-gear by a quick-return crank of the drag link type, as will be seen by referring to Fig. 1. This crank imparts a slow motion to the ram during the cutting stroke and a quickly accelerated motion for the return stroke. The driving motor is mounted on a sliding base, and drives through a single set of speed-change back-gears. The drive for the indexing mechanism is taken directly from these gears. A pump for circulating the cutting oil is driven from a small sprocket on the end of the motor shaft opposite the driving pinion. The motor is controlled by a push-button switch, an automatic compensator, and a solenoid electric brake.

The Work-arbor

The work-arbor is provided with a thrust collar and a taper shank to fit the socket in the ram spindle. The thrust collar prevents the shank from being thrust too tightly into the socket. Gear blanks are put on the arbor and fastened in place by a nut while the arbor is held in a vise-like fixture attached to a bench at the side of the machine. After loading the arbor, it is dropped into the spindle socket and the machine is ready to work. The thrust of the cut forces the arbor back into the socket until the shoulder is reached. The tight fit of the taper shank is sufficient to prevent the arbor from turning under the pressure of the cut, but it is not great enough to make it difficult to remove. While one arbor of gears is being cut, another arbor is loaded with blanks. As soon as the work on the arbor in the machine is finished, the operator stops the machine and presses a conveniently located foot-pedal, which, by means of a long bar passing through a hole in the center of the spindle, knocks out the arbor of completed gears. He then drops the arbor with uncut blanks into the socket, touches the starter button, and the cutting operation again proceeds almost without interruption. The entire operation of stopping the machine, changing the arbors, and starting again, occupies less than one-half minute. The machine illustrated is 7 feet high, weighs 17,000 pounds, and when operating at full capacity is driven by a 100-horsepower motor. It has a capacity for gears 12 inches diameter, 6-inch face, and 4 diametral pitch. The machine will also be built in other sizes.

Advantages of the Machine

In cutting some gears, it is desirable to use as many tools as there are teeth in the gear. In others it is more practical to use only half or a third as many tools as there are teeth. With this arrangement a tool-head equipped with

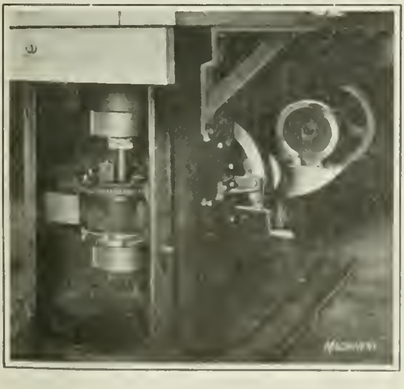


Fig. 6. Mechanism provided for Indexing the Work after the Completion of Each Stroke

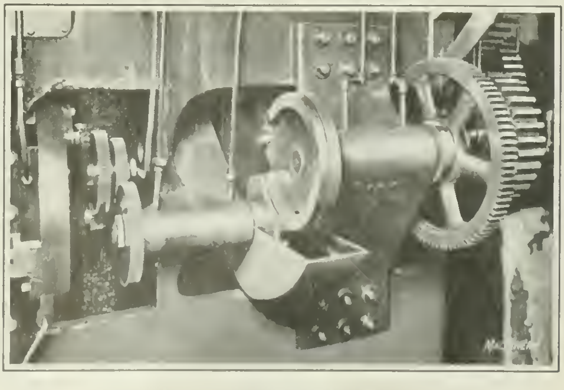


Fig. 7. Close-up View of that Portion of the Indexing Mechanism that is on the Side of the Machine

any number of tools can cut gears having any number of teeth which is a multiple of the number of tools used. Thus a spacing plate having ten tools could be made to cut ten, twenty or thirty teeth, etc. In a case like this, if it is desired to cut a number of teeth greater than the number of individual tools which can conveniently be placed within the space, a gang tool is used to cut two or more teeth. This arrangement is particularly advantageous in cutting gears having a large number of very fine teeth, on account of the fact that although the amount of power required for the cutting of all the teeth is small, it would, nevertheless, be practically impossible to use as many individual tools as there are teeth in the product. Where it is desired to cut a gear having an odd number of teeth, and it is not practicable to use a tool for every tooth, ten tools may be used.

In some cases, every other tool is made in the form of a roughing tool, either a square-nose gashing tool or the usual type of stepped roughing tool. These tools are so adjusted that they will remove most of the stock from the tooth space. The alternate tools are then made in the usual type of finishing tools and take the last few finishing cuts. At other times, a special cam is provided for one tool, so that this tool is held back during the stock-removing cuts and is then fed forward ahead of the other tools to take the finishing cut on all the teeth.

This gear-tooth shaper is also adapted for the production of other cylindrical products having teeth or grooves, such as sprockets, splined shafts, reamers, taps, milling cutters, saws, ratchets, etc. The machine may also be used for cutting gears made of different materials, such as laminated gears composed of sheets of steel, brass, rawhide, fiber, etc.

POLIAKOFF MILLING MACHINE DYNAMOMETER

To enable an accurate determination of the different pressures exerted by the cutter of a milling machine on the work and on the working parts of the machine, the Cincinnati Milling Machine Co., Cincinnati, Ohio, has placed on the market the Poliakoff milling machine dynamometer. This dynamometer is equipped with dial gages which permit a direct reading of the vertical pressures on the work and either the longitudinal or the transverse pressures relative to the table of the machine. It thus furnishes a means of ascertaining the difference in the pressures exerted by cutters of various types when taking duplicate cuts, and should prove valuable in supplying information to designers of milling cutters, fixtures, and machines. It should also be of assistance to the designers of parts to be milled, because in the final analysis the pressure of the cutter is first exerted on the work and then transferred to the milling fixture and machine. In experimental shops, laboratories, and technical schools it may be used to determine the efficiency of machines.

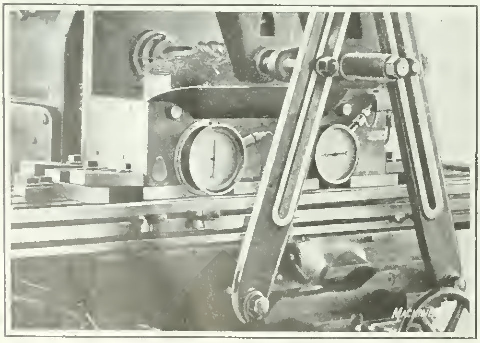


Fig. 1. Milling Machine Dynamometer placed on the Market by the Cincinnati Milling Machine Co.

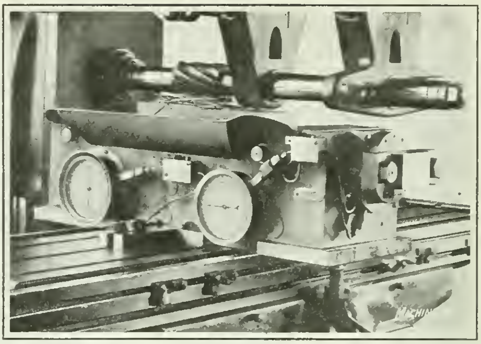


Fig. 2. Poliakoff Dynamometer being used to determine the End Thrust of a Cutter

The dynamometer consists essentially of a work platen supported by a baseplate which is bolted to the table of the machine. In Fig. 1 the device is shown mounted on a milling machine, and a heavy cut is being taken on a piece of steel. The vertical downward and upward pressures of the cutter are read directly from the left-hand dial, while the longitudinal pressure relative to the table is read on the right-hand dial. When it is desired to obtain the transverse pressure, that is, the pressure in line with the arbor of the machine, the dynamometer is mounted on the table as shown in Fig. 2, and the pressure ascertained from the right-hand dial. This arrangement enables the end thrusts of spiral- and face-milling cutters to be determined.

The work platen of the dynamometer is supported at the ends by wide plate fulcrums, the lower ends of which rest on levers which carry a definite portion of the vertical load on the platen to a hydraulic chamber located centrally beneath the platen. This chamber is connected with the left-hand dial gage, the latter being graduated to indicate the pressure in pounds. The horizontal pressures on the platen are transmitted through bars, which are flexible vertically, to the cross-head seen at the right-hand end of the dynamometer in Fig. 2. This cross-head transmits the load to a hydraulic chamber between the cross-head and the end of the main frame of the dynamometer, the hydraulic chamber being connected to the right-hand dial gage. Heavy springs place initial loads on each chamber.

The plate fulcrums which carry the loads to the levers, as previously mentioned, are so constructed as to be rigid against vertical and cross loads, but flexible to longitudinal loads, and the bars to the cross-head are flexible to vertical loads so that neither of the two registering mechanisms of the dynamometer interferes with the action of the other Guards are provided so that lubricant may be supplied to the cutter. The dynamometer has a capacity for withstanding longitudinal loads up to 25,000 pounds, vertical downward pressures up to 10,000 pounds, and vertical upward pressures up to 7000 pounds. The working surface of the platen is 16 by 10 inches, and it is provided with three T-slots. The base is 35 inches long and 14 inches wide, and the height of the platen above the bottom of the base is 8 inches. The dynamometer is not confined to investigations of pressures on milling machines, but can also be used on planers, shapers and, with modifications, on drilling machines.

KNIGHT ONE-HAND ELECTRIC DRILL

The Knight Engineering & Sales Co., Los Angeles, Cal., has developed a one-hand electric drill for drilling small holes up to and including ¼ inch in diameter. The tool has been given the trade name of "One-Hand-Y" drill. It is one of the lightest of its class ever placed on the market, and is designed for drilling holes for oiling purposes, cotter-pins, nameplates, etc. It will prove especially useful in garages and sheet-metal shops. The housing of the drill is an aluminum die-casting, and has a pistol grip designed to fit the hand. The grip is in a direct line with the chuck, thus giving a straight-line pressure on the drill bit and eliminating side strains. A switch-button, operated by the thumb, controls the power, and so the motor does not run unless desired.

The drill is equipped with a Westinghouse motor intended for operation on either alternating or direct current of 110 voltage, and so can be connected to a lamp socket. The chuck spindle has a bronze gear that is driven from a pinion integral with the hardened and ground armature shaft. The spindle has a large bronze bearing. The thrust bearing consists of a loose steel ball in bronze bushings. A knurled nut on the extended end of the armature shaft furnishes a quick and simple method of holding the chuck spindle stationary when it is desired to remove a drill bit. The drill is regularly equipped with six feet of cord and a three-jaw chuck. It is 8 inches long, and weighs about 3 pounds.

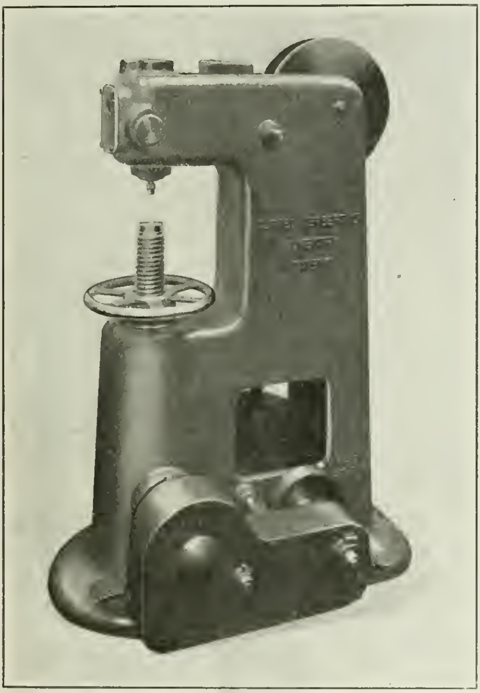


Fig. 1. Power-operated Brinell Hardness Testing Machine built by Alfred Herbert, Ltd.

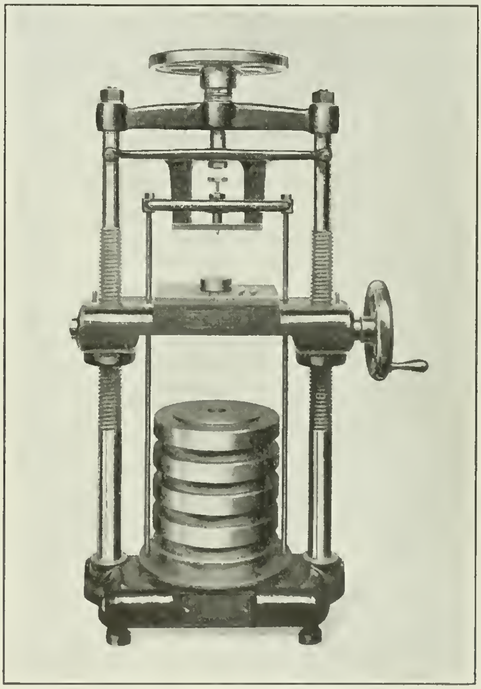


Fig. 2. Machine developed by Alfred Herbert, Ltd., for testing the Hardness of Thin Specimens

ALFRED HERBERT HARDNESS TESTING MACHINES

Two machines employing the Brinell principle of testing the hardness of metals have been developed by Alfred Herbert, Ltd., 50 Church St., New York City. The outstanding features of the machine shown in Fig. 1 are its operation by power, which eliminates physical exertion on the part of the operator; the automatic application of pressures on parts to be tested; and the uniformity of the periods of pressure applications. The ball through which pressure is applied to a specimen is 10 millimeters in diameter and is used with the standard pressures of 500 and 3000 kilograms, according to the kind of material being tested.

The ball is carried by the lower end of a vertical plunger, the weight of which is neutralized by a light spring. This plunger moves upward a slight amount when a specimen is raised into contact with the ball, the pressure between the specimen and the ball being weighed through a lever and a weight which becomes poised when the full pressure is reached. The point of application of the pressure on the lever is a hardened steel roller. At the other end of the lever is a spur gear segment which meshes with a pinion keyed between two sheaves. A wire cord with its ends attached to the sheaves, passes around them and also around a third sheave that is attached to an adjustable weight inside the column. An indicator located at the front of the machine shows when the weight is poised and the full load is on the specimen. Openings are provided in the column to permit the changing of weights to apply either a 3000 or 500 kilogram load as required.

The object to be tested is placed on a flat anvil, which rests on a spherical seat on the top of a vertical screw. The anvil is elevated by a handwheel, in order to bring the specimen in contact with the ball. The spherical seat on the screw has a recess at the center which enables the proper location of V-blocks or other special forms of support required for the work when these supports are provided with a suitable projection. The elevating screw occupies an axial position in a vertical cylindrical ram. A slight upward movement of this ram forces the work against the ball and causes the application of the pressure, the latter being regulated and resisted by the poised weight of the weighing element.

The lower end of the ram carries a roller which rests on a cam that makes a single revolution for each test. The contour of this cam is such that the load is applied gradually, maintained for the predetermined period, and then removed. Rotation of this cam is effected by a worm-wheel and worm which are driven through spiral gearing and

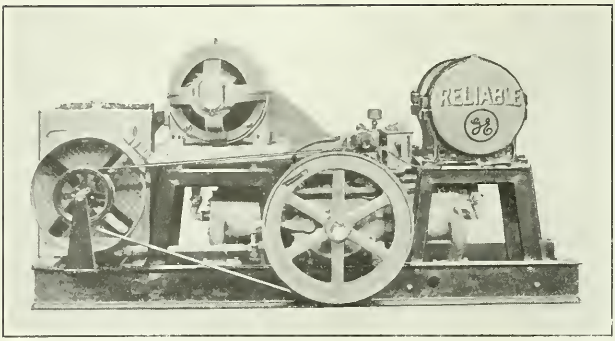


Fig. 1. Portable Medium-duty Arc Welding Equipment made by the General Electric Co.

shafts from a single driving pulley located near the base of the machine. The mechanism is engaged by depressing a pedal, and is automatically disengaged at the conclusion of a cam revolution. The maximum height between the ball and the anvil is 10½ inches; the distance from the center of the ball to the face of the column at the gap, 9½ inches; and the approximate weight of the machine, 1680 pounds.

Another Alfred Herbert hardness testing machine is illustrated in Fig. 2. The essential difference between this machine and other Brinell machines is not in principle, but in the size of the pressure ball and in the amount of the load applied. The machine was developed to enable an accurate determination to be made of the hardness of thin specimens and finished articles that cannot be subjected to the pressure of ordinary testing machines, either because of their small size or because of the injury caused by making a comparatively large impression. The balls used on this machine in ordinary practice are 1 and 2 millimeters in diameter, and loads up to 50 kilograms are applied. However, balls 5 millimeters in diameter are also supplied for use in testing extremely soft metals.

With this machine thin-walled tubes and other hollow forms may be tested without internal support, tests may be made on loaded small-arm cartridge cases without necessitating the removal of the bullet or charge, articles may be tested by an impression so small as to be imperceptible to the naked eye, the hardness of wire can be tested at successive stages of the drawing process, and the hardness of the skin of casehardened work may be determined. The hardness numbers are calculated in the same way as in ordinary Brinell tests, the diameter of the impression being measured by means of a microscope designed especially for use with the machine.

The base of the machine is provided with leveling screws and supports two threaded columns on which is mounted a table that holds the specimens to be tested. This table is adjustable up and down on the columns by means of a handwheel. At the center of the cross-head mounted on the top of the columns, is a fine-pitch screw which can be raised and lowered by means of the handwheel. The lower end of the screw carries a suspended casting which is prevented from rotating by arms that bear against the columns. From this suspension is hung a member on which the ball holder is mounted and to which are attached two rods that carry the weights. In using the machine, a size of ball and holder is selected to suit the character of the material to be tested, and the ball is attached to the holder by means of rubber. This method of holding renders the changing of balls an easy matter.

After the ball and holder have been mounted in place, the table is set to the required height, the work is placed in position by using a supporting block or fixture, if necessary, and the upper handwheel is slowly turned until the ball rests on the specimen. The loading member is free and disconnected from the suspension, and so the entire weight rests on the specimen. The upper handwheel is then turned backward to remove the weight from the specimen, after which the latter is removed, the diameter of the impression measured, and the hardness determined. The over-all height of this machine is 36 inches; the size of the work-table, 7½ by 6 inches; the maximum height between the work-table and the ball when using a weight of 50 kilograms, 8 inches; and the weight of the machine, 210 pounds.

GENERAL ELECTRIC ARC WELDING SETS

Two portable arc welding sets driven by gas engines and intended for use in odd places about industrial plants where the amount of work is not sufficient to deserve a permanent installation have been placed on the market by the General Electric Co., Schenectady, N. Y. The sets are particularly suitable for use in places where electric current is unavailable. One set was developed for medium duty, and the other for heavy duty. The medium-duty equipment, shown in Fig. 1, is intended particularly for intermittent work. The generating unit consists of a generator directly connected by means of a flexible coupling to a four-cylinder, 20-horsepower gasoline engine. The engine, radiator, generator, and welding panel are assembled on a cast-iron base, which is mounted on wooden skids. The gas engine is of the overhead valve type, and the cylinders are cast en bloc with the upper half of the crankcase.

The generator is self-exciting and regulating, and gives a practically constant energy throughout the working range. It gives a "no load" voltage of 60, which is automatically decreased to the proper welding voltage when the arc is struck, this voltage usually being from 18 to 20. The speed of the generator is 1200 revolutions per minute. A panel carries the generator field rheostat and series field dial switch by which the current can be adjusted from 200 to 75 amperes. This equipment is 86 inches long, 28 inches wide, and has a net weight of approximately 2000 pounds.

The heavy-duty arc welding equipment is shown in Fig. 2. This outfit can be arranged to supply either one or two welding currents. It consists ordinarily of a 20-horsepower, two-cylinder gas engine, a generator, and a welding panel, all of these being mounted on a structural steel base. The

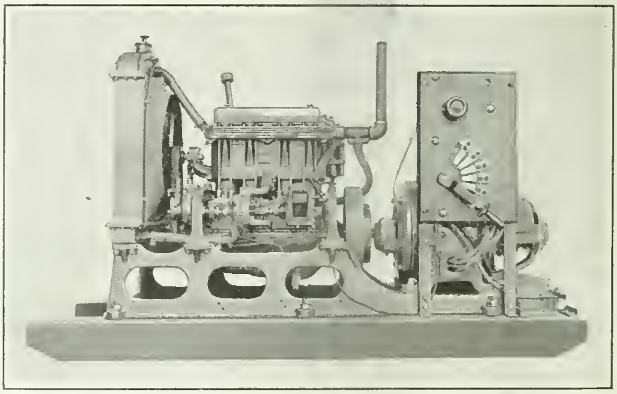


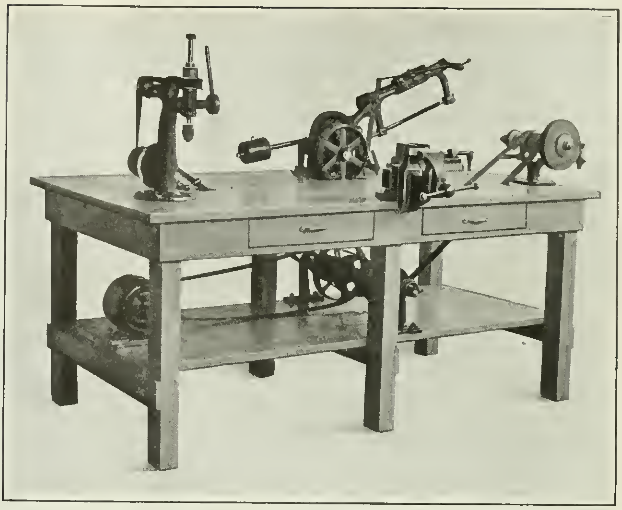
Fig. 2. Heavy-duty Arc Welding Set made by the General Electric Co.

net weight of a single-current equipment is 2400 pounds, and that of a double-current equipment is 3200 pounds. The gas engine of this equipment is designed for continuous operation, and will run on kerosene, gasoline, or natural or artificial gas. The generator is driven by a silent chain running in oil, and, except for the speed, it is similar to that furnished with a medium-duty outfit. The generator runs at the rate of 1750 revolutions per minute. An ammeter is mounted on the panel of this welding set.

MYERS COMBINATION WORK-BENCH

The Myers Machine Tool Corporation of Columbia, Pa., is making a combination work-bench designed to meet the requirements of automobile repair men, mechanics, and inventors who desire to build experimental equipment. The bench is shown in the accompanying illustration, from which it will be seen that it is furnished with a number of pieces of handy equipment. These consist of a No. 2 geared automatic hacksaw provided with a vise, a 10-inch sensitive drilling machine equipped with a table and a ⅜-inch chuck, a No. 6 grinder head with emery and muslin polishing wheels, and a 4-inch machinists' vise having hardened steel jaws.

The different pieces of equipment are driven by a ½-horsepower alternating-current motor running at 1750 revolutions per minute. The motor drives through a countershaft that permits individual or collective use of the different machines without requiring the changing of belts. The table is 78 inches long, 39 inches wide, and 33 inches high. It is provided with two drawers for the storing of small tools, etc.



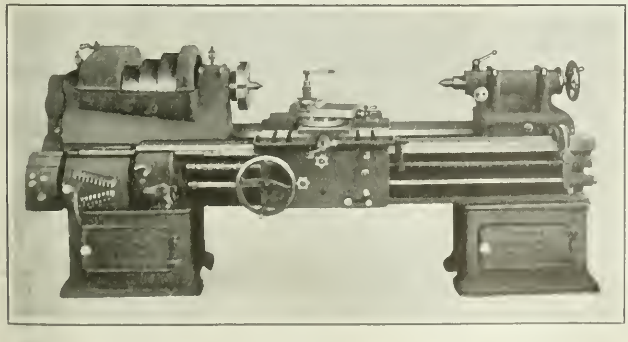
Combination Work-bench made by the Myers Machine Tool Corporation

LEHMANN DOUBLE BACK-GEARED ENGINE LATHES

Two double back-geared engine lathes of 22- and 24-inch nominal swing, respectively, are now being built by the Lehmann Machine Co., Chouteau Ave. at Grand, St. Louis, Mo. As will be seen from the accompanying illustration, the construction of these machines is similar to that of the geared-head types built by the same concern, which were described in January MACHINERY. On the new machines the headstock is provided with a three-step cone pulley which, through double back-gearing, furnishes nine spindle speeds ranging in geometrical progression. The portion of the headstock casting between the spindle bearings extends to the same height as the axis of the cone pulley so as to prevent the belt from drawing the hand of the operator beneath the pulley.

The spindle is made of an alloy steel, hardened and ground, and has a nose provided with a bearing for faceplates and chucks both behind and in front of the threaded portion. The spindle runs in bronze bearings. The apron has a removable front plate so that its mechanism is accessible without dismounting the entire unit from the carriage, and a central oiling system is provided for the unit, the oil reservoir being located near the top of the apron. Bearings are provided on the apron for the lead-screw and feed-rod so as to prevent sagging and undue wear on the half-nut and the reverse gears. A thread indicator is attached to the carriage for use in cutting threads, this device permitting the carriage to be run back quickly by hand at the completion of a cut and the half-nut to be re-engaged at the correct point. This correct point is determined by reference to the dial on the indicator.

The standard equipment furnished with each lathe consists of a compound rest, a steadyrest, a thread-cutting dial, two faceplates, a double friction clutch countershaft, and wrenches. A taper attachment and follow-rest are furnished extra when ordered. The maximum distance between the centers of machines equipped with 9-foot beds is 4 feet. The weight of the 22-inch lathe with a 9-foot bed is 7500 pounds, while the weight of the 24-inch lathe with the same length of bed is 7800 pounds.



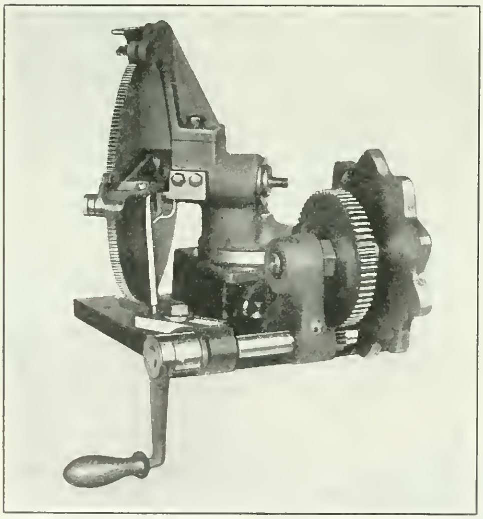
Three-step Cone Double Back-geared Engine Lathe built in 22- and 24-inch Sizes by the Lehmann Machine Co.

GORTON GRADUATING FIXTURE

In order to graduate, neatly and rapidly, dials, collars and other circular parts up to 4 inches in diameter, the George Gorton Machine Co., Racine, Wis., has developed the fixture shown in the accompanying illustration, which is intended for use in connection with the engraving machines built by the same concern. By means of this fixture graduations may be cut on the flat face of a disk when the lines start at the periphery, on the cylindrical surface of straight collars, and on the beveled faces of such dials as are commonly used on machine tools. The fixture was originally designed for graduating beveled dials 3 inches in diameter and requiring 100 graduations on one-half the circumference. The actual time for cutting these graduations is about forty seconds.

The indexing of the work is positive, and occurs as the operator turns the crank in a clockwise direction. The turning of the crank also causes the rotation of a small pinion mounted on the opposite end of the same shaft as the crank. This pinion meshes with a gear on a horizontal shaft, directly above the pinion-shaft, to which a ten-point cam is keyed. This cam transmits motion to the work-holder and causes the latter to be moved to and fro in a dovetail slide in the base of the fixture. As the work-holder is moved in and out, the work is traversed past a cutter held in the spindle of the engraving machine. The work-holder can be swiveled through an arc of 90 degrees in order to bring the surfaces to be graduated parallel with the slide. The points on the cam are made to suit the lengths of the graduation lines to be made on the work, and if certain lines are longer than others, the correct graduating is accomplished by having the cam projections of different heights to suit the length of the various lines.

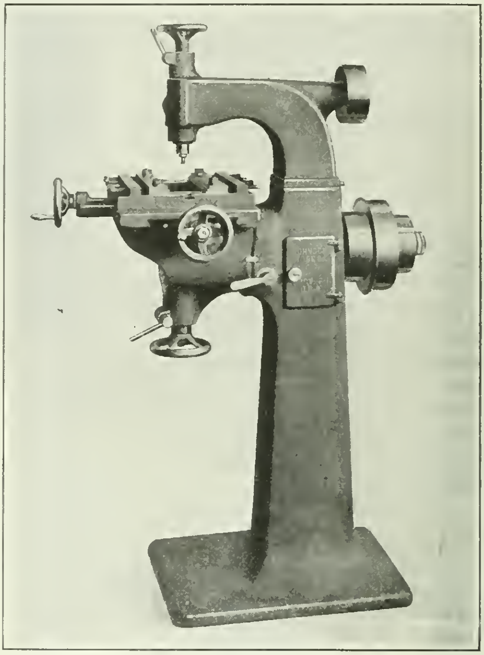
The cutter has a straight shank and is held in a collet that fits a tapered hole in the machine spindle. Any width of line can be produced by grinding the cutter to the proper width and angle. The graduation lines will be uniform in length, depth, and width if the blanks are accurately made. A stop is provided on the indexing wheel to limit the graduations to any predetermined portion of the circumference. This provision insures that the indexing movements will stop exactly at the proper place. The machine spindle is run at a speed of 2000 revolutions per minute when cutting steel parts; from 2000 to 2500 revolutions per minute for cast-iron parts; and 4000 revolutions per minute for brass and bakelite parts. In graduating bakelite dials. the cuts are clean and no burrs are raised, so that additional polishing operations are unnecessary.



Fixture developed by the George Gorton Machine Co. for Use in graduating Dials and Collars

JOHNSON DIE MILLING MACHINE

A milling machine designed for the rapid and accurate manufacture of drawing dies and hubs has recently been placed on the market by the Johnson Tool Co., 201 Eddy St., Providence, R. I. This machine has two spindles, one of which is carried under the vise table and the other in a swinging head mounted on top of the column. When the machine is to be used on a job for which the upper spindle is not required, this head may be swung at right angles to the position shown in the illustration. Taper bearings are provided for both spindles, so that wear may be taken up. By means of a clutch arrangement which is located inside the cone pulley, the lower spindle can be made inoperative while the upper spindle is being used.



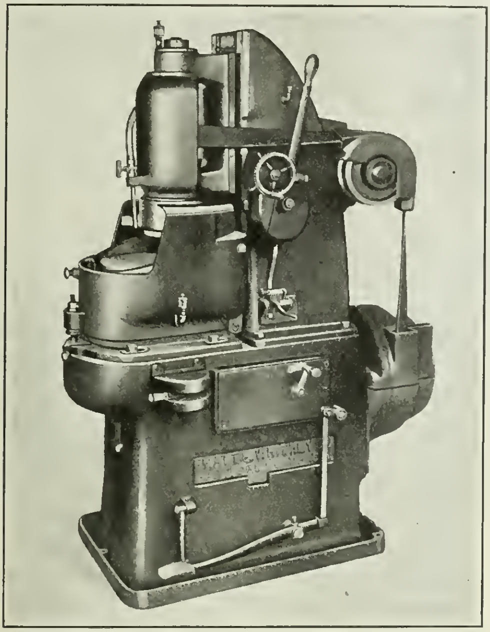
Die Milling Machine manufactured by the Johnson Tool Co.

The machine is also equipped with a tilting table which enables the operator to obtain a good view of the work in progress. Special adjustments are furnished for taking up the wear on both cross and longitudinal screws. A patented pull-type countershaft is supplied with the machine. The tilting table has a capacity of 9 inches when not fitted with jaws; when jaws are provided, the capacity is 5½ inches. Some of the other principal specifications are as follows: Cross-feed of the table, 4 inches; lateral feed, 6 inches; weight of machine, 600 pounds; and floor space occupied, 29 by 40 inches.

PRATT & WHITNEY ROTARY SURFACE GRINDING MACHINE

A machine designed principally for the grinding of disks, rings, and cylinders requiring flat and parallel surfaces, such as gear blanks, washers, cutter hubs, and sprockets is shown in the accompanying illustration. This machine is an 8-inch rotary surface grinder, and is a recent product of the Pratt & Whitney Co., Hartford, Conn. The spindle is mounted on ball bearings, amply lubricated, protected from dirt, and provided with adjustments for wear. The grinding wheel is cemented in a holder screwed to the spindle, and thus the changing of wheels is a simple proposition. A band clamped around the wheel guards it from breakage, and an adjustable steel guard automatically covers the entire wheel. The feed of the wheel is controlled by a lever, and a positive stop is provided to facilitate grinding work to a specified thickness. Fine adjustments are made through a handwheel which can be locked and used as a feed-wheel when desired. The wheel-slide is overweighted in order to obtain an easy control.

The machine is equipped with a rotary magnetic chuck having two speeds, which can be tilted to enable the grinding of concave or convex surfaces. The chuck is controlled by a foot-pedal, and a connecting brake retards the rotation in stopping. A pump and tank are furnished for supplying lubricant to the inside and outside of the wheel, the flow being regulated by valves. The shut-off valve is ordinarily controlled by the feed-lever, but it can be disconnected and operated by a pull-knob. The spray is confined by a guard, the front of which can be lowered to facilitate the handling of work. The main driving shaft and idler pulleys are mounted on ball bearings, while the clutch is mounted on a thrust bearing. A belt drive is regularly furnished with the machine.



Eight-inch Rotary Surface Grinding Machine built by the Pratt & Whitney Co.

Some of the principal specifications of the machine are as follows: Maximum distance from top of chuck to face of new wheel, 5 inches; diameter of chuck, 10 inches; maximum amount chuck can be tilted for concave or convex grinding, 2 degrees; diameter of grinding wheel, 8 inches; speed of grinding wheel, 2000 revolutions per minute; speed of chuck, 50 and 100 revolutions per minute; and weight of machine, 3000 pounds. The regular equipment furnished with the machine includes two wheel mounts, one grinding wheel, one wheel dresser, a countershaft and wrenches. When motor drive is desired, a 7½-horsepower constant-speed motor, running at 1800 revolutions per minute, is furnished.

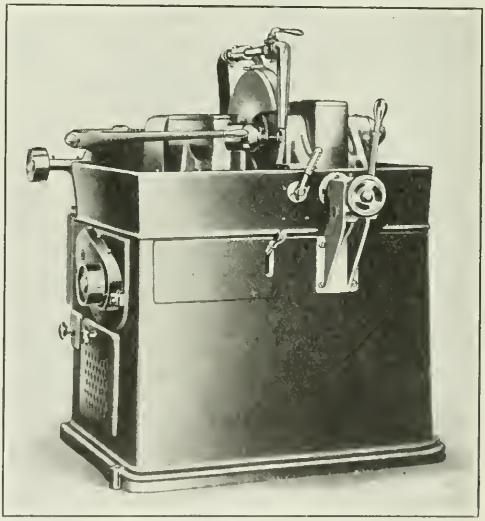
GENERAL ELECTRIC HEATING UNIT

A sheath wire unit for electric heating applications has been perfected by the General Electric Co., Schenectady, N. Y. The new unit is known as the "helical coil" sheath wire unit, and is an improvement over the drawn sheath wire unit which this company has manufactured for several years. The unit consists of a heating element in the form of a helical coil of wire that is held firmly in place in a metal tube by a filler of powdered insulating material. The sheath is made of different metals or coils, depending upon the use for which the unit is intended.

Three special forms of the unit have been developed. The first is an air-heating unit, and is intended for heating small storage rooms, exposed valve houses, crane cages, etc. The second style is particularly adapted for warming glue troughs, flat plates on machines, etc. The third type is an immersion heater, of which there are several forms. These are intended for heating water or oil in kettles, tanks, etc., and for oil tempering baths. They are entirely immersed, so that all the heat generated by the unit is absorbed by the liquid. The units are regularly made 0.333, 0.4, or 0.496 inch in diameter, the lengths being up to 6 feet for the smallest diameter unit and up to 8 feet for the largest.

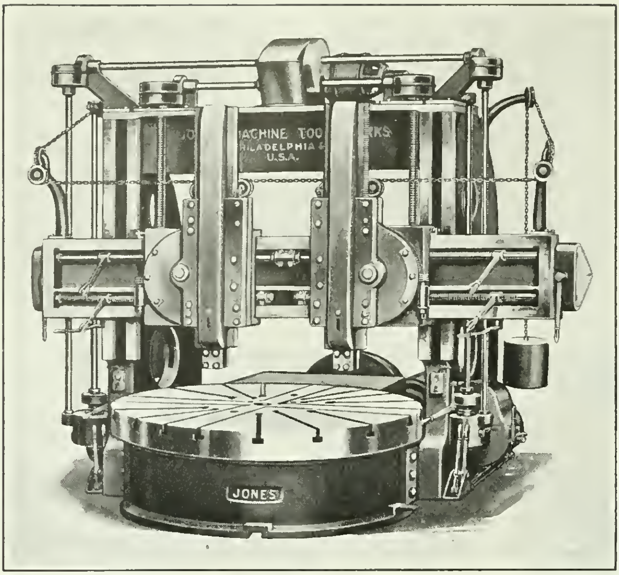
FITCHBURG POPPET VALVE GRINDING MACHINE

The Fitchburg Grinding Machine Co., 76 Winter St., Fitchburg, Mass., has recently placed on the market a machine arranged for grinding the seating surface of gas-engine poppet valves, as shown in the accompanying illustration. During the operation, the valves are held in a collet chuck, although the machine may also be arranged for grinding valves held between centers. The collet chuck is operated by a lever on one side of the work-head. The work-head can be set at any angle to suit the valves being ground, and it has an automatic movement parallel to the wheel-spindle, which can be varied to meet different conditions.



Machine built by the Fitchburg Grinding Machine Co. for grinding the Seating Surface of Poppet Valves

The wheel-head has a cross-movement, and is operated by a vertical lever directly in front of it. A handwheel having a micrometer reading enables accurate compensation to be made for wear of the wheel. The lever to the left of the handwheel is used for operating a diamond truing tool, and the lower lever to the left of the handwheel is employed for starting and stopping the work-head. The machine is driven by a three-horsepower motor located in the base, and the weight of the machine, including the motor, is approximately 2500 pounds. The general construction of this machine is such that it can also be arranged for grinding a variety of small parts in plants where a large production is required, thus permitting the machine to be kept busy on one particular part.



Vertical Boring and Turning Mill built by the Jones Machine Tool Works

JONES VERTICAL BORING AND TURNING MILL

A vertical boring and turning mill designed for rapid production and simple operation has been recently brought out by the Jones Machine Tool Works, Philadelphia, Pa. The push-buttons for starting and stopping the motor, and the control levers, are located on each side of the machine for the convenience of the operator. The machine may be driven either by a constant- or a variable-speed motor; the constant-speed motor supplies sixteen speeds through a speed-change box. The drive from the motor to the large ring gear bolted to the under side of the table is through sliding speed-change gears, miter gears, and a pinion.

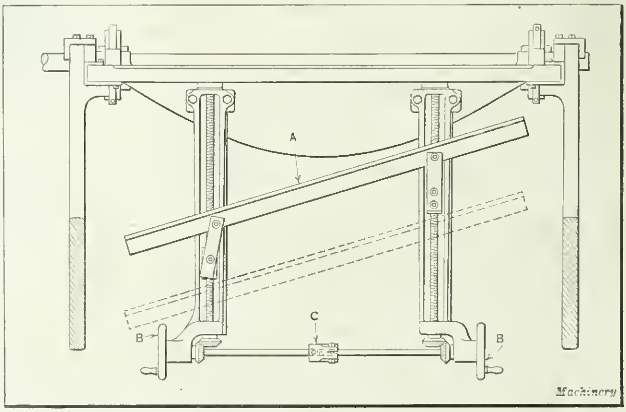
The table runs in a constantly lubricated annular V-shaped bearing of large diameter. The table spindle is supported in vertical bronze bearings situated in the main base, the top bearing being cone-shaped and provided with means of compensating for wear. The lower bearing is straight and supports a step bearing composed of alternating bronze and steel washers that run in oil and are used for raising the table from the annular bearing when machining light work at high speeds. T-slots are provided for bolting down work and accommodating chucks or special fixtures. The cross-rail is of the three-track type; it has the saddle screws located between the two lower tracks, and the worm-shafts for operating the boring-bars between the upper tracks. The cross-rail clamps to the inner and outer guides of the housings, and is raised and lowered through screws and nuts. A motor located on the bridge which ties the housings together at the top furnishes the power for this mechanism.

The saddles are fitted with clamps, tapered gibs, and a clamping screw for locking them to the cross-rail when the boring-bar is being fed. The saddles are operated by a hand ratchet feed in making fine adjustments, and they are also provided with power feed and quick traverse. The boring-bars are fitted in saddle members which can be swiveled 30 degrees on either side of the vertical position by using a ratchet wrench, which, through a worm, drives a worm-gear segment on the saddle member. The face of this segment is graduated in degrees to indicate the angle at which the slide is set. The bars can also be operated by a hand ratchet feed or by a power feed or quick traverse. They are counterbalanced by weights located at the rear of the housings, and are equipped with clamping screws for locking them in place when the saddles are being fed. The tool-holders are made from steel forgings and have tapered shanks.

No friction clutches are employed in the speed-change box unless the machine is driven by belt, in which case the driving pulley is of the friction clutch type. Speed changes are obtained by operating levers on each side of the machine. The feeds for the saddles and boring-bars are independent for each side of the machine. Safety friction clutches are supplied to prevent breakages that would be likely to occur if a saddle or bar should become jammed. The quick-traverse driving shafts receive their power from the motor on the bridge, and the operating levers for these shafts are located at each end of the cross-rail. This machine is made in the following sizes: 60, 72, 84, 100, 120, and 144 inches. The weight of the smallest size is 25,000 pounds, and that of the largest, 96,000 pounds.

NIAGARA SHEAR GAGE

The power sheet-metal squaring shears built by the Niagara Machine & Tool Works, Buffalo, N. Y., are now being equipped with a patented gage which may be accurately adjusted to govern the length of the sheet being cut or the angle at which it is severed relative to the face of the shear blades. This gage is shown diagrammatically in the accompanying illustration, with the gage-bar *A* placed at an angle to the shear blades. When the attachment is on a machine, one leg of the bar projects beneath the upper blade, so that sheets inserted between the blades may be pushed against this leg. The distance of the bar from the shear blades is set by adjusting screws, which may be rotated in unison or independently of one another. The rotation of the screws in unison is accomplished by turn-



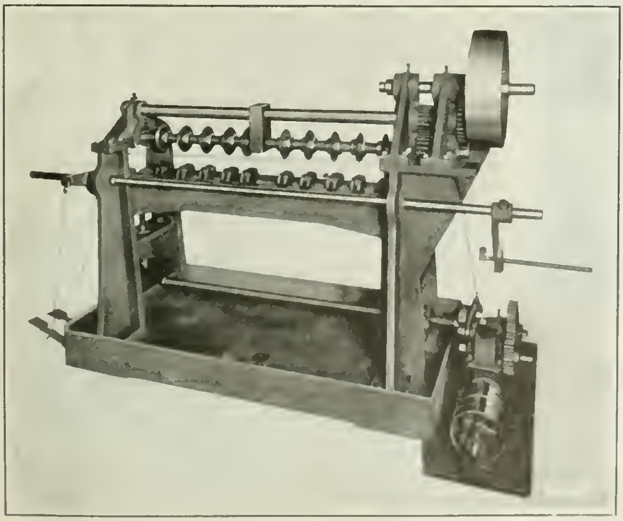
Diagrammatic Illustration of Adjustable Gage furnished on Shears built by the Niagara Machine & Tool Works ing either of handwheels *B* when the nut of a clamping bolt on coupling *C* has been tightened. By loosening this nut, the adjusting screws may be rotated independently.

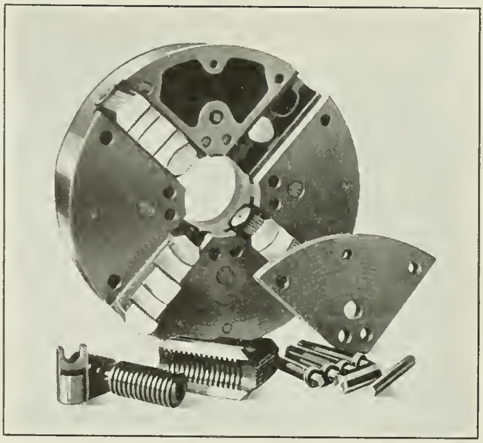
Each of the handwheels *B* has sixteen holes equally and accurately spaced about a circle on its web, and a locking pin is provided to engage these holes. Thus, as the adjusting screws have four threads per inch, the adjustment of the sliding block on each screw, which is connected to one end of the gage-block, may be governed within 1/64 inch. In assembling the parts the sliding blocks are located in approximately the correct positions through the use of measuring scales mounted on the sides of the arms which support the device. Each inch on these scales is divided into four parts to equal the lead of the adjusting screws, and so one complete revolution of a handwheel changes the position of the sliding blocks a distance corresponding to one division on the measuring scales. This gage is also made in a style which does not have the provision for rotating the two adjusting screws simultaneously.

FRETTER TUBE-CUTTING MACHINE

The accompanying illustration shows a machine which cuts a pipe or tube into a number of pieces in one operation by bringing the stock into contact with rotary cutters. This machine is built by Nathan F. Fretter, 9113 Columbia Ave., Cleveland, Ohio. The cutters are mounted adjustably on a horizontal shaft, which is driven through back-gearing and a pulley, and they can be readily removed from the shaft for replacement. The cutters are sharpened while they rotate on the machine by employing an electric grinder.

There is a dovetail groove in the table in which are placed a number of tube-rests, which may be positioned to correspond with the cutters. The table height is adjusted to suit the diameter of the tube and wear of cutters, by turning a crank at the front of the machine. The table is raised by means of cams mounted on the shaft at the bottom of the machine, this shaft being rotated one revolution through a clutch operated by a foot-treadle. In operating the machine, the attendant places a long tube on the machine table, and then operates a treadle which controls the work-stop and, finally, the treadle that operates the clutch. The cut pieces of a tube are pushed off the machine when a new piece of tubing is inserted. The machine has a capacity for cutting tubes having an outside diameter of 2½ inches and a wall thickness of 3/16 inch.


Multiple Tube-cutting Machine made by Nathan F. Fretter

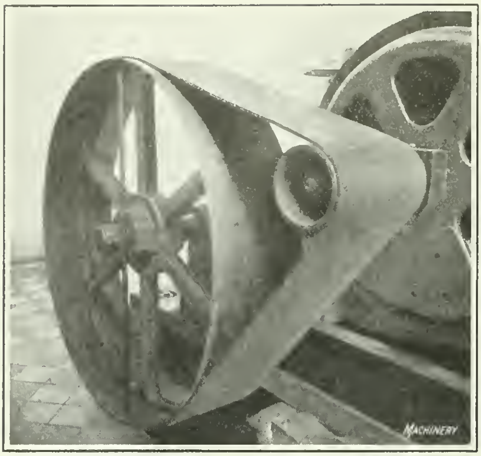

Coventry Four-jaw Independent Chuck made by Alfred Herbert, Ltd.

ALFRED HERBERT FOUR-JAWED INDEPENDENT CHUCKS

A line of Coventry four-jaw independent chucks designed to withstand, without breakage, the severe usage generally accorded such accessories is now being sold by Alfred Herbert, Ltd., 50 Church St., New York City. One of these chucks is shown in the accompanying illustration with some of the details disassembled in order that an idea may be obtained of their ruggedness. It will be noted that the jaws and screws are retained in the chuck by means of detachable sector plates. These plates are attached to the chuck body by bolts inserted from the back of the chuck. The chuck body is made sufficiently thick to withstand abuses which might cause this member to become fractured where it is machined to accommodate the jaws. The jaw screws are made of chrome-nickel steel and of large proportions, and the jaws are hardened all over. Ample metal is furnished around the square wrench holes in the ends of the screws. The thrust blocks for the screws are also made of chrome-nickel steel and heat-treated. All parts of the chuck may be replaced if this should prove necessary. On the lathes manufactured by the same concern, the chuck is attached directly to a spindle flange by studs and nuts, but adapters must be employed when the spindles are not flanged, and these adapters should be turned up in position on the spindles of the lathes on which the chucks are to be mounted, before the chucks are attached.

PIEUVRE BELTING

An installation of a special belt sold under the trade name of "Pieuvre" by J. L. de Rabot, 191 Greenwich St., New York City, is here illustrated. This belt consists of a length of oak-tanned leather belting, to the inner surface of which are attached narrow longitudinal strips of chrome-tanned leather. The oak-tanned leather is used to give the necessary strength to the belt, and the purpose of the chrome-tanned leather is to increase the adhesive qualities. The chrome-leather strips are held in position by means of hollow brass rivets, which are clenched well home on the under side so that a small pocket is formed around each rivet. These pockets, combined with the blind holes in the rivets, create a suction

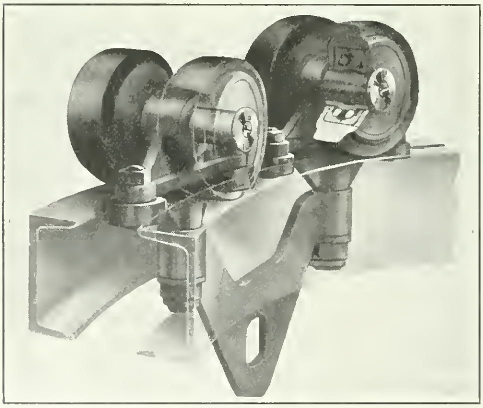


An Installation of Pieuvre Belting which is sold by J. L. de Rabot

when the belt passes around the pulley, and so augment the adherence of the belt. In some cases, narrow grooves are cut between the strips, to increase the crosswise flexibility of the belt and allow it to mold itself more completely to the shape of the pulleys. It is stated that no compound is required to obtain satisfactory friction between this belting and a pulley, because the coefficient of friction is exceptionally high, and even though the center distance between the pulleys is very short, idler pulleys are not required.

WHITING SHORT-TURN TROLLEY SYSTEM

An overhead trolley system in which the curvature of the switches and corners is only 18 inches, so that it is especially adapted for serving a row of machines placed close to a wall, is being marketed by the Whiting Corporation, Harvey, Ill. The track consists of two standard rolled channel irons, spaced 2⅛ inches between the flanges and held in place by clamps. It does not have any intermediate supports except at the splices, corners, and switches; and another special feature of the system is that long spans, such as from one building to another, can be made without any intermediate supports by simply using a heavier section of channel.

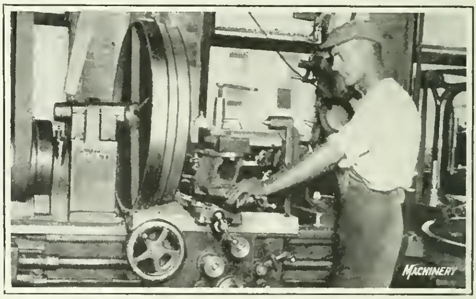


Four-wheeled Trolley and Track of System built by the Whiting Corporation

Each corner and switch connection is interchangeable, so that at any time a double or universal switch may be substituted for a corner. The track is built in single units and can be erected as such. Two-, four-, and eight-wheeled trolleys can be supplied, a four-wheeled trolley being shown in the illustration. These trolleys have ball-bearing wheels and guide rollers. The latter run between the toes of the channel irons, and eliminate friction by making it impossible for the wheels to bind against the track when rounding curves. The trolleys run on the top of the channel tracks as shown. This trolley system can be readily wired, when it is desired to use an electric hoist in place of a chain block. Switches of 90 or 45 degrees, or of the universal style can be supplied.

LATHE ATTACHMENTS

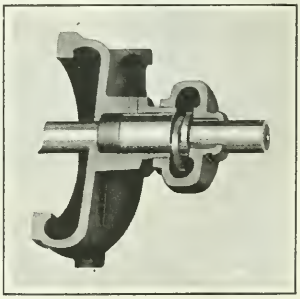
A lathe equipped with attachments made by the Star Machine & Tool Co., 433 Champlain Ave., Cleveland, Ohio, to double the capacity of such machines, is here illustrated. One attachment is a special headstock which has a faceplate spindle mounted directly above the regular spindle. The top spindle is connected to the lower one through gearing. The two other attachments provided are for raising the toolpost and tailstock center to suit the height of the faceplate. These attachments may be set up on a machine in less than ten minutes, and are especially useful in toolrooms and garages on jobs necessitating a greater swing than can be obtained on the lathes available.



Lathe equipped with Capacity-increasing Attachments made by the Star Machine & Tool Co.

ARROW PUMP PACKING GLAND

Centrifugal and rotary pumps built by the Arrow Pump Co., Room 54, Buhl Bldg., Detroit, Mich., are now being equipped with the type of packing gland here illustrated, this gland being also applicable to many other devices or machines on which a rotating shaft requires packing. The ring-oiling principle of lubrication is incorporated in the design of this packing gland, this provision permitting a constant supply of oil to the gland so that it is practicable to use the latter also as a bearing. This arrangement permits the shaft to be supported close to the load. With this method of lubrication there is always a film of oil between the packing and a rotating shaft, thus reducing wear of the parts

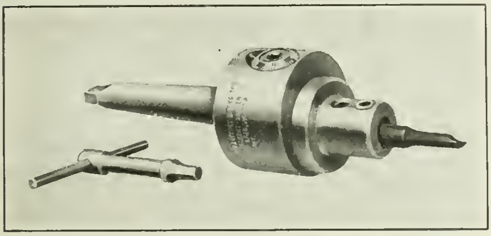


Packing Gland supplied in the Pumps built by the Arrow Pump Co.

RICKERT-SHAFER ADJUSTABLE BORING HEAD

An adjustable boring head adapted to various machine tools for use in drilling, boring, and turning operations is shown in the accompanying illustration. This tool has just been placed on the market by the Rickert-Shafer Co., 612 W. 12th St., Erie, Pa., and is especially recommended for work where accuracy and high speed of operation are desired. Accuracy of the tool is obtained through a cross-screw machined within a tolerance of 0.0005 inch. This screw is provided with a friction dial graduated in thousandths of an inch, which eliminates the necessity of employing cut-and-try methods in using the tool. Moreover, with this provision it is unnecessary for a person to remember previous settings, as the dial can be reset to zero as required.

When the boring tool has been adjusted and locked in position, the tool is said to be practically as rigid as a solid tool. This result is obtained by a clamping means which, besides locating the tool-holder in the desired position, also pulls and holds the tool-holder rigidly against the head and shank. The clamp is actuated by a safety setscrew that works at right angles to the adjusting screw. The boring head is made in three sizes, the diameter of the hole for the tool in the different sizes being ½, ¾, and 1 inch, respectively.



Adjustable Boring Head manufactured by the Rickert-Shafer Co.

McCROSKY FLOATING HOLDERS

Parallel and angular misalignments of the tool in reaming, tapping, and similar operations may be avoided by the use of the holder shown in Fig. 1, which belongs to a line of floating holders being placed on the market by the McCrosky Tool Corporation, Meadville, Pa. These holders are intended for application on various types of machine tools, and may be supplied for either vertical or horizontal use. Each holder consists of three principal units a driving member, an intermediate floating member, and a driven member.

As will be seen by reference to Fig. 2, in which a holder is shown disassembled, the shank or driving member is provided with a piece having two lugs that interlock with two similar lugs on the driven member. Four hardened rollers are placed between these lugs and the intermediate floating member in order to eliminate friction resulting from the driving action. A hole is provided at the center of the floating member, and a hardened steel ball is placed in this hole. The diameter of the ball is greater than the thickness of the floating member, and therefore it projects beyond the sides of the latter and bears against both the driving and driven members. In this way, it takes the entire thrust of the cut and acts as a pivot to allow free angular movement. One end of the housing which encloses the floating unit screws on the threaded part on the shank. A collar is screwed into the opposite end of the housing and this collar bears against the driven member. By adjusting the collar the amount of float may be regulated. When the holder is used horizontally, an adjustable spring support, which bears against the driven member, is added to counteract the weight of the tool shank in the holder.

The driven member of the holder is made in three styles. One style may be bored to accommodate a shank of any diameter within certain limits; the second is provided with a Morse taper socket; and the third has a shell reamer arbor. The holders may also be furnished with either straight or taper shanks. The smallest holder of each style has a capacity for reamers up to 1½ inches in diameter, while the largest size is suitable for reamers up to 6 inches.

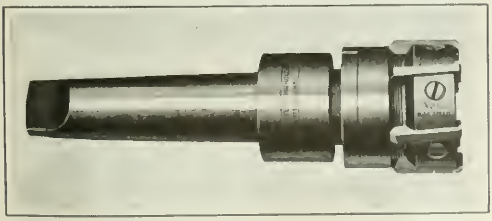


Fig. 1. Floating Holder made by the McCrosky Tool Corporation

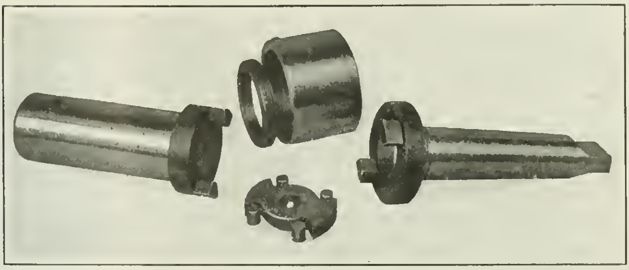
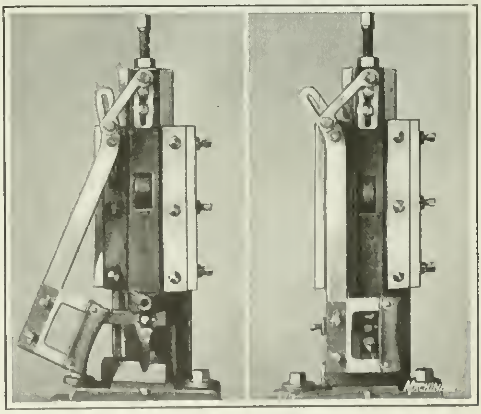


Fig. 2. Parts of the McCrosky Floating Holder



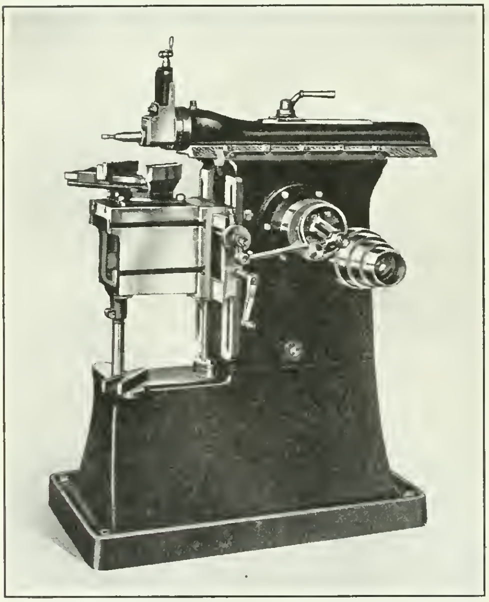
Foot-press Safety Guard made by Woodward & Wolf

WOODWARD & WOLF PRESS GUARD

A guard for preventing injury to operators of foot presses has been placed on the market by Woodward & Wolf, 213 Rosemont Ave., Trenton, N. J. This guard is shown at the left in the accompanying illustration in its position at the beginning of a downward stroke. It will be seen that it is well out of the way so as not to interfere with the placing or removal of work in the press die. When the ram begins its downward stroke the guard swings well across the danger spot, as shown at the right in the illustration, in only a ⅜-inch movement of the ram, thus making it impossible for the most careless operator to become caught as the punch descends. At the end of the ram stroke, the guard extends to the right of the punch in such a way that it is impossible for an operator to work around or in back of the guard. This guard can be changed in a few minutes' time to suit either right- or left-hand operators.

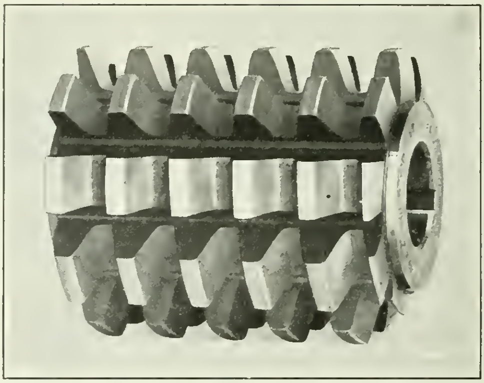
MILWAUKEE 9-INCH SHAPER

A 9-inch shaper, designed for handling accurate work in the tool-room as well as for use in the quantity production of small parts which must be shaped quickly and economically, is now being manufactured by the Milwaukee Shaper Co., 1023-1029 Cold Spring Ave., Milwaukee, Wis. The ram has wide bearings and is scraped to an accurate fit with the ram gib so as to assure smooth operation without vibration. Adjustments can be made to compensate for wear. The length of the ram stroke is changed quickly by releasing a friction lock-nut, turning a handwheel until an indicator points to the desired stroke, and then again tightening the lock-nut. The cross-rail has wide bearing surfaces which are accurately scraped, and the saddle is provided with a taper gib to take up any wear of the cross-rail. T-slots are furnished on the top and sides of the table, and the latter can be tilted to either side.



Nine-inch Tool-room Shaper built by the Milwaukee Shaper Co.

A screw inserted in a graduated rocker-arm attached to a handwheel regulates the feed, and a connecting-rod which slides in a steel tube permits raising and lowering of the cross-rail. The tool-head is graduated; it can be swiveled through an arc of 60 degrees, and is provided with a micrometer adjustment. The swivel vise has a graduated base, steel jaws, and is supplied with an extra set of jaws for the accommodation of tapered work. Some of the principal specifications of this shaper are as follows: Size of table top, 8¾ by 8½ inches; automatic cross-traverse, 11 inches; vertical adjustment of table, 8 inches; down feed of tool-head, 4 inches; cutting speeds of ram, 4; keyseating capacity, 2 inches; maximum opening of swivel vise jaws, 6 inches; and net weight, 800 pounds.



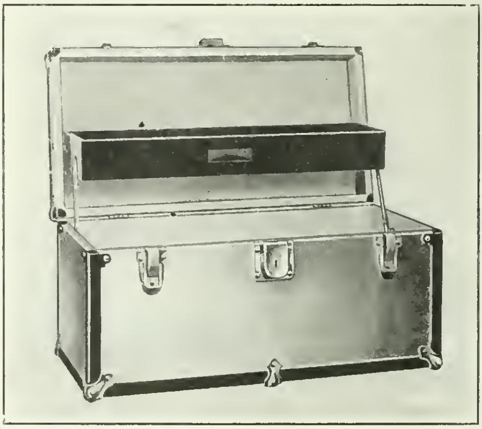
Gear Hob manufactured by the Simmons Method-Hob Co.

SIMMONS-METHOD GEAR HOBS

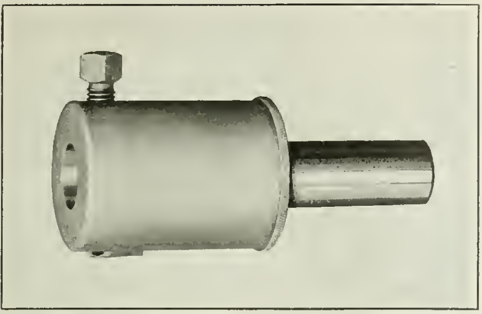
The Simmons Method-Hob Co., 2nd St. and Duncannon Ave., Olney, Philadelphia, Pa., is now manufacturing gear hobs that have the teeth generated on special machines by a process known as the Simmons method. One of the hobs is here illustrated. Because of the fact that the teeth are generated, the hobs produced by this method can always be duplicated with precision. In cutting a large number of gears of one kind, the hobs, of course, wear out, and so a means of duplicating the worn-out hob should be appreciated. In the Simmons method each hob is a duplicate of another, because every hob is an original master generated on the same or a similar machine by the identical mechanical movement.

UNION ZINC-COVERED TOOL CHESTS

Electricians, mechanics, plumbers, etc., will be interested in a line of zinc-covered tool chests which is now being manufactured by the Union Tool Chest Co., 83 Mill St., Rochester, N. Y. These new chests are provided with a tray that automatically raises with the top and in doing so, remains level and out of the way. However, the chests can be furnished without trays if desired. The covering is of lacquered zinc, carefully formed over at the edges and securely attached, and will not corrode. All corners, catches, clamps, and locks are either brass plates or lacquered steel, and are securely riveted in place. The chests are furnished with a leather handle and a special Corbin lock.



Zinc-covered Tool Chest made by the Union Tool Chest Co.



Releasing Tap- and Die-holder made by the Warner & Swasey Co.

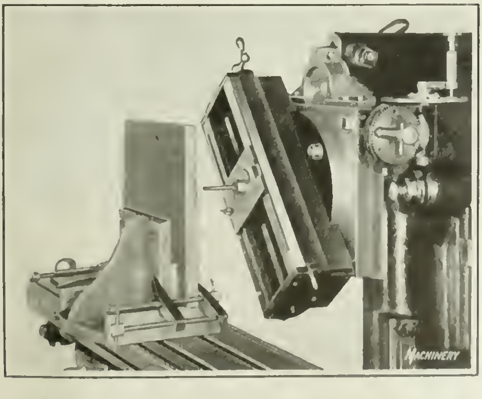
WARNER & SWASEY RELEASING TAP- AND DIE-HOLDER

The Warner & Swasey Co. Cleveland, Ohio, has developed an improved type of releasing tap- and die-holder which, while consisting of only eight pieces, has incorporated in it all the features of the older twenty-three-piece style. The new holder is shown in the accompanying illustration. It is suitable for either right- or left-hand taps or dies. In changing the holder to accommodate a different hand tool, a small tightening screw is first loosened by means of a screwdriver, and then a pawl is turned half way around in its hole. A small pin secures the pawl in position. In threading a part, this pawl holds the tool rigid until the turret stop is reached. Then the head moves forward on the work and pulls a cam over the pawl, which releases the head and allows it to revolve freely. A spring cushions the pawl so that the releasing action is without jar and practically noiseless. The holder can be readily cleaned and oiled, and by reason of its adaptability for right- and left-hand tools, it reduces the number of tap- and die-holders required in a shop.

MILLING MACHINE FIXTURE

To eliminate the slow and costly practice of figuring and checking angles or using buttons for locating purposes when boring accurately spaced holes in a jig member the Supreme Machine & Tool Co., 1738 St. Clair Ave., Cleveland, Ohio, has developed the milling machine fixture illustrated. By means of this fixture it is unnecessary to shift the work after it has been set up on the table of the machine, the boring tool being moved as required. The fixture is arranged for fastening on the column and over-arm of any milling machine, the base being designed to suit the particular machine on which the fixture is to be attached.

A gear fitted to the spindle of the milling machine drives the fixture spindle through bevel and spiral gears. The fixture spindle can be moved radially in a slide which can be accurately adjusted through the use of the vernier scale with which it is furnished. The member that supports the slide has a circular movement obtained through two worms and gears, and is graduated to allow settings to be made in seconds. In using the fixture, the work is clamped on the milling machine table, the starting hole is located relative to the fixture spindle, and the knee and table are clamped in place. All movements from this point are made with the fixture, and thus one of the greatest sources of error in work of this kind is avoided. The illustration shows the fixture mounted on a Brown & Sharpe universal milling machine.



Jig Boring Fixture for Application to Milling Machines, which has been brought out by the Supreme Machine & Tool Co.

A chart furnished with the fixture gives the exact movements of the indexing gears necessary to set the boring head at the required angle. This information is presented in such a way that there is no chance for an operator to misread the directions. The spindle is provided with tapered bearings that are adjustable for wear, and provision is also made to prevent backlash of the indexing worms. Besides work of the class mentioned, the fixture will handle other work of circular or irregular shape, and thus is particularly suitable for the machining of cams.

NEW MACHINERY AND TOOLS NOTES

Portable Electric Drill: Louisville Electric Mfg. Co., Louisville, Ky. A No. 3, two-speed universal drill which operates on either direct or alternating current. The speed changes are obtained by shifting a small knob located close to the handle, while another knob on the handle controls the switch for operating the motor. A Jacobs chuck is included in the standard equipment. The drill has a capacity for drilling ½-inch holes at high speeds, and ⅝-inch holes at low speeds.

Shaft Coupling: Kay Mfg. Co., South Norwalk, Conn. A free-floating shaft coupling which compensates for both parallel and angular misalignment of connected shafts, as well as providing for axial movement, such as the floating of an armature shaft. Power is transmitted from the driving to the driven hub through a floating link. A casing surrounds the parts, retaining rings preventing the hubs from slipping out. The coupling is made in sizes to fit shafts from ⅞ to 6½ inches in diameter.

Drill Chuck: Karge-Baker Corporation, Phoenix, N. Y. A chuck provided with a cushioning feature which permits a moderate relative rotation between the shank and the socket ends. A helical spring transmits the driving torque from one end of the chuck to the other, thus absorbing shocks and eliminating chatter. The chuck is made in five sizes to carry drills from ¼ inch to 4 inches in diameter, taps from ¼ inch to 7 inches in diameter, and die-heads from ¾ inch to 9 inches in diameter.

Filing Machine: Boston Tool & Mfg. Co., 262 Dover St., Boston, Mass. A bench filing machine having a reciprocating movement for using ordinary files in the regular manner, or a rotary motion for round files or special milling cutters. The table may be tilted to any desired angle for the purpose of giving draft to dies or similar pieces. The machine is driven through a three-step cone pulley. Special files having inverted teeth can be supplied so that the pressure on the work will always be downward.

Quick-change Lathe: Rockford Lathe & Drill Co., Rockford, Ill. A 12-inch single back-geared quick-change engine lathe having a spindle with a 1 1/16-inch hole which permits the use of draw-in collets up to ⅝ inch in capacity. The carriage is provided with a thread indicator which permits the proper engagement on a thread being cut without reversing the lathe. A quick-change gear-box furnishes thirty-two changes of feed. Threads of special pitch may be cut by substituting suitable gears on the quadrant.

Ring and Circle Shear: Niagara Machine & Tool Works, Buffalo, N. Y. A No. 13-B deep-throat ring and circle shear, intended for work on light material. The machine cuts not only outside circles, but also holes and reverse curves. The upper cutter can be raised and lowered to penetrate the stock, so that the cut can be started in any part of the sheet and not only on an edge. The machine has a capacity for cutting up to No. 20 gage soft steel, and the distance from the throat of the cutting head to the frame is 18 inches.

Tool-holder: Rapid Universal Tool-holder Corporation, 199 Franklin St., New York City. A tool-holder intended for general use in a lathe, boring mill, or shaper. A square hole is broached through the front end of the shank to suit the holding of square-section tool bits. Round, square, or hexagonal bars can be held to the shank transversely, and small bars can be secured in place by means of a V-block. It is thus possible to hold boring tools, drills, taps, etc., up to 3/4 inch in diameter. A special clamping device is provided for holding a parting or cutting-off tool.

Movable Side-rail Planer: Betts Machine Co., 400 Blossom Road, Rochester, N. Y. A 13-foot planer with the left-hand side-head mounted on a vertical rail that can be moved relative to the table, the advantage being that work of different widths can be accommodated without any undue overhanging of either side-head. The center of the table is offset from the center of the machine. The movable member on which one of the side-heads is mounted has a bearing at the top on the cross-rail and at the bottom on the foot of the upright, and moves up and down with the cross-rail. Two heads are also provided on the cross-rail, and all four heads are equipped with patented feed and power rapid traverse mechanisms.

Couplings for Shafts, Pulleys, Gears, and Clutches: Karge-Baker Corporation, Phoenix, N. Y. A flexible "cushion" coupling made in a variety of forms to adapt it for various uses. The coupling, when used for connecting rotating shafts, corrects parallel and angular misalignment and permits armature float. A helical steel spring of square section is used for transmitting the drive between the two members of the coupling, and this arrangement provides for the absorption of shocks. The coupling is also made with a bushing on which a pulley can be mounted, one end of the coupling being connected to the shaft, and the other end to the pulley bushing. A pulley of this type is especially applicable to motors for absorbing shocks produced in starting. Similar devices are made to do away with shocks in gear trains and in friction-clutch drives.

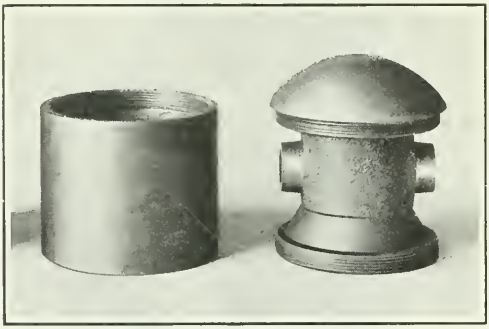


Fig. 1. Shell and Center of Ringless Piston

Bevel Gear Planer: Gleason Works, Rochester, N. Y. A 37-inch two-tool bevel gear planer designed for cutting large diameter and coarse pitch bevel gears. It has a capacity for cutting gears of a pitch cone radius up to 26 inches. A 37-inch diameter miter gear has a pitch cone radius of approximately this dimension. A pivoted work-head and a column which carries the tool-heads are mounted on the bed of the machine. The column is stationary and also carries the driving pulley, the tool speed-change box and the crank plate drive. Two hinged arms on the face of the column are free to open and close vertically about the center of the machine, this center being the apex of the cone of a gear being cut. Each arm carries reciprocating slides on which the tools are mounted, and the stroke movements of the slides are effected through a rack and pinion. The tool-slides are so constructed that gears can be cut from the center outward, as well as from the outside toward the center.

* * *

Wages in the machine shop industries in Belgium vary from 2.45 to 2.60 francs (about 18 to 20 cents, present exchange) an hour. In foundries the wages for skilled molders are somewhat higher—3 francs (about 23 cents) an hour.

RINGLESS PISTONS FOR AUTOMOBILE ENGINES

A novel ringless type of automobile engine piston, invented by Paul G. Tismer, has recently been placed on the market by the Ringless Piston Co., New York City. The outer shell and the inner shell-supporting member of a piston of this type are shown in Fig. 1. The outer shell is of uniform thickness (usually about 1/8 inch), and threads are cut at each end to fit the threaded ends of the inner member; the latter, shown at the right, carries the piston wrist-pin and also forms the piston head. An unthreaded outer shell is shown at the right in Fig. 2, while a completely assembled piston is shown at the left.

The ringless piston is so designed that there is very little tendency to force out the shell walls and increase the piston diameter at the upper end. Two advantages result from screwing the parts together: one is that the transmission of heat from the central member to the shell is delayed, and the other, that a small mechanical clearance is provided in the screw threads, so that the center may expand slightly within the shell without forcing the latter outward. The shell is of practically uniform thickness, and is thin enough to permit it to be maintained at about the same temperature as the cylinder wall; it is held from actual contact with the cylinder wall by an oil film.

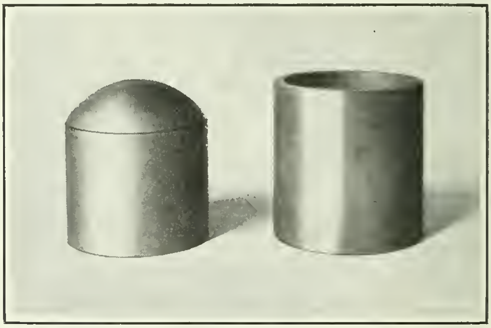


Fig. 2. Assembled Ringless Piston, and Shell

A small test engine was fitted with ringless pistons about four years ago and was run two or three years, intermittently, using various kinds of liquid fuel and operated with air-cooling, water-cooling, and with oil circulating in the cylinder jacket. Under all conditions of this test, it is stated that smooth piston action, satisfactory compression and no appreciable leakage were noted. A Ford automobile equipped with a set of ringless pistons was driven for two months under the worst possible conditions, and subjected to the most severe tests in order to demonstrate the reliability of the pistons. These pistons were originally fitted without grinding. It was found that the tool marks remained at the end of the test period, and that the pistons operated without appreciable wear. This would seem to indicate that the oil film between the piston and cylinder wall remained unbroken at all times. Ringless pistons are now being fitted into the engines of several makes of cars for extended tests, and are also being placed in the hands of at least two motor manufacturers for trial on their own test-blocks.

* * *

According to the *London and China Telegraph*, the Paris Academy of Science has been informed by M. Guillaume, director of the International Bureau of Weights and Measures, that the Japanese Parliament has passed a law making the adoption of the metric system obligatory in Japan. The metric system has been optional in Japan since 1893. In China the metric system was adopted in 1913 and should become obligatory in 1923.

BALL BEARINGS FOR MACHINE TOOLS

By HARRY N. PARSONS
Chief Engineer, U. S. Ball Bearing Mfg. Co., Chicago, Ill.

The use of the ball bearing in its present form in machinery construction, outside of its application to automotive machinery, is comparatively recent. The success that has resulted from the use of ball bearings in automotive machinery has encouraged the manufacturers of machinery, and especially machine tools, to investigate their possibilities in the machine tool field. The many advantages to be derived from their use in the construction of precision machinery have been apparent but not realized to the fullest extent, chiefly because of lack of information on the part of the machine manufacturers and an aversion on their part to experiment, due to the failures of previous attempts to apply ball bearings to such machinery.

This is particularly true with respect to the application of ball bearings to the main spindles of lathes, boring machines, and milling machines. Some experiments have been made in the adaptation of ball bearings to this field, but the attempts have been unsuccessful because of the lack of knowledge of the particular adaptation of ball bearing types to the peculiarities of the work in hand. The ball bearing manufacturers share to some extent in the lack of knowledge of the adaptability of certain types of ball bearings to this field, and it is only recently that they have made any great effort in the exploitation of ball bearings in the machine tool industry.

Ball bearing manufacturers today have secured information that is available to manufacturers of precision machinery, and any hesitancy on the part of the manufacturer to experiment may be easily overcome by the cooperation of the ball bearing manufacturer with the machine tool manufacturer. If the machine tool manufacturer is considering the use of ball bearings in his product, he has at his disposal the information that he desires in this respect from the ball bearing manufacturer.

All that is necessary is that the machine tool builder be frank in his statements and specifications concerning his machine. If he sends with his inquiry a drawing illustrating the locations in his construction in which he desires to use ball bearings, and accompanies that drawing with full information with respect to the operation of the machine, it will enable the ball bearing manufacturer to study his problem and determine the types and sizes of ball bearings to meet the requirements and exigencies of the design.

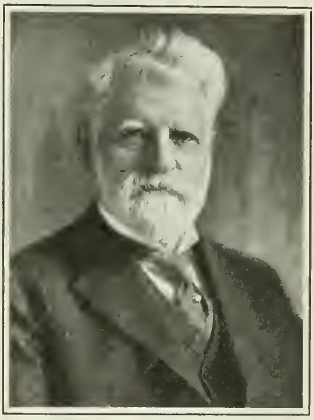
Every type and every size of bearing is best suited to some particular requirement. To endeavor to determine without previous knowledge the type and size best suited for any particular application invites trouble at the outset, and any machine tool builder will save himself considerable expense, time, and trouble in his work of applying ball bearings to his product, if he will first permit a reliable ball bearing manufacturer to study his problem and submit recommendations.

* * *

The United States Civil Service Commission announces an open competitive examination for instrument makers in the following departments: Coast and Geodetic Survey; Naval Observatory; Office of the Secretary of Agriculture; Bureau of Standards, Department of Commerce; and Weather Bureau. It is desired to secure instrument makers qualified to do repair work and make instruments from drawings. Applicants must have completed the eighth grade of common school and additional credit will be given for general or technical education in universities, colleges and technical schools of recognized standing, particularly for courses in physics, engineering, and allied subjects. Those interested should apply for Form 1312 to the Civil Service Commission, Washington, D. C., stating the title of the examination desired. Applications should be received not later than October 1.

AMBROSE SWASEY HONORED ABROAD

Ambrose Swasey, president of the Warner & Swasey Co., Cleveland, Ohio, and past president of the American Society of Mechanical Engineers, has visited Europe during the last two months as chairman of a delegation representing the four great national engineering societies, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Society of Civil Engineers, and the American Institute of Electrical Engineers. The specific purpose was to present the John Fritz medal to Sir Robert A. Hadfield of England, and to Dr. Eugene Schneider of France. During this visit Mr. Swasey was singularly honored both by engineering societies in Great Britain and France, and by the French Government. Honorary membership was conferred upon him in three British engineering societies, the Institute of Mechanical Engineers, the Institute of Mining and Metallurgy, and the Institution of Mining Engineers. The French Government made him an Officer of the Legion of Honor, of which he was made a Chevalier in 1900, and the Society of Civil Engineers of France conferred honorary membership upon him.



Ambrose Swasey has always been active in pioneer work in engineering societies as well as in engineering. He was one of the forty-eight men who organized the American Society of Mechanical Engineers. He served as president of that society in 1904, and in 1916 was made one of its honorary members. He is a past president and honorary member of the Cleveland Engineering Society, and a member of the National Research Council. His connection with various engineering and scientific societies includes membership in the British Astronomical Association, and the Royal Astronomical Society of which he is a Fellow, in addition to the honorary memberships now conferred upon him in the three British and one French engineering societies.

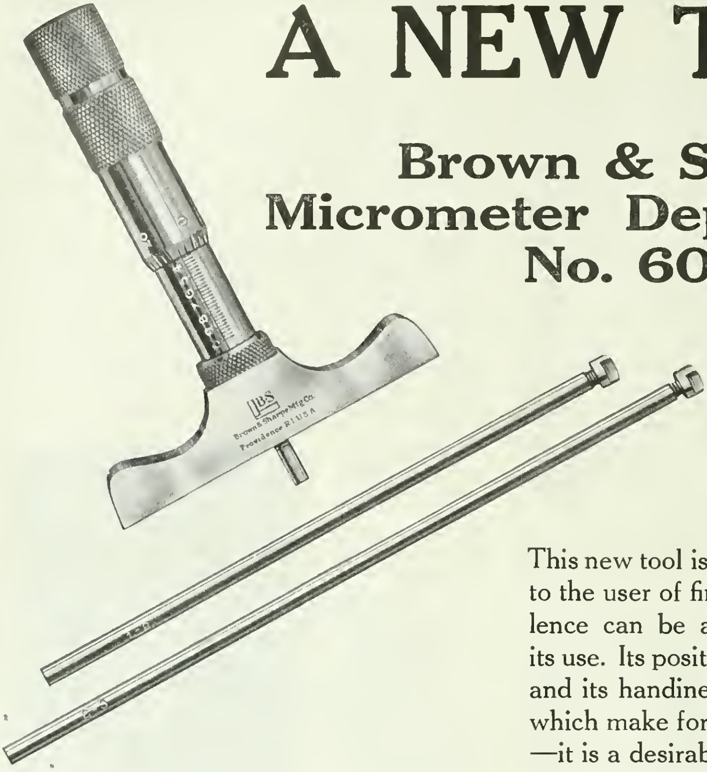
In 1914 he provided the initial fund which established the engineering foundation of the United Engineering Societies, the first known instance of a foundation devoted to engineering purposes and intended for promoting the good of mankind through the work of the engineer along the broadest lines.

In 1905 the Case School of Applied Science, Cleveland, Ohio, conferred upon him the degree of Doctor of Engineering, and in 1910 he received the degree of Doctor of Science from Denison University, Granville, Ohio. He has also held many positions of trust in the business world. He was president of the Cleveland Chamber of Commerce in 1905; and served as a member of the Jury of Awards at the Nashville, Pan-American, and St. Louis Expositions, and as vice-president of the Jury of Awards of the Jamestown Exposition.

* * *

It is estimated that at least 33,000 tractors were in operation in western Canada during the year 1920, the valuation of which was about $21,000,000. Tractors of 8-16 to 10-20 horsepower represent more than half the total sales in 1919 and 1920.

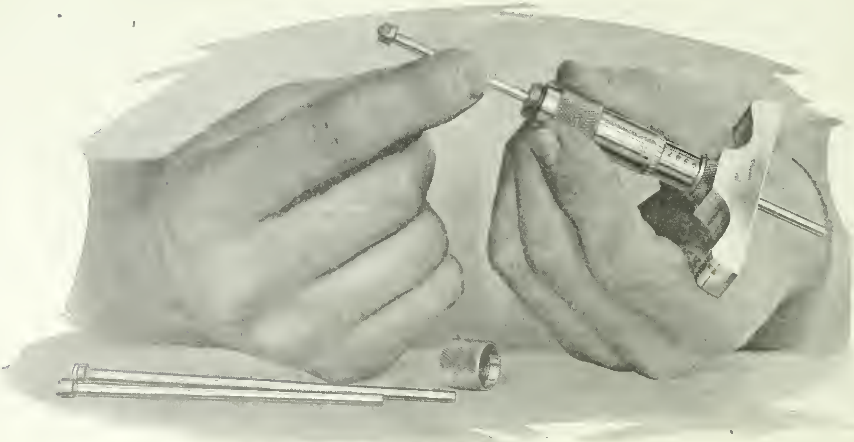
A NEW TOOL—



Brown & Sharpe Micrometer Depth Gauge
No. 607

This new tool is of a design which appeals to the user of fine tools and whose excellence can be appreciated daily through its use. Its positive and quick adjustments, and its handiness of operation are points which make for faster work and accuracy —it is a desirable kit-member and helper. The illustration below shows the simplicity with which measuring rods are inserted. Measures 0 to 3" by thousandths of an inch.

BROWN & SHARPE
MFG. CO.



The pride and care which go into the construction of Brown & Sharpe products are reflected in the long and satisfactory service they return to the user.

You will find in the 1000 and over varieties of machinists' tools, in each and every one—that quality predominates.

B·S
TRADE MARK

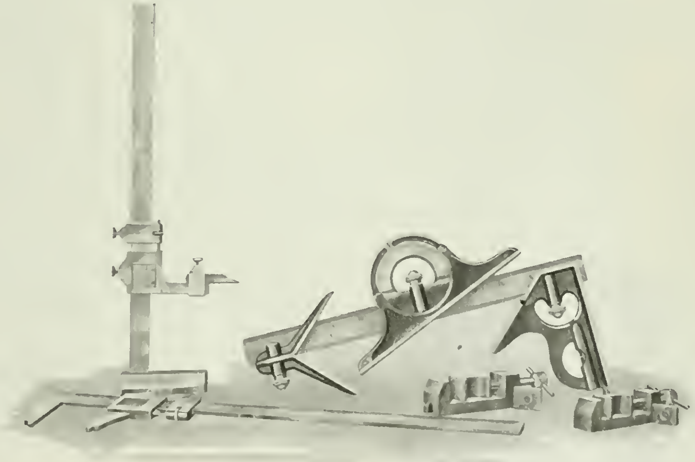
Other Improvements and Additions

in the line of

Brown & Sharpe Machinists' Tools

Small Tool Catalog No. 28, or circular describing Micrometer Depth Gauge No. 607, or both mailed to any address.

Providence, R. I.
U. S. A.



The illustration above shows other new tools in the Brown & Sharpe Line—The Vernier Height Gauge with base extending back as well as in front of the measuring bar which gives added stability. The Vernier Calipers—these, as well as the Vernier Height Gauge have the new feature of reading inside and outside measurements in thousandths of an inch DIRECT. The Combination Set with Center Head to take work of any diameter. Note the Toolmakers' Vise No. 752, with base and jaw of new and improved design. Note also the New Toolmakers' Vise Clamp No. 753 at its right. You will see these new tools and others in the No. 28 Catalog.

OBITUARIES

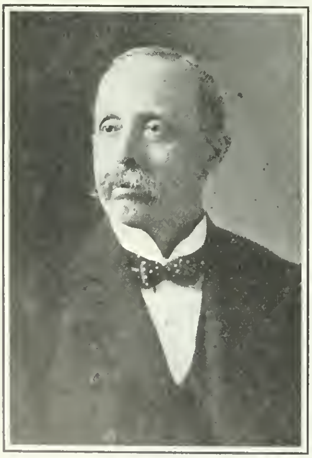
J. L. Larson, sales manager of the Foote Bros. Gear & Machine Co., Chicago, Ill., died in Chicago on July 14.

John Jernberg, who had been instructor in forge practice at the Worcester Polytechnic Institute, Worcester, Mass., since 1882, recently died at his old home in Sweden at the age of sixty years. Mr. Jernberg, accompanied by his wife, left Worcester in May intending to spend his summer vacation abroad. He was known as an expert metallurgist.

Charles F. Beaman, a sheet-metal-working expert and member of the sales organization of the Adriance Machine Co., Brooklyn, N. Y., died July 7 in St. Catherine's Hospital, Omaha, Neb., after an illness of three weeks. Mr. Beaman was born in Independence, Iowa, in 1849, and devoted the greater part of his life to the sheet-metal-working and allied industries. He was connected with the sales organization of the E. W. Bliss Co. for thirty-two years, going from that organization to the Adriance Machine Co. in 1904. During his seventeen years' service with the Adriance organization, he traveled in the South and West, and it was while he was engaged in the performance of his duties that he was stricken with his fatal illness. He was a pioneer in introducing sheet-metal-working machines in Mexico.

Henry S. Manning, who at one time was a partner of the firm of Manning, Maxwell & Moore, Inc., dealers in machine tools, 119 W. 40th St., New York City, died July 9 in New York at the age of seventy-six. Mr. Manning originated the present business of Manning, Maxwell & Moore, Inc. After having been in business for himself for several years, he established the concern of H. S. Manning & Co., with headquarters at 111 Liberty St., New York, in which concern E. L. Maxwell became a partner in 1873, continuing his connection with the firm until his death in 1894. In 1880, Charles A. Moore became a partner, and it was at that time that the present name was adopted. In 1905 Mr. Moore purchased Mr. Manning's interest, and since that time Mr. Manning has been connected with Milliken Bros., structural iron and steel manufacturers, and the International Banking Corporation. He was a member of the American Society of Mechanical Engineers.

FRANCIS REED



Francis Reed, founder of the Francis Reed Co., Worcester, Mass., manufacturer of sensitive drilling machines, died July 11 at his home in Worcester, aged sixty-nine years. Mr. Reed was born in Danbury, N. H., and attended the public schools of that town. When he was nine years old, his family moved to Penacock, N. H., where he attended the Penacock Academy. Nine years later he went to Manchester, N. H., and it was there he learned the machinist's trade, starting as an apprentice with the Amoskeag Mills and later working at the Blood Locomotive Works. In 1880 he went to Worcester, and for two years was employed with the Union Water Meter Co., after which he spent three years with the Boynton-Plummer Machine Co.. Leaving this company he entered the electrical business, forming the partnership of Reed & Page. In 1889 Mr. Reed bought out the business of George Burnham, manufacturer of drilling machines, located at 15 Herman St. He continued the business under the old name until 1902, when he started the present business at 43 Hammond St., under the name of Francis Reed Co. Mr. Reed developed a line of sensitive drilling machines, well known in this country and abroad. He is survived by two sons, Ralph G. and Merton F. Reed, both of whom are connected with the Francis Reed Co., and by whom the business will be carried on in the future.

PERSONALS

J. G. White has been appointed district sales manager at Detroit, Mich., of the Sharon Pressed Steel Co., Sharon, Pa. Mr. White's headquarters will be located at 1214 Dime Bank Bldg., Detroit.

Victor M. Summa, a frequent contributor to the columns of Machinery, has opened an office at 415 Merchants-Laclede Bldg., 408 Olive St., St. Louis, Mo., to engage in general engineering practice.

C. G. Johnson, formerly in charge of thread gage manufacturing in the small tool division of the Taft-Peirce Mfg. Co., Woonsocket, R. I., left that company on June 25 to engage in business for himself in Hartford, Conn.

George Greenlee, formerly general superintendent and mechanical engineer for the National Wire Wheel Works, Geneva, N. Y., has become associated in the same capacity with the Morrison Machine Products, Inc., Rochester, N. Y., manufacturers of collets for lathes and screw machines.

W. R. Hyde, for several years special western representative (with headquarters at Chicago) of the Hilo Varnish Corporation, Brooklyn, N. Y., will take over the New York and Pennsylvania territory of the company, formerly covered by J. Frank Brown. Mr. Hyde will make his headquarters at Buffalo for the present.

R. G. White, manager of the Cleveland branch of B. M. Jones & Co., Inc., has been appointed special western representative and will be located in Chicago. His headquarters will be with the company's western sales agents, Crerar, Adams & Co., 259 E. Erie St., where complete stocks of mushet and "Titanic" tool steels and Taylor's "Best Yorkshire" iron are carried.

John D. Hurley, president of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., manufacturer of "Thor" air and electric tools, sailed from New York City on the steamship *Olympic*, July 16, for an extended trip throughout continental Europe. Mr. Hurley was accompanied by his wife, and will make his trip one of combined business and pleasure.

Robert D. Black, formerly assistant sales manager of the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., has been appointed manager of the company's Philadelphia branch office with headquarters at 318 N. Broad St. Mr. Black succeeds W. C. Allen, who has been made a special factory representative, with headquarters at the company's Cleveland branch office, 6225 Carnegie Ave.

I. D. Bielostozky is at present in the United States representing the firm of Morris & Bramer of Petrograd, Russia. He is desirous of getting in touch with high-class machine tool manufacturers with a view to securing their representation in Vladivostok, Russia. Morris & Bramer also intend to extend their activities to China, Japan, and Finland. Mr. Bielostozky expects to be in this country for at least three months and can be addressed in care of the W. P. Neth Co., 44 Whitehall St., New York City. He would be glad to receive complete catalogues and price lists from machine tool manufacturers who may be interested.

C. E. Davies has been appointed managing editor of "Mechanical Engineering"—the journal of the American Society of Mechanical Engineers—succeeding the late Lester G. French. Mr. Davies joined the editorial staff of the society in March, 1920, as associate editor of "Mechanical Engineering" and assistant secretary in charge of meetings and publicity. Previous to his association with the society he was connected with the Smith Premier Works of the Remington Typewriter Co., Syracuse, N. Y. During the war he was in the Ordnance Department at the Frankford Arsenal, serving as assistant production superintendent on the artillery ammunition division, and later as superintendent of the fuse shop.

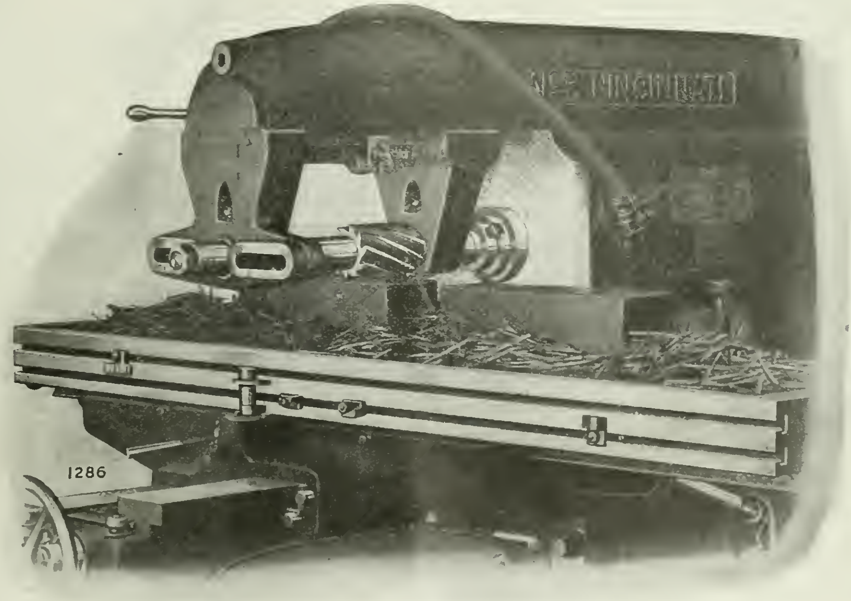
Vance McCarty, who was formerly vice-president of the Edward R. Ladew Co., New York City, has become associated with the Chicago Belting Co., 113 N. Green St., Chicago, Ill., in the capacity of vice-president of the corporation. Mr. McCarty has had extensive experience in the leather belting industry, having been associated with the Ladew company for twenty-one years, the first five of which he spent in the various departments of the manufacturing end of the business, and the last sixteen in the sales end of the work. Mr. McCarty will make his headquarters at the New York branch of the Chicago Belting Co., 127 Water St., New York City. He will have charge of all sales in New York, Pennsylvania, Connecticut, Rhode Island, New Jersey, Maryland, Delaware, Virginia, West Virginia, and District of Columbia, and will also have supervision over all export sales.

24 Cubic Inches of Steel Removed Without Braces on the No. 5 Cincinnati

THE CINCINNATI RECTANGULAR OVERARM

(PATENTED)

enables the new Nos. 4 and 5 machines to take cuts up to their normal rated capacity without the use of braces.



Material, machinery steel, cutter, 4½-in. diameter, Cincinnati design spiral mill, 2 in. arbor
Cut, ¼-in. deep, 5 in. wide Feed, 19 in. per minute

Removing 23¾ cubic inches of steel per minute—without the use of braces

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI OHIO, U.S.A.

NEW JOURNAL OF MANAGEMENT

The first number of a new journal *Management Engineering* has made its appearance. It is edited by L. P. Alford, formerly editor of *Industrial Management* and previous to that of the *American Machinist.* The new journal is devoted entirely to management problems, the first number containing articles on labor costs, storekeeping, cost accounting, accident prevention, management education, and other subjects closely connected with the management of all types of industrial undertakings. It is published by the Ronald Press Co., New York City.

RIVET CUTTING RECORD

In June MACHINERY, page 926, mention was made of an operator who cut 1038 rivets in two hours and forty-six minutes, using an oxy-acetylene blowpipe with a rivet-cutting nozzle. Of this number 683 were ⅝-inch rivets; 228, ¾-inch rivets; and 127, ⅞-inch rivets. Referring to this rivet cutting record, H. K. Griggs of Portland, Me., states that about a year ago an operator of the Portland Co., using an ordinary Davis-Bournonville torch with bent tip, cut over four hundred ⅝-inch rivets in one hour on the water tank of the S. S. *Hindustan.*

COMING EVENTS

September 7-28—Shipping, Engineering and Machinery Exhibition, Olympia, London, W., England. General Manager, Frederic W. Bridges, 36-38 Whitefriars St., Fleet St., London, E.C.4.

September 14-16—Annual convention of the National Association of Cost Accountants in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary's address, 233 Woolworth Bldg., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

September 28-October 8—New York Electrical Exposition at the 71st Regiment Armory, Park Ave. and 34th St., New York City. For information relating to exhibits, apply to Norman Maul, the Electrical Show Co., 130 E. 15th St., New York City, Room 828.

October 3-4—Regional meeting of the American Society of Mechanical Engineers in Cleveland, Ohio; headquarters, Hotel Winton.

November 4-5—Regional meeting of the American Society of Mechanical Engineers in Kansas City, Mo.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Delaware, Newark, Del Annual catalogue for 1920-1921 containing calendar and announcements for 1921-1922.

Cooper Union, Fourth Ave. and Eighth St., New York City. General circular of information embracing all the courses of study pursued in the institution.

Hebrew Technical Institute, Stuyvesant and 9th Sts., New York City. Catalogue for the year 1921-1922, containing calendar, requirements for admission, courses of instruction, etc.

Armour Institute of Technology, 33rd and Federal Sts., Chicago, Ill. Bulletin for May 1920, containing calendar, courses of study, and other general information concerning the institute.

NEW BOOKS AND PAMPHLETS

Investigation of Warm-air Furnaces and Heating Systems. By A. C. Willard, A. P. Kratz, and V. S. Day. 145 pages, 6 by 9 inches. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill., as Bulletin No. 120.

Effects on Concrete of Immersion in Boiling Water and Oven Drying. By W. J. Schlick. 24 pages, 6 by 9 inches. Published by the Engineering Experiment Station of the Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa, as Bulletin No. 59.

Scientific Selling and Advertising. By Arthur Dunn. 119 pages, 5 by 7½ inches Published by the author, Quincy, Ill. Price, $2.50.

This little book on advertising and selling deals in a brief concise way with the problems involved. It is divided into four parts and an appendix, the four parts dealing respectively with Human Energy; Essentials of Success; Scientific Method of Presenting your Products; and How Related to War and Reconstruction. The appendix contains an application of the system to different classes of salesmanship.

Iron and Steel in Sweden. 183 pages, 7½ by 10 inches. Published by Svenska Teknologforeningens Forlag, Stockholm, Sweden.

The present work, printed in the English language, is intended to give information on the subject of Swedish iron and steel and its production, to American and English readers. The book contains, first, a general review of the iron and steel industry in Sweden, together with a map showing the location of the various works. It then describes in detail, in articles profusely illustrated, the leading iron and steel works in the country, and contains, in addition, a list of the producers of iron and steel products in Sweden.

Year Book for 1921, of the American Chamber of Commerce in London. 111 pages, 6 by 9 inches. Published by the American Chamber of Commerce, 8 Waterloo Place, Pall Mall, S. W. 1, London, England. Price, 5s.

This book comprises a classified trade directory, for the benefit of Americans who are interested in selling in the British market or for English people who are interested in the American market. It contains an alphabetical and classified list of members of the American Chamber of Commerce in London, indexed and cross-indexed for ready reference, giving the name, address, and business in each case. It should be useful in selling, buying, appointing agents, or securing agencies.

Handbook of Standard Details for Engineers, Draftsmen, and Students. By Charles H. Hughes. 312 pages, 4½ by 7 inches. Published by D. Appleton & Co., 35 W. 32nd St., New York City. Price, $6.

This book was compiled especially for engineers and draftsmen, so that they might have in a convenient form drawings, tables, and formulas of standard details for use in designing. Most of the material in the book is similar to that found in the general engineering handbooks. The tables cover fastenings; power transmission; pipe, tubes, and fittings; rope and chain fittings; miscellaneous details; structural details; weights and measures; strength of materials; specific gravities; etc.

Financing an Enterprise. By Hugh R Conyngton. 667 pages, 6 by 9 inches. Published in three volumes by the Ronald Press Co., 20 Vesey St., New York City. Price, $7.

The three volumes of this work deal, respectively, with the enterprise to be financed; its organization; and the actual financing problems themselves. In the first volume the main subjects discussed are the conditions and the methods of financing; the investigation of an enterprise; and the protection of an enterprise. The second volume deals with the shaping up of an enterprise; its capitalization; and special corporate adjustments. The third volume treats of preliminaries to the actual presentation to financial underwriters; private and public presentation of an enterprise; prospectus and other presentation papers; and special features of promotion. These volumes should be of considerable interest to business men planning to finance or increase the capitalization of an enterprise.

A Manual of Marine Engineering. By A. E. Seaton. 984 pages, 6 by 9 inches Published by D Van Nostrand Co., 8 Warren St., New York City. Price, $10.

This is the eighteenth edition of a well-known work on marine engineering, covering the design, construction, and working of marine machinery. The new edition has been thoroughly revised, greatly enlarged, and largely rewritten in order to bring it up to date. Since the issue of the last edition the changes in engineering practice have been many and great. Special appendixes have been added to deal with heavy oil engines, geared turbines, and superheaters. The work is doubtless one of the most complete in existence on the subject with which it deals. The thirty-one chapters of the book deal with practically every phase of marine engineering—with the properties of steam, and the different constructional details of marine engines and turbines, condensers, pumps, valve gears, propellers, and auxiliary machinery, as well as with boilers. It is impossible in a brief review to do justice to so comprehensive a work, but the fact that the book is appearing in its eighteenth edition, revised and brought up to date, would appear to be all that need be said in its favor.

Sheet Metal Drafting. By Ellsworth M. Longfield 236 pages, 6 by 9 inches; 327 illustrations. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $2.25.

The author of this book is head of the sheet metal department of the Boston Trade School, and the book is one of the industrial education series prepared by the Extension Division of the University of Wisconsin for correspondence instruction. It comprises a text-book on the underlying principles of sheet metal pattern drafting. The arrangement and presentation of the material have been successfully used for several years in the teaching of the subject. The problems in related mathematics point out the application of mathematical principles to sheet metal work, and serve as a guide for the proper correlation of the work in mathematics, drawing, and shop practice. The material is divided into sixteen chapters dealing with the following subjects: Rectilinear Figures; Wired Cylinders; Cylinders Cut by Planes; Intersecting Cylinders; Cones of Revolution; Intersecting Rectangular Prisms; Planning for Quantity Production; Sections Formed by Cutting Planes; Frustums of Rectangular Pyramids; Combinations of Various Solids; Frustums of Cones; Return and Face Miters; Triangulation of Scalene Cones; Triangulation of Transition Pieces; Developments by Sections; and Developed and Extended Sections.

The Engineering Index 1920. 586 pages, 6 by 9 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $6.

This is the second volume of the Engineering Index to be issued by the American Society of Mechanical Engineers. The alphabetical or dictionary arrangement, found so convenient and satisfactory in the 1919 volume, has been retained. Each item contains the exact title of the article indexed; the author's name, if given; the name of the periodical in which the article appeared; the volume, number, and date of publication; and the page numbers and number of figures in the article. It also includes a brief note summarizing the article indexed, and this feature, together with the numerous cross-references throughout the volume, makes it possible for a person to confine his search to those particular articles which bear directly upon his problem. The volume contains nearly 14 000 items referring to articles in about 700 engineering and allied technical publications. In preparing the Index the engineering staff of the society has reviewed the 1200 different periodicals, reports and publications regularly received by the Engineering Societies library in New York. These periodicals are printed in ten different languages and comprise what is believed to be the most complete collection of scientific and engineering publications in the world.

Thomas' Register of American Manufacturers. 4218 pages, exclusive of advertising, 10 by 12 inches. Published by the Thomas Publishing Co., 129 Lafayette St., New York City. Price, $15.

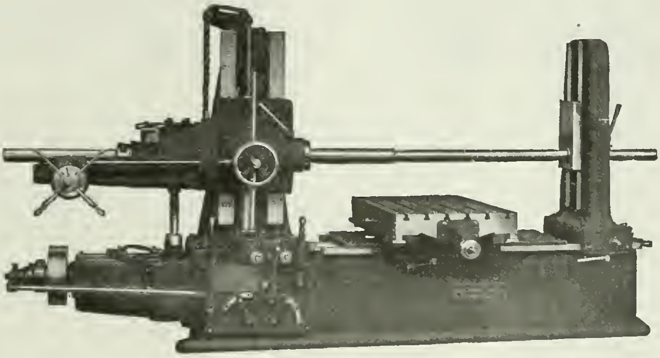
The twelfth edition of Thomas' well-known purchasing guide and directory contains a considerable amount of additional material not found in previous editions. The arrangement is the same as in former issues. The work is divided into seven main sections, the first of which is an index to the classified section of products and businesses, this index being so thoroughly cross-indexed that it covers by itself 172 pages. This section, in order to facilitate easy reference, is printed on yellow paper. The next section, which is by far the largest section of the work, covers 3325 pages, and is devoted to a list of names and addresses of manufacturers of machines, devices, products, and materials classified according to their business. This list is thoroughly subdivided so that reference can be made to a specific class of manufacturers with little difficulty, and in addition to the index in the first section of the book referred to, the main classified list has so many cross-references that if the index is always referred to, the particular line of manufacturers to be found can be readily located. This section of the work is printed on white paper. Next follows a section listing the representative banks in the United States, which covers 23 pages. Another list of 9 pages gives the names and addresses and the name of the secretary of commercial organizations. A section of 12 pages gives the name, address, and subscription price of all the leading trade journals in the country. The third main section of the book, covering 414 pages, gives a complete alphabetical index of manufacturers in the United States, their home offices, branches, names of officers, sales manager, purchasing agent, etc. This section is printed on blue paper. The fourth alphabetical section gives a list of trade names and brands, including the names and addresses of the manufacturers. This section covers 263 pages, and is printed on pink paper. Another

THE LUCAS

“PRECISION”

Boring, Drilling and

MILLING MACHINE



As It Stands Today Is

“THE SUM OF SMALL HAPPENINGS”

of 20 Years’ Experience

(but we are not too old to learn)

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U. S. A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

feature of the work is the list of export and import houses, steamship lines, and forwarding agents listed on the first of the yellow pages toward the end of the book. This list, it is stated, contains only responsible concerns, and should therefore be of considerable value to American merchants and manufacturers. In addition, the work contains numerous advertising pages, there being in all 2372 advertisers and 6261 separate advertisements. Buyers and purchasing agents in all industries will find this work useful in answering the many questions that come up in their daily work and in locating the sources of supply for their products or the manufacturers of machinery, devices, or materials which they have to buy. It will also prove useful to the sales manager or sales promotion department in determining the possible number of customers for any given product, and it is therefore a work that may be recommended as a reference book or directory.

NEW CATALOGUES AND CIRCULARS

Northern Engineering Works, Detroit, Mich. Bulletin 520, illustrating installations of electric traveling grab-bucket cranes, designed for severe classes of service.

National Machinery Co., Tiffin, Ohio. National Forging Machine Talk No. 41, describing the making of clutch hub drive rings on a National heavy-pattern forging machine.

Smith Forge Co., Camden, N. J. Circular illustrating the Smith safety cargo hook, a special open-hearth steel drop-forged hook designed to prevent a load from slipping.

General Electric Co., Schenectady, N. Y. Bulletin 48121.1, describing in detail a line of direct-current mill-type motors developed to meet the severe requirements found in steel mills.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Bulletin 9141, illustrating and describing the new C-H auto-transformer starter for use with squirrel-cage induction motors, in capacities from 5 horsepower up.

Pearson-Scott Co., Indianapolis, Ind. Catalogue illustrating and describing the "Iron Man"—an attachment for hand screw machines and turret lathes, by means of which the operation of these machines is made fully automatic.

Cutter Co., Philadelphia, Pa. Circular containing data on the "U-re-lite Senior"—a combined covered switch and circuit breaker for application to machine tools and other machinery, which is made in capacities of from 5 to 150 amperes.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf data sheets, 130, 131, 132 and 133 FE, containing illustrations and descriptions of ball bearing installations on a die-tapping machine, automatic drill press head, multiple-speed drilling machine countershaft, and planetary gear spindle pulley.

Rickert-Shafer Co., Erie, Pa. Bulletin 8, descriptive of the features of the R-S adjustable boring head, which is a universal tool suitable for use on any drilling, turning, or boring machine. The circular illustrates the use of this type of boring head on the different classes of work for which it is adapted.

John Bath & Co., Inc., Worcester, Mass. Bulletin 20, describing the construction of the Bath internal thread micrometer which is a combination adjustable plug gage and micrometer for accurately measuring threaded holes, so that it is possible to tell at a glance whether or not the part is within the prescribed limits.

Ingersoll-Rand Co., 11 Broadway, New York City. Booklet illustrating and describing the complete line of "Little David" pneumatic tool accessories, including air hose, hose couplings, hose clamps, drill chucks, chisels and chisel blanks, rivet sets and blanks, wire brushes, oils and greases, rail bonding drills, rail drills, and railroad kit boxes.

Conradson Machine Tool Co., Green Bay, Wis. Catalogue entitled "Contract Work," showing examples of the Conradson line of production machinery for producing details for automobiles, locomotives, electrical machinery, tractors, gas engines, etc. Examples of the machine details which this concern is prepared to contract for are also illustrated.

Link-Balt Co., 910 S. Michigan Ave., Chicago, Ill. New steel chain data book No. 475, presenting completely the Link-Belt heavier types of rugged steel chains used for power transmission, as well as elevating and conveying chains. The line of chains shown in this book ranges from the rugged slow-speed classes to the machine-finished high-speed chains.

Jones Machine Tool Works, Philadelphia, Pa. Circular illustrating and describing the features of construction of the Jones horizontal boring, drilling, and milling machine, designed for boring cylinders, motor housings, or any other horizontal boring mill work. Complete specifications are given for this line of machines, which includes six sizes, namely 3, 3½, 4, 4½, 5, and 6 inches diameter of spindle.

Rhodes Mfg. Co., Hartford, Conn. Loose-leaf catalogue containing pamphlets illustrating and describing the Rhodes 7-inch horizontal crank shaper for shaping small tool and die work and machining all small production work; the 3½-inch vertical slotter for slotting small complicated dies and tools; and the combined horizontal shaper and vertical slotter, which can be quickly changed from a horizontal shaper with a 7-inch stroke to a vertical slotter with a stroke of 3½ inches.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 230, containing a series of papers dealing with the principles governing industrial heating operations. This bulletin is not a mere catalogue of the firm's products, but contains considerable information of general value. The subjects treated in the papers are factors governing quality and cost of heat-treated products; relation of temperature control to uniformly heated product; selection of furnaces; relation of price of fuel to cost of production; and influence of furnace design on quality and cost of product.

Farrell-Cheek Steel Foundry Co., Sandusky, Ohio. Catalogue (41 pages, 9 by 12 inches, printed in two colors) entitled "The Illustrated Story of a Farrell-Cheek Steel Casting," containing a detailed description of the different steps in the production of steel castings in this company's plant. The catalogue is fully illustrated with views of the different departments and the operations involved, so that the reader has the advantage of a trip through the factory without having to travel to Sandusky. Every alternate page contains views showing the application of these castings in different classes of machinery.

Geometric Tool Co., New Haven, Conn. Circular showing the different styles of Geometric self-opening and adjustable die-heads, and giving information on the class of work for which each is particularly adapted. The circular also shows Geometric chaser grinders, threading machines, and Jarvis high-speed tapping devices and quick-change chucks and collets. Circular containing illustrated descriptions of the Jarvis high-speed tapping device, Jarvis quick-change chucks and collets, and the Jarvis combination tapping device and quick-change chuck. Complete specifications for these tools are given, and instructions for operating the tapping device are included.

Jones & Lamson Machine Co., Springfield, Vt. Cloth-bound book containing 63 pages, 6 by 9 inches, descriptive of the Hartness automatic chucking lathe, designed for rapid production. Following the detailed description of the machine, which is fully illustrated with both half-tone and line engravings, is a section showing examples of quantity production on this machine. Next comes a description of the operation, tooling, and lubrication, in connection with which illustrations of tooling equipment for typical classes of work are presented. The last section of the book illustrates other products of the company, including Hartness single-spindle flat turret lathes, double-spindle flat turret lathes, standard Fay automatic lathes, automatic dies, and the Hsrtness screw thread comparator.

TRADE NOTES

National Machinery Co., Tiffin, Ohio, manufacturer of bolt, nut, and forging machinery, has opened an eastern sales office at Room 637, Knickerbocker Bldg., Broadway and 42nd St., New York City. F. J. Mawby will be in charge of the new office.

Walworth Mfg. Co., whose general offices have been at the Boston factory, First and O Sts., Boston, Mass., has moved its general offices to Pearl and High Sts., Boston. The building embraces an entire block on High St., and the offices cover two floors.

Royal Forwarding Co., Inc., 24 Stone St., New York City, announces that the company is in a position to advise manufacturers in the United States as to lists of dealers and merchants in Reval, Esthonia, and Riga, Latvia, who would be willing to handle American goods in those countries.

Universal Crane Co., Swetland Bldg., Cleveland, Ohio, manufacturer of portable gasoline or electric locomotive cranes, announces that the Allied Machinery Co. of America, 51 Chambers St., New York City, has been appointed foreign representative for the company in all countries except Canada.

Pennant Tool & Engineering Co. is a new concern located at 125 E. Warder St., Springfield, Ohio, which is engaged in making special tools and doing contract work. The officers of the company are H. H. Swope, president and treasurer; C. F. Chronister, vice-president; and George Metcalf, secretary.

B. M. Jones & Co., Inc., 192 Chambers St., New York City, announces that its Cleveland branch at 115 St. Clair Ave. N. W., is now being managed by the Connelly & Kendal Co., H. Connelly and J. Day having direct charge of the sale of double mushet high-speed steel and "Titanic" carbon tool steels.

Electric Furnaca Co., Alliance, Ohio, announces that it has received more orders for Bailey electric furnaces during the month of June than in any single month in the last two years. These orders include standard brass melting units, car furnaces for steel plant purposes, and a special electric enameling equipment.

Goddard & Goddard Co., Inc., Detroit, Mich., announces the opening of an eastern sales office and permanent exhibit of high-speed steel milling cutters in the building of the Manufacturers' Exhibit, Inc., at 45 W. 18th St., New York City. James W. Sederquist, eastern sales manager, is in charge of the New York office.

Brown Instrument Co., Philadelphia, Pa., manufacturer of instruments for indicating and recording temperature, pressure, speed, operation and draft, has opened a branch office at 201 Reliance Bank Bldg., 1634 Euclid Ave., Cleveland, Ohio. This makes a total of eleven district offices maintained by the company.

Barbour, Love & Woodward, Inc., machine tool dealers, formerly of 149 Broadway, New York City, have now moved from their temporary office and warehouse at 131 Washington St., to new offices and show rooms at 45 W. 18th St. Surplus stock will be carried in the building for the convenience of those desiring to inspect machines.

Shields Cutter Co., 18511 Euclid Ave., Cleveland, Ohio, maker of milling cutters and special cutting tools, will maintain a branch office and store beginning August 1, at 192 Chambers St., New York City (telephone, Barclay 8796) in charge of J. V. Carlin, district manager. This store will make it possible to serve the New York district adequately with milling cutters and special cutting tools.

Swadeshi Brass & Iron Works, 233 Kika St., Bombay, No. 4, India, announce that they are in the market for a number of small, medium, and large machine tools, including 3 planers, 6 shapers, 8 milling machines, 10 screw machines, 4 slotters, 8 grinding machines, 8 brass finishing lathes, 10 engine lathes, 6 automatic profiling machines, 3 shaft-turning lathes, 12 drilling machines of different sizes, 2 cold-sawing machines, and 3 hacksaw machines.

Dominion Oxygen Co., Ltd., broke ground in the middle of July for a new oxygen plant at Montreal, Canada, which will double the company's present capacity. The building will be 100 by 100 feet, and will be substantially a duplicate of the Toronto plant, which until now has supplied oxygen to Canadian users through five distributing stations. This is the second of the five producing plants projected at the time the company was organized last year.

Sharon Pressed Steel Co., Sharon, Pa., has recently been reorganized, and Harry W. Torney of Torney & Co., has been elected president. The company states that it is now in a position to handle the production and delivery of car and truck frames up to 1500 per day. Arthur W. Swan, general manager, is in charge of manufacture. In addition to its automobile and truck frame business, the company is equipped with machinery for forging and hot-pressed work.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., has acquired all the capital stock of the **H. W. Caldwell & Son Co.**, and Frank C. Caldwell has been elected a director of the Link-Belt Co. By this combination the Link-Belt Co. has added two new lines—helicoid conveyors, and power transmission machinery—to its line of manufactures. The Caldwell plant will continue to be operated as a separate unit, and there will be no change in the policy or product. The management will also remain substantially the same.

National Machinery Sales Co., Chicago, Ill., which was recently incorporated, has opened headquarters at 28 N. Desplaines St., Chicago. The officers of the new concern are James L. Gough, president and treasurer; James Jay Sheridan, secretary; and George D. Benson, assistant secretary. Mr. Gough was until recently president of the Federal Machinery Sales Co. of Chicago, which company he was largely instrumental in founding in 1915, and has been in the machine tool business for more than twenty-five years. Mr. Sheridan was until recently vice-president of the Federal Machinery Sales Co., and Mr. Benson was associated with the same company in the capacity of salesman.

Morsa Chain Co., Ithaca, N. Y., announces that the company will have on exhibition at the Seventh National Exposition of Chemical Industries, held at the Eighth Coast Artillery Armory, New York City, during the week beginning September 12, a large Morse rocker joint silent chain drive with the washers of the chain removed from one side and a revolving shutter ingeniously arranged so that the rocking action of the joint can be followed as the chain goes on and off the sprockets. This drive is capable of transmitting 100 horsepower and withstanding occasional overload of 100 per cent. There will also be other small drives used for connecting individual motors to machines, and a number of samples of different sizes of chain ranging from ⅜ inch pitch to 3 inches pitch, in several widths, for horsepowers ranging from ½ to 5000. F. G. Anderson, New York manager of sales, will be in charge of the exhibition.

F&G
BLACK LABEL GRADE
CLAVIERSAITEN
GARANTIRT
AUS VORZÜGLICHSTEN PATENT GUSSSTAHLDRAHT
PATENT STEEL MUSIC WIRE WARRANTED PERFECT.
F·G NEPTUN
F·G NEPTUNE
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CARLSWERK
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HAMMACHER, SCHLEMMER & C°
NEW YORK.
PATENT STEEL MUSIC WIRE WARRANTED PERFECT.

THE CELEBRATED
“F & G”
(Felten & Guilleaume)

IMPORTED POLISHED STEEL
MUSIC WIRE

Is Unexcelled for Use in

Electrical Work, Calculating Machines, Automatic Machines of all kinds, Typewriters, Adding Machines, Knitting and Weaving Machinery, Carpet Sweepers, Vacuum Cleaners, Mechanical Toys, for Dental and Surgical Work, in fact anywhere where a positively safe and perfect wire must be used.

Made in three Grades—Black, Red, and Green Label

Tell us your particular requirements, or better still try out a small lot.

If your springs are made on the outside it will be to your advantage *to insist* they be made of “F & G” wire.

Special Circular No. 232 upon request.

Hammacher, Schlemmer & Co.
Hardware, Tools and Factory Supplies
New York Since 1848
4th Ave. & 13th st.

SAVE

TOOL STEEL, GRINDING WHEELS and TIME

Inefficient investment whether in wages, tools or material is bad management.

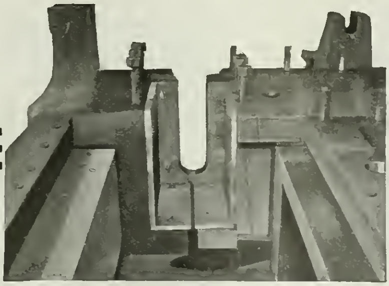
The use of Armstrong Tool Holders reduces investment in high-speed Tool Steel 90 per cent and increases Tool efficiency. No Forging—Little Grinding.

Equip every lathe and planer in your plant with a complete set; no other investment you can make will pay you better returns.

Specify Armstrong and Get the Best

Catalog mailed free upon request

ARMSTRONG BROS. TOOL CO.
"THE TOOL HOLDER PEOPLE"
313 N. FRANCISCO AVE. CHICAGO, U.S.A.



Forging Machine Capacity

The capacity of a forging machine is determined by its space to accommodate work and its ability to accomplish work; in other words, its *DIE AND TOOL SPACE and POWER.*

AJAX

(Trade Mark Registered)

New Model Upsetting Forging Machines

possess these two factors in proportions never before equaled.

Their unusual Die Height and Length, which are completely utilized by the fully adjustable Triple-high Tool-holders, and their great Stock Gather make it possible to complete the largest and most intricate upset forgings with a minimum number of heats and die changes.

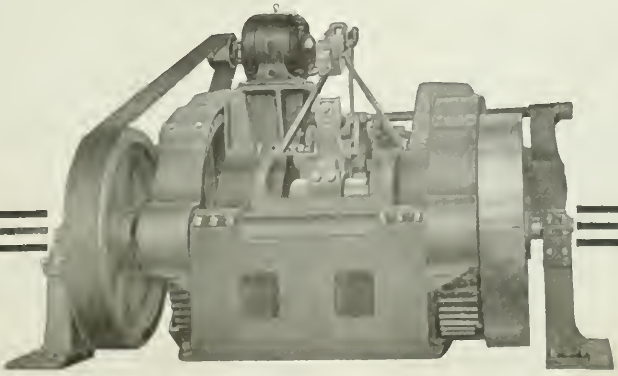
Their Twin Gear Drive with twin fly wheels applies power to both ends of the crankshaft, and the Ajax Drop Lock makes it possible to utilize the momentum of the rotating crankshaft and pitman, delivering working power equal to the hardest forging job.

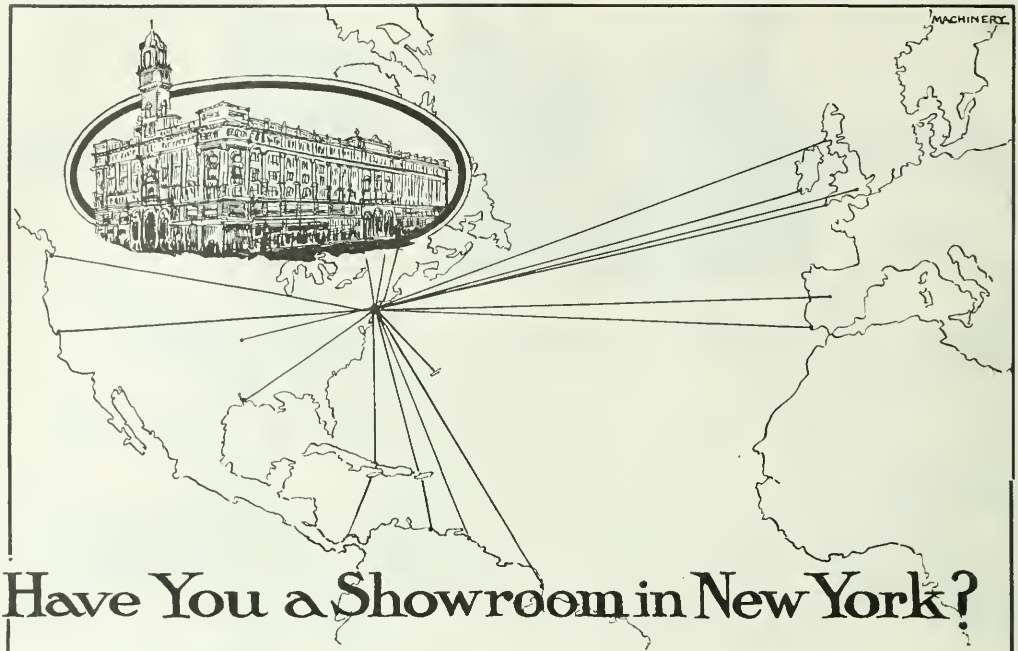
THE AJAX MANUFACTURING COMPANY

1369 Hudson Terminal
NEW YORK CITY

Cleveland, Ohio

621 Marquette Building
CHICAGO, ILL.





Have You a Showroom in New York?

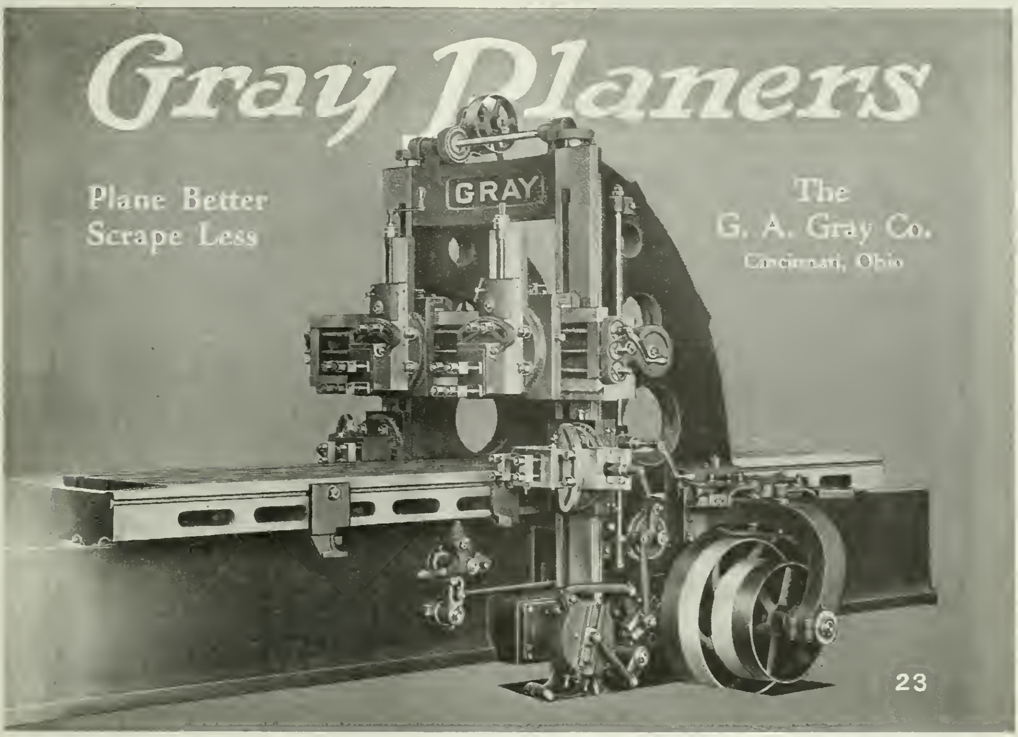
Commercially, New York is the hub of the universe. From Europe, from South America, from all sections of our own country buyers come to New York to trade.

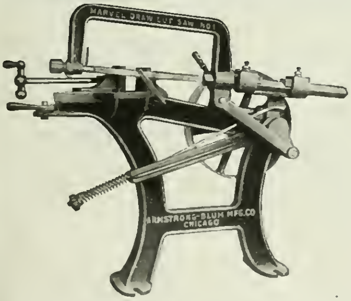
A showroom here is a business asset you can't afford to overlook—and you can easily have it.

Our building is centrally located—within easy reach of all railway and shipping terminals. Subways and other local transportation routes at the door. We can offer you unparalleled service facilities, any sized space you need—floor space covers approximately 170,000 square feet—in sections laid out from 150 square feet, up—power for demonstration purposes, and attendants ready to give information about your products, note inquiries and promote your interest in every way. Rentals are low and include light, heat, janitor service, etc. No need to keep a special man on the job. We forward notice of all inquiries to your nearest representative, or direct.

We solicit permanent exhibits of all classes of Machinery, Machine Tools, Accessories and Mechanical Appliances. Make your selection while some of the choicest locations are still available. Floor plans, circulars and further details on request.

Manufacturers' Exhibition Company, Inc.
45 West 18th Street (corner 6th Ave.,) NEW YORK CITY





Marvel Hack Saw No. 1

Have you a good Hack Saw in your shop?

Marvel Hack Saws

Are built right. They bring RESULTS. The two shown here are general work saws. Both have quick action vise. Both have a device for raising the saw frame above the work and holding it in that position, allowing free use of both hands in measuring and adjusting the material to be sawed.

The Price is Low

MARVEL

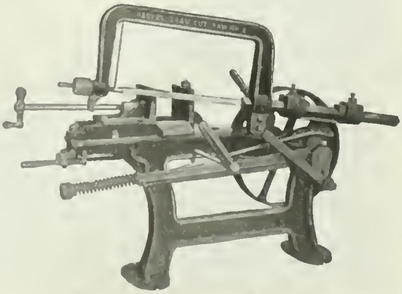
The Marvel Hack Saw No. 1 has a capacity of 4" by 4", the length of blade is 12". The Marvel Hack Saw No. 2 has a capacity on the long stroke of 6" by 6", on the short stroke of 8" by 8" and takes saw blades from 12" to 17".

We also make the MARVEL high-speed hack saws, the highly improved No. 8 metal band saw, and a line of lever punches, shears, rod cutters, and drill press vises.

Send for the Marvel Catalogue

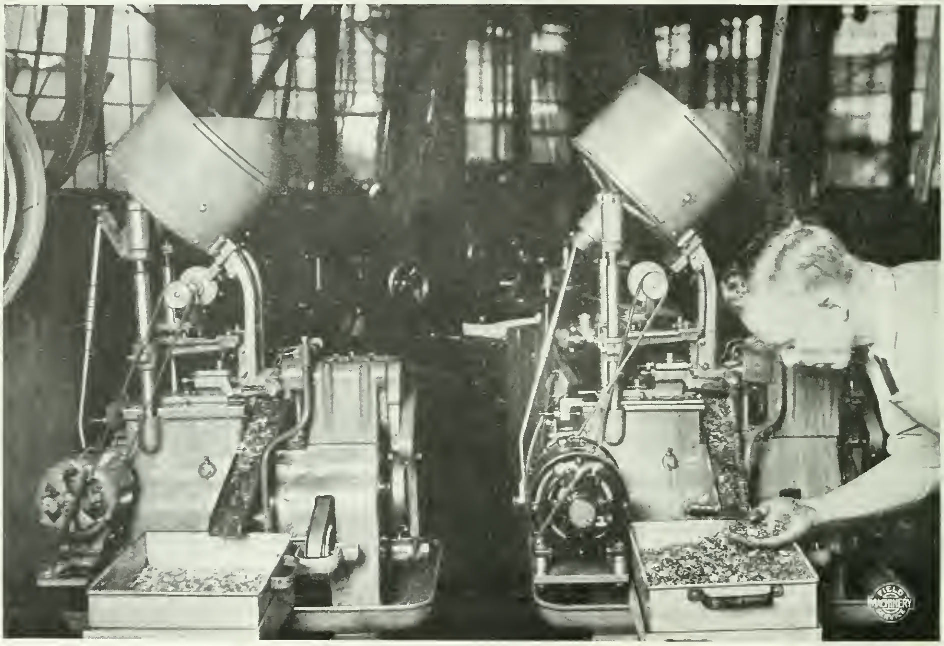
ARMSTRONG-BLUM MFG. CO.

343 N. Francisco Avenue
CHICAGO ILLINOIS, U. S. A.



Marvel Hack Saw No. 2 with Swivel Vise

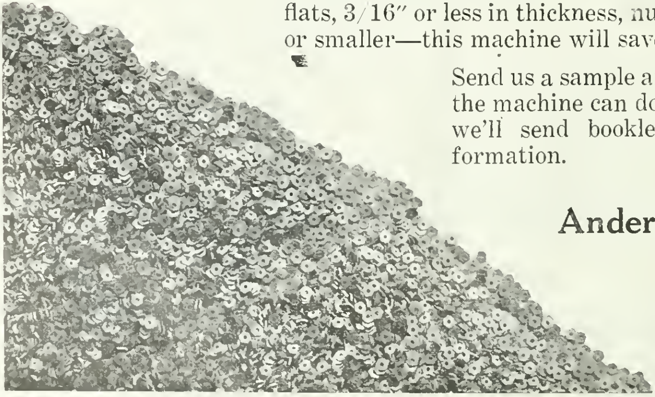
ANDERSON AUTOMATIC NUT TAPPER



A New Machine—Fully Automatic—A Big Producer

Taps 112 to 136 nuts a minute. Uses standard taps. No clutches in spindle drive—segment and pinion provides positive drive ahead and reverse. Chutes are adjustable and cannot clog. Unpierced blanks will not break taps. The machine is durable, simply constructed, entirely automatic in operation and one operator can handle six machines easily.

If you have nuts—square or "Hex"—5/8″ or less across flats, 3/16″ or less in thickness, number 10 —24 thread or smaller—this machine will save money for you.



Send us a sample and we'll tell you what the machine can do with it or write and we'll send booklet and complete information.

Anderson Die Machine Company
Bridgeport
Conn., U.S.A.

TAFT PEIRCE Manufacturers

You have seen our special colored insert advertisements in MACHINERY for months now—fine advertisements for a fine line of products.

This month we are taking a vacation—same as you are—in fact, *because* you are—but there is a crackerjack two-color insert advertisement all ready for September.

Keep a sharp lookout for the Taft-Peirce advertisement next month—it will interest every man who is interested in things mechanical.

Taft-Peirce Manufacturing Co.
WOONSOCKET, R. I.
New York Chicago Detroit

CABLE ANCHORAGES relieved of twisting strains by AUBURN THRUSTS

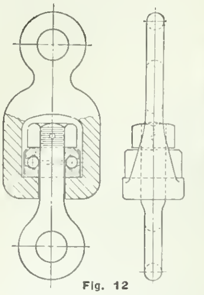
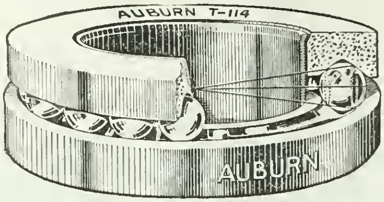


Fig. 12
Swivels and Crane Hooks when equipped with Auburn Thrusts freely take a safe position for carrying the load.



The elimination of twisting strains in cables for Elevators, Hoists and Winding Drums is necessary to prolong the life and to add to the safety of the cables. AUBURN BALL THRUST BEARINGS, with their minimum of friction permit instant relief from all twisting strains and allow all the strength of the cable to be employed in lifting or pulling.

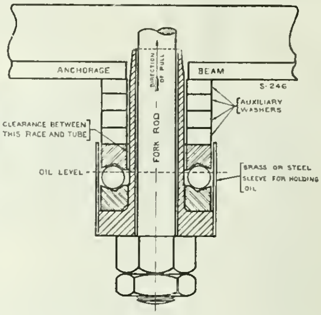

ANCHORAGE
BEAM
S-246
DIRECTION OF PULL
FORK ROD
AUXILIARY WASHERS
CLEARANCE BETWEEN THIS RACE AND TUBE
OIL LEVEL
BRASS OR STEEL SLEEVE FOR HOLDING OIL

Fig. 23
The Cable Anchorage installation above shows how the Auburn Bearing is used.

Auburn Self-contained Ball Thrust Bearings are made in open Style T-114 shown here and enclosed Style T-100 used in Fig. 12. These features answer the need of a wide variety of machine operating conditions. Tell us your problem and obtain the Auburn Answer.

Steel, Brass and Bronze Balls

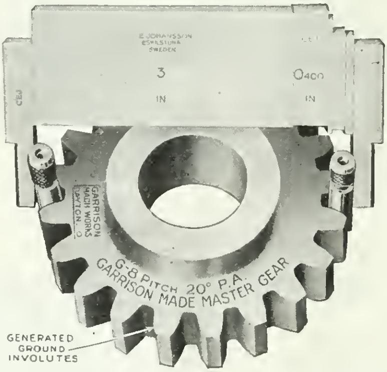
Auburn Ball Bearing Co. 33 Elizabeth St., Rochester, N.Y.

ENGINEERING DATA:

Beginning with January, 1921, issue we are showing each month in this space suggestions and data on Ball Bearing Installations which will be of value and assistance to all Manufacturers, Designers and Users of Machinery. Reprints of these 4¼ x 7¼ inches, for three ring standard binders supplied on request. Next month we will show data and suggestions on providing for Double Thrust.

GARRISON MADE-SUPPLIES

For Gear Manufacturers


C.E. JOHANSSON ESKILSTUNA SWEDEN
3 IN
0400 IN
GARRISON MACH WORKS DAYTON, O.
G-8 PITCH 20° P.A. GARRISON MADE MASTER GEAR
GENERATED GROUND INVOLUTES

OPERATORS

Can readily check adjustment of gear cutting machine and form of cutter or hob
also
form, spacing and thickness of teeth.

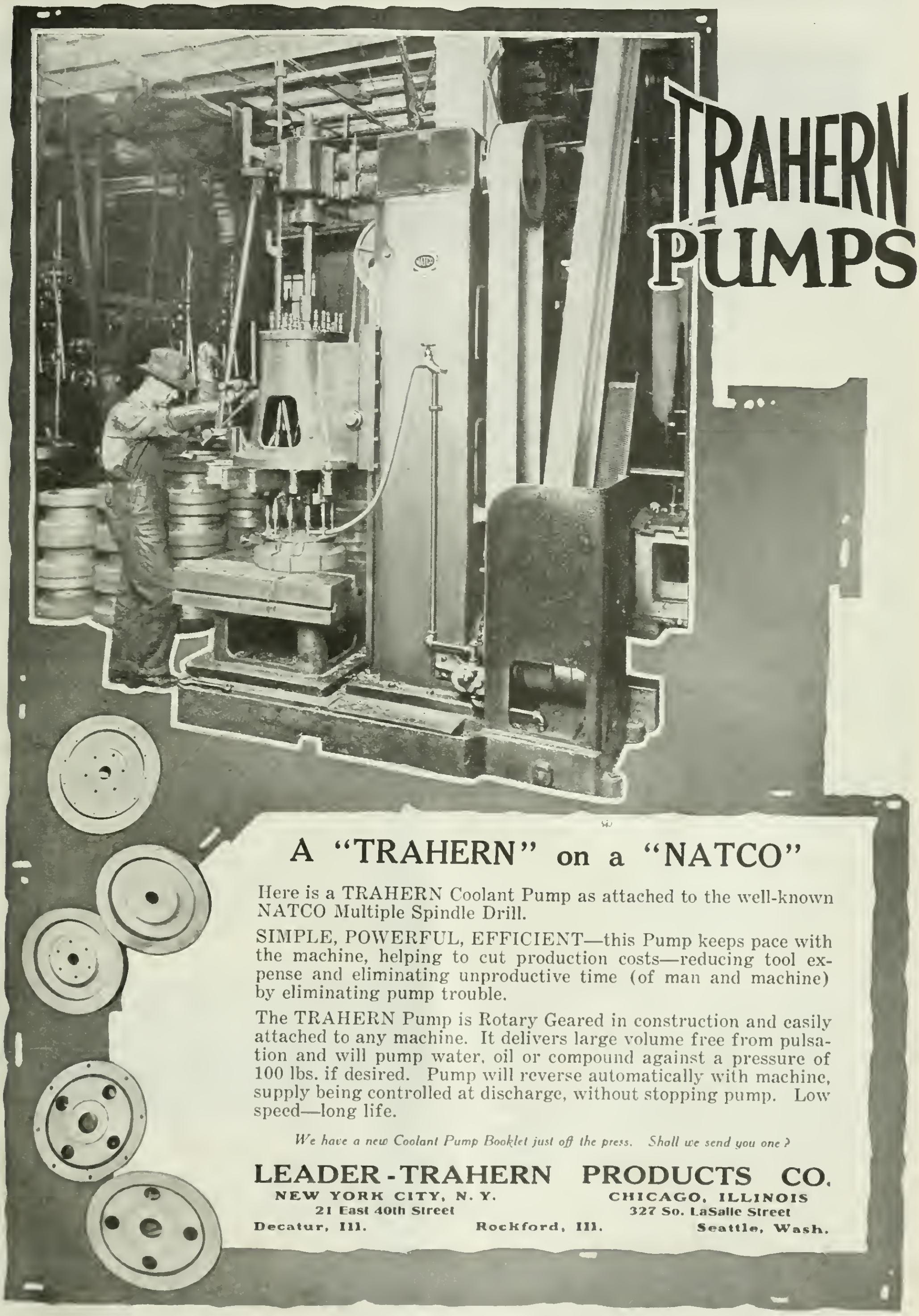
INSPECTORS

Can readily discern amount of any error in diameter, tooth form or spacing of teeth
also
concentricity of P. D. after holes are ground.

Practical Precision Tools for the Shop Man

Master Gears—any pitch or pressure angle. Tooth Contour and Indexing Testing Machines.
Concentricity and Pitch Diameter Testing Machines.
Chucks for use when grinding holes in Spur, Helical, Cluster, Internal and Bevel Gears.
Worms, Worm Wheels or Sprockets for Silent, Roller or Block Chain. Pitch and Root Diameter Control.

GARRISON MACHINE WORKS, Dayton, Ohio



A “TRAHERN” on a “NATCO”

Here is a TRAHERN Coolant Pump as attached to the well-known NATCO Multiple Spindle Drill.

SIMPLE, POWERFUL, EFFICIENT—this Pump keeps pace with the machine, helping to cut production costs—reducing tool expense and eliminating unproductive time (of man and machine) by eliminating pump trouble.

The TRAHERN Pump is Rotary Geared in construction and easily attached to any machine. It delivers large volume free from pulsation and will pump water, oil or compound against a pressure of 100 lbs. if desired. Pump will reverse automatically with machine, supply being controlled at discharge, without stopping pump. Low speed—long life.

We have a new Coolant Pump Booklet just off the press. Shall we send you one?

LEADER-TRAHERN PRODUCTS CO.

NEW YORK CITY, N. Y.
21 East 40th Street

CHICAGO, ILLINOIS
327 So. LaSalle Street

Decatur, Ill. Rockford, Ill. Seattle, Wash.

Casehardening of Guaranteed Uniformity

We've Been Heat-treating Metals for More Than 30 Years

Owing to the skill we have obtained during our long and varied experience, many shops regularly include our Casehardening Process in manufacturing metal parts. Adaptable for work ranging from steel stampings, screw machine products, small tools, to parts for automobiles, steam engines, printing presses, etc.

We use gas furnaces exclusively. This assures perfect uniformity of quality and depth, eliminates guesswork and permits a definite basis in estimating on contracts and figuring costs.

We are prepared also to do annealing, hardening, coloring, etc. Let us estimate on your requirements.

AMERICAN METAL TREATMENT COMPANY
Office Corner of Spring and Lafayette Streets
ELIZABETH, N. J.

Put $1.40 Into Your Own Pocket

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Reamers

Gear and Milling Cutters

"Tools You Buy Again"

UNION

Union Twist Drill Company
DRILL AND CUTTER MAKERS
ATHOL, MASS., U. S. A.
NEW YORK CHICAGO

Heat Treated +!

HEAT-TREATED not in the common, collective sense, but heat-treated according to size and individual form.

Not only is every "Allen" case hardened to give the hardest and deepest "case" around a tough core, but each *diameter* of screw is differently treated.

Going still further, each different style *point* is individually treated:—flat, oval, dog, cup, cone —hardened for the stresses peculiar to each.

When you do all this on top of the Allen process of *cold-drawing the sockets,* you have the supreme article in a set screw—easily 30% stronger than any other hollow set screw made.

There's only one object in making the "Allen" so good:—economy to you, the buyer. Economy in length of service, economy in fewer replacements, economy in your mechanics' time.

A booklet illustrating the Allen process, with complete price list of the screws, will be mailed you in time to make these savings on your next purchase. Write—

THE ALLEN MFG. CO.
125 Sheldon Street, Hartford, Conn.

Pacific Coast Branch Office · The Charles A. Dowd Sales Co., 320 Market Street, San Francisco, Calif.

Announcing an Addition to the Fosdick Line

THE

FOSDICK

TRADE MARK REG U.S. PAT OFF

(Formerly the PIERLE)

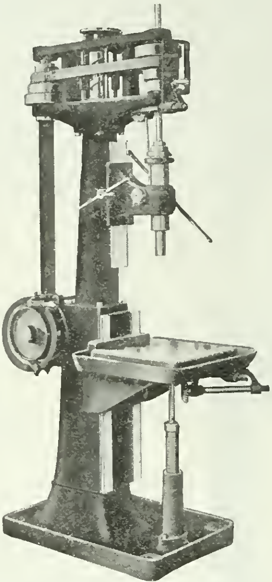
Patented

High Speed Ball Bearing Sensitive Drill

with

Spiral Gear Drive

Built in All Combinations
One to Eight Spindles
16" Swing (8" Overhang)
and
24" Swing (12" Overhang)



These well-known drills are now built in the same high standard of excellency which has made the FOSDICK Uprights and Radials famous throughout the world.

An Advanced Engineering Design

This line of HIGH-SPEED DRILLS represents developments far ahead of general practice in building machines for rapid, accurate drilling operations met in general manufacturing.

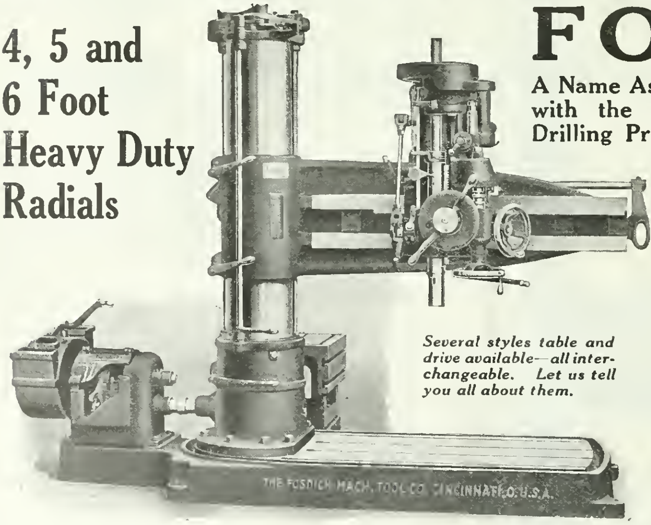
Many factors in the design contribute greatly to this result.

We are ready to submit for your careful engineering analysis, descriptive circulars, fully illustrated, and complete specifications.

Remember, our engineering department is ready to solve your drilling problems.

THE FOSDICK MACHINE TOOL CO., Cincinnati, Ohio, U. S. A.

4, 5 and 6 Foot Heavy Duty Radials



Several styles table and drive available—all interchangeable. Let us tell you all about them.

FOSDICK

A Name Associated for More than 33 Years with the Most Advanced and Efficient Drilling Practice.

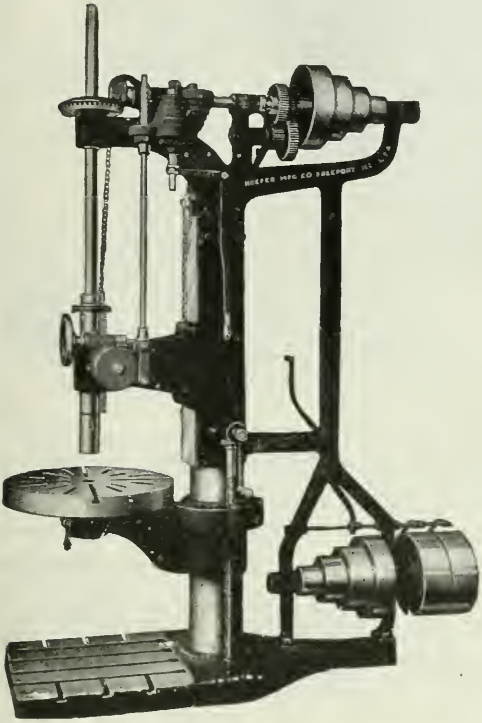
From the heavy, full ribbed base to the large annular and thrust bearings which cap its double tubular type column, quality and convenience are apparent in every feature of this heavy duty radial.

Wide range of cutting speeds with only one speed at the pulley provide for drilling up to 3" and heavy boring; ball bearings are liberally used throughout; feed and speed boxes are each controlled by a single lever and powerful tapping reverse frictions are mounted on the sleeve and run in oil.

THE FOSDICK MACHINE TOOL CO., Cincinnati, Ohio, U. S. A.

AGENTS Biggs-Watterson Co Cleveland, Ohio. Colcord-Wright Mchy. & Supply Co., St. Louis, Mo Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore. Barbour, Love & Woodward, Inc., New York City. E. A. Kinsey Co., Cincinnati Ohio. Indianapolis, Ind. Homer Strong, Rochester and Buffalo, N. Y. Peninsular Machinery Co., Detroit, Mich. H. A. Smith Machinery Co., Syracuse, N. Y. Swind Machinery Co., Philadelphia, Pa. (Somers, Fitler & Todd Co., Pittsburgh, Pa. Radials only.) (Thompson Machinery Co., Pittsburgh, Pa. Uprights only.) Stocker-Rumely-Wachs Co., Chicago, Ill., Milwaukee, Wis. Taylor Machinery Co., Boston, Mass. A. R. Williams Machinery Co., Ltd., Toronto, Ont., Canada. Burton, Griffiths & Co., Ltd., London, England. Fenwick Freres & Co., Paris, France. Wynmalen & Hausmann, Rotterdam, Holland. Rylander & Asplund, Stockholm, Sweden. Wilh. Sonneson & Co., Malmo, Sweden, Copenhagen, Denmark. Alfred Herbert, Ltd., Tokyo, Japan.

How many machines should a driller be?



Drillers have not been given the place in many machine shops that they are entitled to hold because their possibilities have not been fully realized. A driller can give a far greater and more economical service than merely that of drilling holes. Reaming, hollow milling, spot facing, tapping and counterboring operations, singly or combined, show a high degree of economy when done on drilling machines with properly designed equipment.

Hoefer Drillers are enabling hundreds of manufacturers all over the country to effect surprising savings in production costs through such combination of operations. We are prepared to study your hole-making jobs, recommend methods and equipment by which they can be done quicker or better, supply every tool, jig and fixture necessary to carry out our recommendations and then guarantee results, both as to quality and quantity of work done. An investigation involves no obligation on your part. Just drop a line to the nearest Hoefer office today.

33

Send for the Hoefer Catalog

HOEFER

FREEPORT, ILL.

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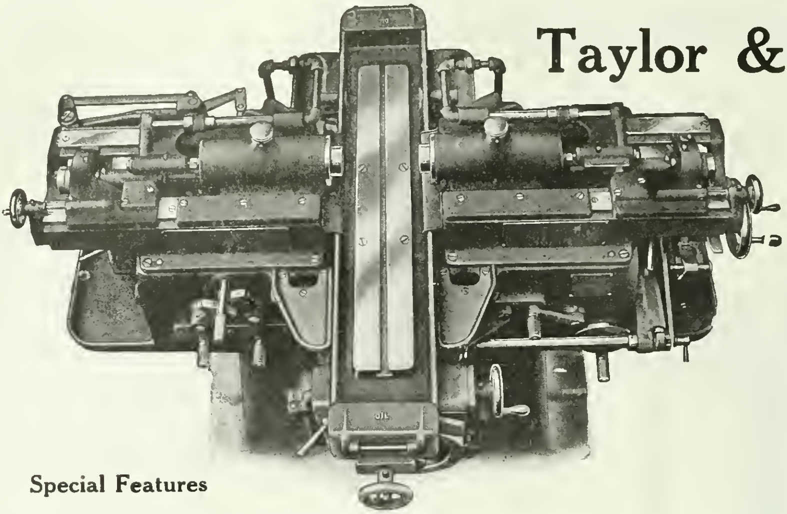
Sales Offices for Hoefer Drillers: **Boston**, Factory & Mill Supply Co., **Providence**, Brownell Machinery Co., **New York**, F. H. Niles & Co., Woolworth Bldg., **Philadelphia**, Fairbanks Morse Co., 917 Arch Street, **Baltimore**, Aumen Machinery Co., 107 E. Lombard Street, **Syracuse**, C. H. Wood Co., **Rochester and Buffalo**, Ogden R. Adams; **Pittsburgh**, Motch & Merryweather Machinery Co., **Cleveland**, Cleveland Tool & Supply Co., **Detroit**, Cadillac Tool Co., **Indianapolis**, E. A. Kinsey Co., **Chicago**, Federal Machinery Sales Co., 12 N. Jefferson St., **Milwaukee**, Badger Packard Machinery Co.; **Minneapolis**, F. E. Satterlee Co., **St. Louis**, Colcord Wright Machinery & Supply Co., **Atlanta**, Walraven Co., **Tampa, Jacksonville** and **Charleston**, Cameron & Barkley, **Spartanburg**, Montgomery & Crawford, **Mobile**, Turner Supply Co., **Birmingham**, Young & Vann Co., **New Orleans**, Oliver H. Van Horn Co.; **Seattle, Portland, Ore., San Francisco, Los Angeles**, Eccles & Smith Co.
Montreal, Canadian Fairbanks Morse Co. (head office for all Canada.



Taylor & Fenn

Spline Milling Machines

Special Features

Fixed position of spindles in heads. No overhang. Spindles run in ball bearings of large size. Cutters are held rigid (whether shank is over or undersize) in a specially designed chuck. Feed scale indicates position of cutters in work. Spindles can be quickly locked while changing cutters. Single belt drive (no countershaft required).

Motor drive is arranged by attaching motor direct to base.

The cutting fluid passes directly through the spindle to the point of the cutters, eliminating the usual adjustment of nozzles. The spindle feeds can be instantly changed from simultaneous to alternate or independent feed. Adjustment of spindles is quickly made by conveniently located hand wheels. Speeds and feeds are controlled from the front of machine.

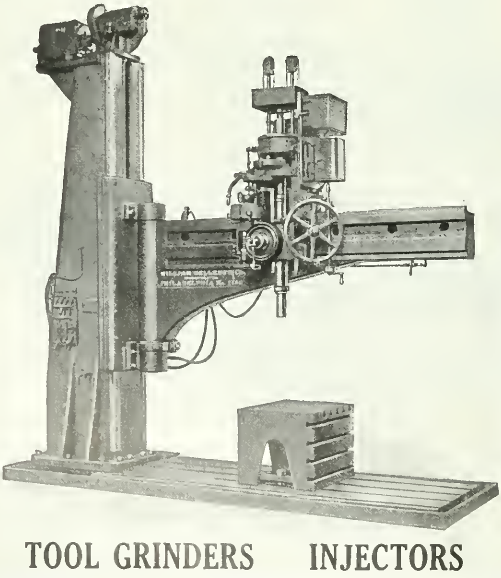
THE TAYLOR & FENN COMPANY, Hartford, Conn., U.S.A.

DOMESTIC REPRESENTATIVES: Stocker-Rumely-Wachs, Chicago, Ill. Ogden R. Adams, Rochester, N. Y. Brownell Machinery Co., Providence, R. I. FOREIGN REPRESENTATIVES: Fenwick Freres & Company, Paris, France. Burton, Griffiths & Co., London, England. R. S. Stokvis & Zonen, Rotterdam, Holland. H. P. Gregory & Company, Sydney, Australia. Rylander & Asplund, Stockholm, Sweden.

William Sellers & Co., Incorp.

PHILADELPHIA, PA.

LABOR SAVING MACHINE TOOLS

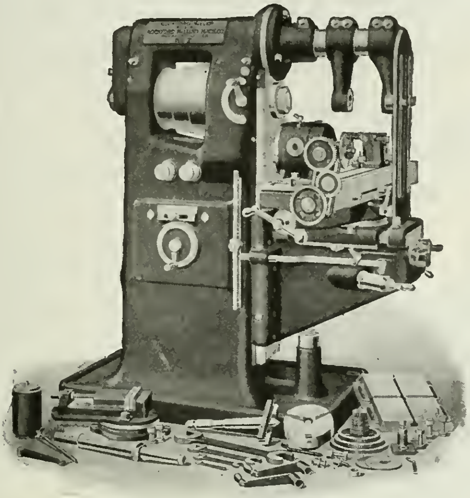


RADIAL DRILL
Direct Geared Head

Driving motor carried on back of head, counterbalancing drilling mechanism, and connected to spindle through spur gearing. Spindle 3¼″ diameter, 15″ stroke, carried close to face of radial arm, reducing twisting tendency to minimum. Spindle speeds and power feeds of wide range, also fine hand feed and quick hand adjustment. Head traversed easily on arm by large hand wheel. Saddle and arm raised and lowered by motor on top of upright. Pneumatic locking device for arm. Power pump and circulating system for lubricant. Means for controlling various movements within easy reach of operator from working position, insuring rapid manipulation.

TOOL GRINDERS INJECTORS SHAFTING DRILL GRINDERS

Rockford No. 2 Heavy Duty Milling Machines



Famous for the Solid Steel Arm, Extra Convenience and Unusual Versatility

Many of the advantages of these machines can be seen at a glance—for example, the overhanging arm, reinforced by our patented flanged support; the heavy box type knee with extended top on the column and extra long bearings; the unusual depth of the table and the location of all controls within convenient reach of the operator as he stands at his work.

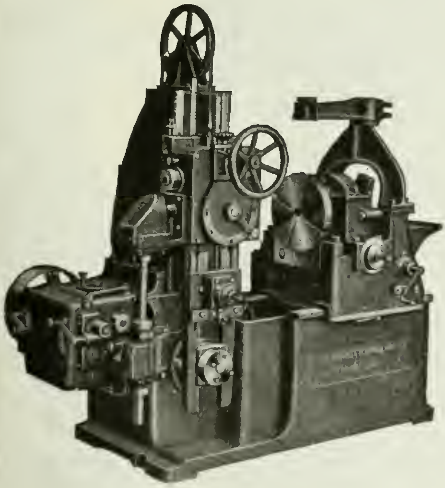
Eighteen spindle speeds are obtained through double back gears placed close together inside the column at the front of the machine; fourteen feed changes are obtained through cut steel gears without change gears. Table presents a working surface 50" by 11½"; swivels 290°; travels 28" longitudinally, 9" transversely and has 18" vertical adjustment and quick return.

Complete description on request.

ROCKFORD MILLING MACHINE CO., Rockford, Illinois

FOREIGN REPRESENTATIVES: Great Britain, A. A. Jones & Shipman, Ltd., Leicester, England. France and Belgium, Louis Besse, Paris, France. Italy and Colonies, Societa Anonima, Adler & Co., Milan, Italy. Scandinavia, Rylander & Asplund, Stockholm, Sweden. Spain and Portugal, Casamitjana Hermanos, Barcelona, Spain. Australia, Selson Engineering Co., Melbourne, Australia. Russia, M. Mett Engineering Co., Petrograd, Russia.

Where do you get your Cams—Make them or buy them?



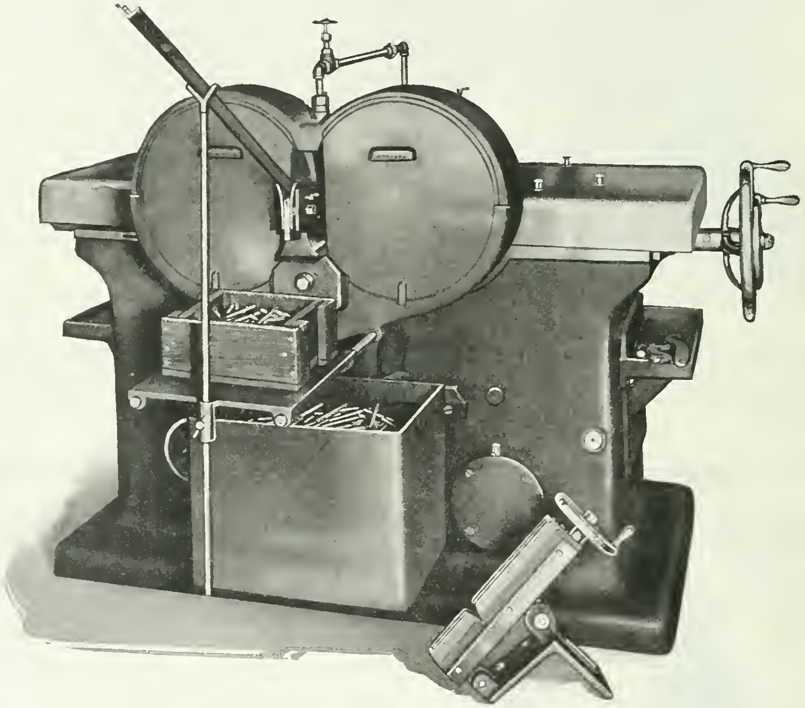
You can get Rowbottom Cams either way. A Rowbottom Cam Milling Machine installed in your plant is one of the most satisfactory, least expensive ways to produce them in quantity. If your needs do not justify the installation of a special machine, get in touch with our contract department. You will find us able to give good deliveries on accurate cams of all classes at fair prices.

Either way we guarantee your satisfaction with Rowbottom Machines and Service. Try them.

THE ROWBOTTOM MACHINE CO.
Factory, Waterville, Conn.
WATERBURY CONNECTICUT

Rowbottom for Cams

HEIM
Centerless Cylindrical GRINDER



A Demonstrative Test

Are you grinding such parts as rolls for roller bearings, wrist pins, cam shafts, valve lifters, pistons, etc.? If so, we've an interesting proposition to make to you. Send us your blue prints or parts, and we'll send you a *guaranteed production estimate* and grind such parts free of charge. The results accomplished will more than surprise you. The Heim Centerless Cylindrical Grinder is unexcelled for handling parts with but one diameter to be ground.

Write for Bulletin 110 and learn all about it.

The Ball & Roller Bearing Company
DANBURY CONN., U. S. A.

Waltham Grinding Wheels

Better the Time Allowance by more than a Minute on this Work

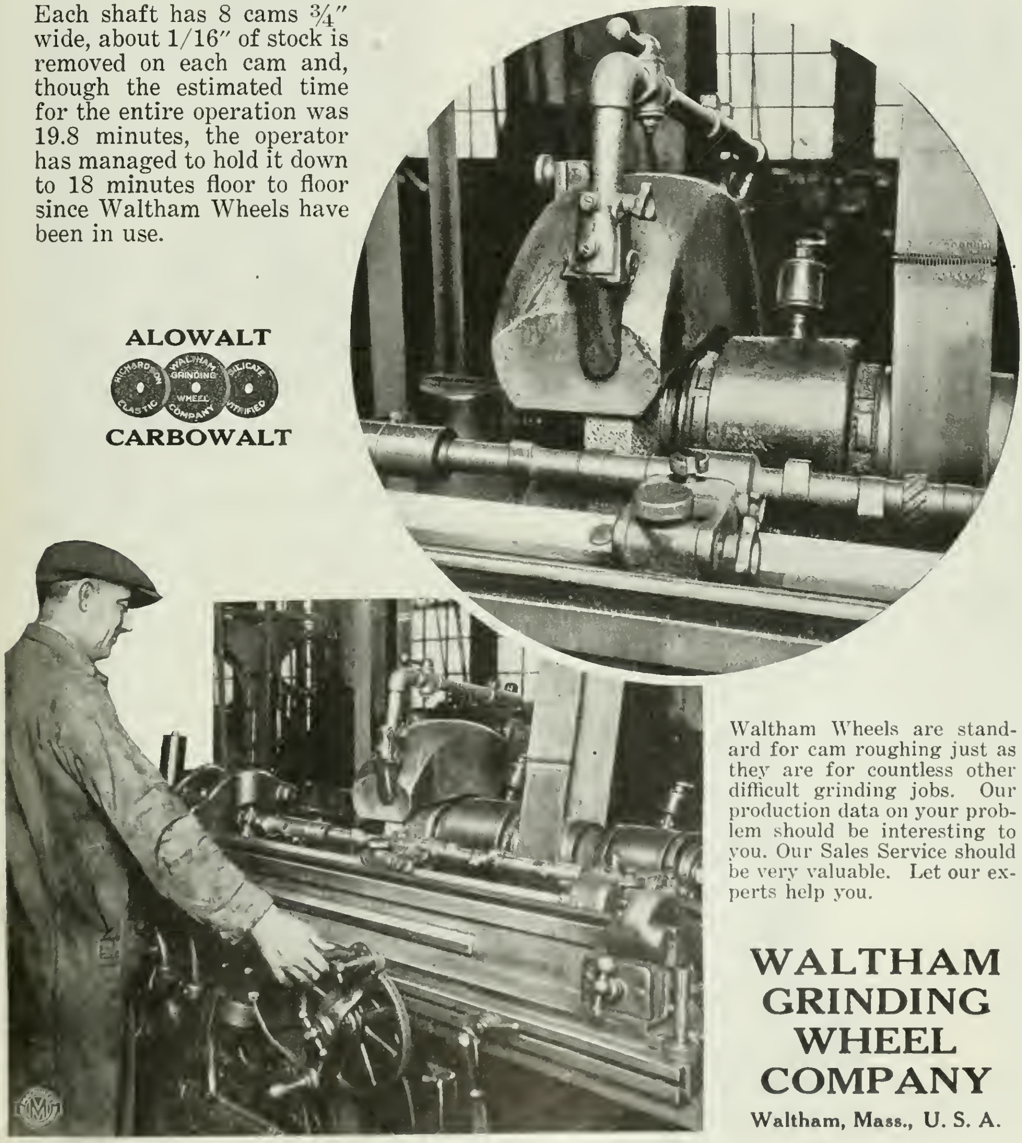
Waltham 36-R Alowalt Grinding Wheels, size 18″ x 2″ x 5″ have been used for more than two years for *rough* grinding cams on forged nickel steel camshafts at the Plainfield, N. J., plant of the International Motor Company.

Each shaft has 8 cams ¾″ wide, about 1/16″ of stock is removed on each cam and, though the estimated time for the entire operation was 19.8 minutes, the operator has managed to hold it down to 18 minutes floor to floor since Waltham Wheels have been in use.

ALOWALT

RICHARDSON ELASTIC · WALTHAM GRINDING WHEEL COMPANY · SILICATE VITRIFIED

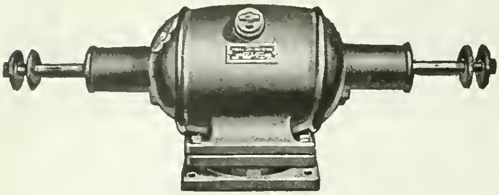
CARBOWALT



Waltham Wheels are standard for cam roughing just as they are for countless other difficult grinding jobs. Our production data on your problem should be interesting to you. Our Sales Service should be very valuable. Let our experts help you.

**WALTHAM
GRINDING
WHEEL
COMPANY**

Waltham, Mass., U. S. A.



Medium Duty Buffer
Bench Type

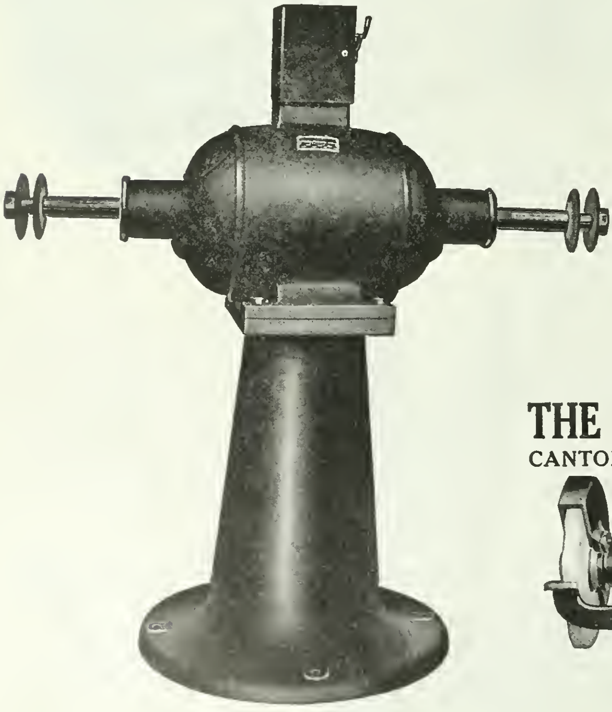
DILLON

ELECTRIC GRINDERS and BUFFERS

Self Contained, Ball Bearing, Dust Proof, Noiseless

Made for Either Direct or Alternating Current

Medium Duty Grinder



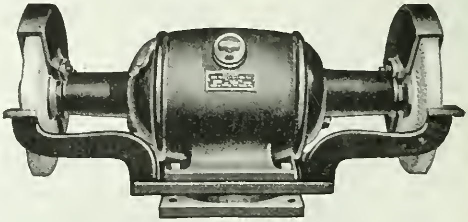
Heavy Duty Buffer

Simple in design—no excess parts. Medium Duty Machines made in ½, 1 and 2 H. P. capacities.

Heavy Duty Machines made in 3, 5 and 7½ H. P. capacities.

Write for descriptive Booklets

THE DILLON ELECTRIC CO.
CANTON OHIO, U. S. A.



Medium Duty Grinder
Bench Type

ALOXITE—
The Wheel for Malleables

A busy battery of Aloxite Wheels in a big Buffalo foundry grinds thousands of small automobile malleable parts in a day. The wheels they use are Aloxite 20x3x2¾ 10 grit G grade—clean, fast, free cutting, wheels that make such production possible, that lessen grinding costs and satisfy the men who run them.

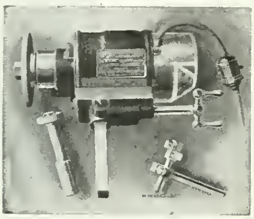
We would welcome the opportunity of putting the right wheel in the right place in your plant

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.
New York Chicago Boston Cleveland Detroit Philadelphia
Pittsburgh Cincinnati Milwaukee Grand Rapids

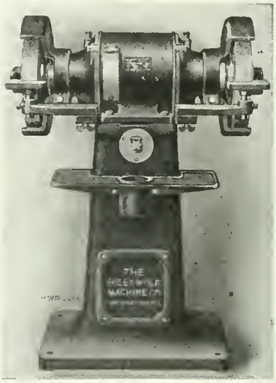
Carborundum Products are:
Carborundum and Aloxite Grains and Powders, Grinding Wheels, Sharpening Stones, Paper and Cloth, Garnet Paper and Cloth and Carborundum Refractories

HISEY ELECTRIC TOOLS

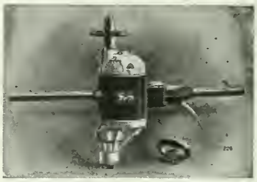
For all requirements from the lightest to the heaviest where dependability is essential



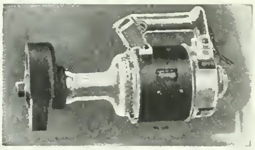
Lathe Center Grinder
Made in ¼ H.P. and ½ H.P. sizes



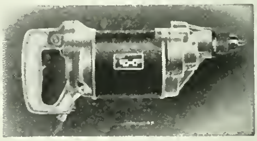
Ball Bearing Floor Grinder
Made in the following sizes:
½ H.P. with 8x¾ inch grinding wheels
1 H.P. with 10x1 inch grinding wheels
2 H.P. with 12x½ inch grinding wheels
3 H.P. with 14x2 inch grinding wheels



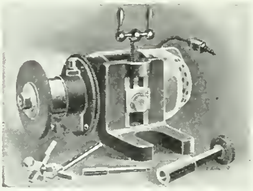
Heavy Duty Drill and Reamer
Made in seven styles and sizes up to 1¾ inch drilling capacity.



Portable Hand Grinder
Made in 4 sizes, ¼ H.P. to 1 H.P.

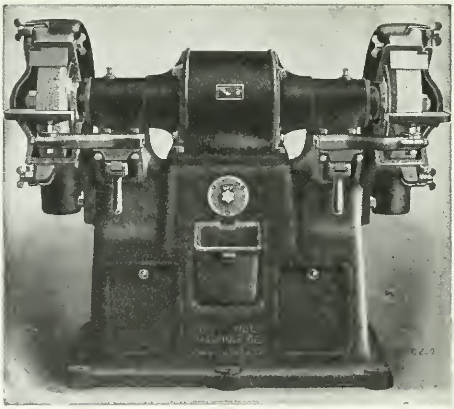


Electric Hand Drill
Made in 3 sizes, 3/16, ¼ and 5/16 inch capacities.

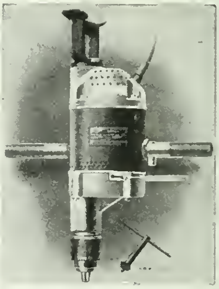


Angle Plate Roll and Surface Grinder
Made in 5 sizes, ¼ H. P. to 3 H.P.

Bulletin 1304-M
Free for the asking



Ball Bearing Floor Grinder
Made in 5 H.P. and 10 H.P. sizes.
5 H.P. recommended for 18x3 inch wheels
10 H.P. recommended for 24x4 inch wheels



Hand and Breast Drill
Made in single and two speed designs in ⅜, ½ and ¾ inch capacities.

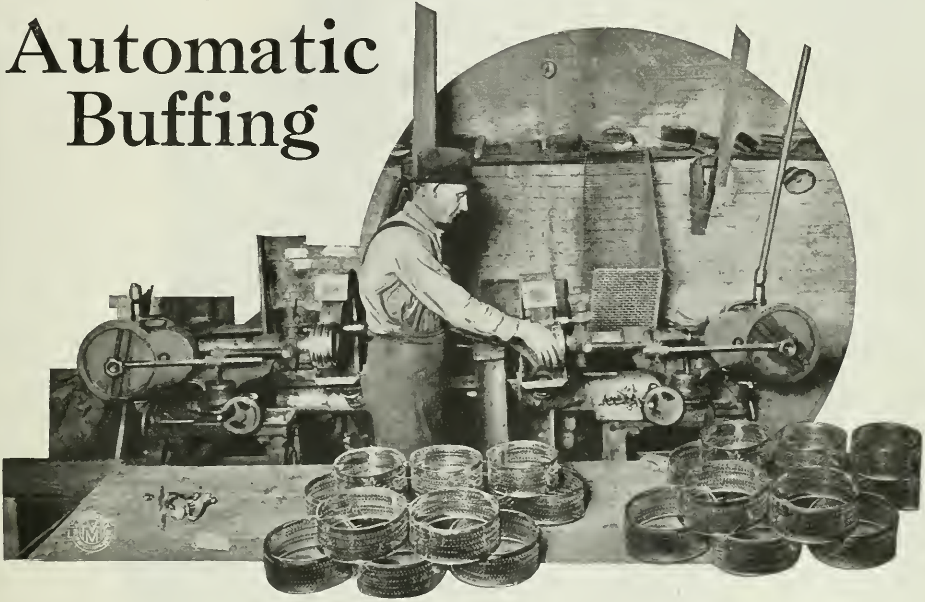
HISEY Products are systematically designed for BALL BEARINGS, which are used where applicable

THE HISEY-WOLF MACHINE COMPANY

CINCINNATI *Agents in principal cities* OHIO, U. S. A.

Fine Finish—A Necessity for Successful Plating—is Easily Obtained by

Automatic Buffing



One operator running this pair of Automatic Buffing Machines polishes an average of 120 brass casserole holders per hour; more than twice the number formerly finished by two operators on two hand polishing machines. The finish is excellent, the high polish—necessary to good plating—is uniform and easily obtained.

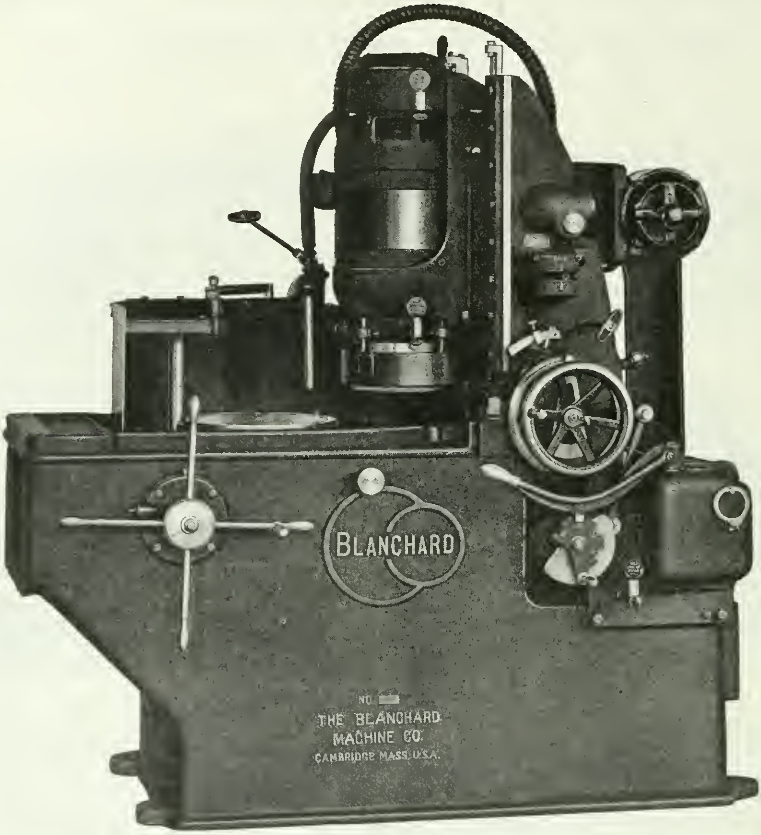
Automatic Buffing Machines give equally satisfactory results on aluminum, brass, copper, steel and zinc and handle a wide range of shapes, both light and heavy work.

A countershaft connected by an extensible shaft insures a positive drive and permits the adjustment of the buffiing machine head to any desired angle to the spindle of the buff lathe. The work can be held against the wheel at any desired pressure and revolved at the correct speed. By means of the stroke which gives the spindle a reciprocating motion of any distance from zero to nine inches, straight or tapered pieces the length of the stroke plus the width of the wheel can be buffed at one operation.

The possibilities are great, the costs low. It will pay you to investigate the possibilities of Automatic Buffing. Write for our catalog.

THE AUTOMATIC BUFFING MACHINE CO.
BUFFALO, NEW YORK

FOR YOUR TOOL-ROOM



The Blanchard No. 10 Vertical Surface Grinder

Will not only grind very rapidly the small hardened pieces done on your present tool-room grinder but will machine jig parts, die blocks, bolster plates, surface plates, angle irons and parallels—whether of cast iron or steel—in a fraction of the time required on a shaper or planer. The machine will regrind the concave surface of saws, or finish the sides of a milling cutter; on rough castings or forgings the time is often less than the setting-up time on a shaper—the powerful steel magnetic chuck eliminates the selection and arrangement of bolts for clamping or blocking.

"A BETTER PRODUCT FOR LESS MONEY"

INVESTIGATE TODAY

The Blanchard Machine Company
64 State Street, Cambridge, Mass.

UNITED STATES: Henry Prentiss & Co. Inc., Motch & Merryweather Co., Marshall & Huschart Machinery Co., W. E. Shipley Machinery Co., Kemp Machinery Co., Robinson, Cary & Sands Co., Pacific Tool & Supply Co., The Hendrie & Bolthoff Manufacturing & Supply Company. CANADA: Williams & Wilson, Ltd., F. F. Barber Machinery Co. GREAT BRITAIN: C. W. Burton, Griffiths & Co. FRANCE: Aux Forges de Vulcain. ITALY, SWITZERLAND, BELGIUM, SPAIN and PORTUGAL: Allied Machinery Co. of America. SWEDEN: A. B. Rylander & Asplund.

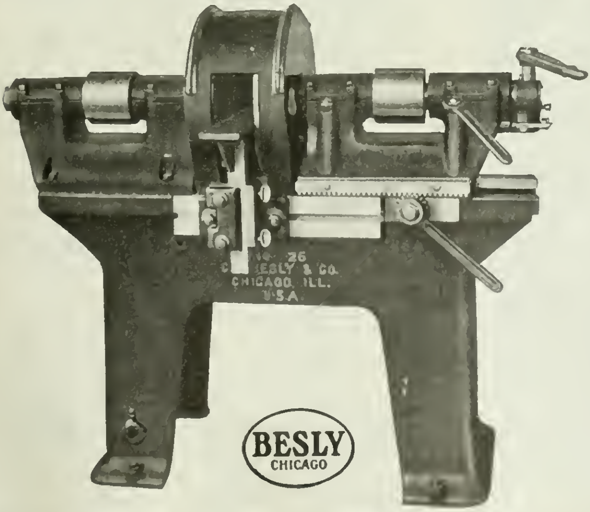
BLANCHARD
Trade Mark, Reg.
U. S. Pat. Office

"Besly" vs. Hand Grinding

For years the sides of hex nuts for O'Malley-Beare Valves were painstakingly finished by hand grinding and if the operator was fairly dexterous he attained an output of 30 to 40 nuts per hour, according to size. For the past two or three years, however, these nuts have been handled six at a time between the wheels of this Besly Double Spindle Grinder and production has jumped from 30 to 300 per hour on nuts for 3/4″ valves such as are here shown. It is accomplished this way: six nuts are placed on a rod and located in a simple fixture so that one feeding stroke finishes two sides of the six and two more strokes, turning the nuts in between, complete the whole 36 sides. An excellent finish is obtained as the O'Malley-Beare Valve Co. is ready to testify.

Besly Grinder No. 26

So many metal parts need to be finish-ground on opposite parallel sides that Besly Double Spindle Grinders are almost as widely used in up-to-date manufacturing as Besly Disc Grinders. Both are fully described in our catalog. Estimates also on request.



BESLY
CHICAGO

Before we built Besly Grinders Ring Oiling we built them grease lubricated. One prominent manufacturer who has both kinds reports that the Grease lubricated machines cost $80 per year for upkeep and the Ring Oiling machines only $5.00.

Let us describe them.

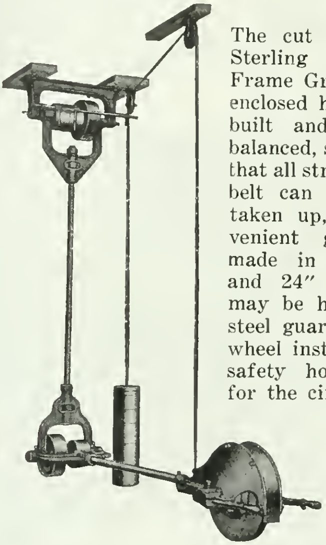
CHARLES H. BESLY
& COMPANY

Originators of Disc Grinders

120 B No. Clinton Street
Chicago, Ill., U. S. A.

STERLING
GRINDING WHEELS and MACHINES

The cut shows the Sterling Swing Frame Grinder with enclosed hood. Well built and carefully balanced, so designed that all stretch on the belt can be readily taken up, this convenient grinder is made in 16″, 20″, and 24″ sizes and may be had with a steel guard over the wheel instead of the safety hood. Send for the circular.



Sterling Grinding Wheels are made of the most effective artificial abrasives carefully combined and correctly bonded by the Vitrified, Silicate and Elastic processes. All the standard grades and grains, styles and sizes carried in stock. Send for the Catalog.

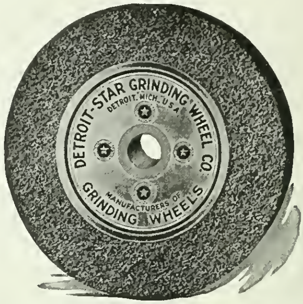
The Sterling Grinding Wheel Co.

Factories and Offices: TIFFIN, OHIO

Distributors: L BEST COMPANY, 28-30 W. Broadway, New York
Chicago Store: 30 North Clinton St.

D-S Grinding Wheel Service is the Real Thing

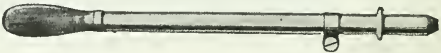
We've been manufacturing grinding wheels for upward of 50 years and know all the ins and outs of the business. We can tell you from working tests and production records which classes of abrasives will best meet your various grinding needs; and have made careful study and record also of production costs of various grinding operations so as to supply our customers with wheels of established efficiency and economy


DETROIT-STAR GRINDING WHEEL CO.
DETROIT, MICH. U.S.A.
MANUFACTURERS OF GRINDING WHEELS

Catalog lists the full line.

Detroit-Star Grinding Wheel Company
DETROIT Established 1872 **MICH., U. S. A.**

DIAMO-CARBO
The Modern Emery Wheel Dresser



Replaces the diamond for most purposes; useful on all but the hardest, coarsest wheels. We also make the Huntington (in 3 sizes), the Sherman, magazine and special dressers for special purposes, and carry a large assortment of carefully selected diamonds.

Get our Catalog

The Desmond-Stephan Mfg. Co.
URBANA, OHIO, U. S. A.
The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ontario
Alfred Herbert, Ltd., Agents for Great Britain

Emery Wheel Dressers
Two Sizes **Nos. 1-2**
CUTTERS
We make the regular Huntington (Pattern) for all sizes.
Roughing for Nos. 1 and 2. Paragon for No. 1 only.

GEO. H. CALDER Lancaster, Pa., U. S. A.

Grinding and Polishing Machinery
Diamond Machine Co.
Providence, R.I., U.S.A.

"ABRASIVE"

Borolon TRADE MARK — TRADE ABRASIVE MARK REGISTERED — **Electrolon** TRADE MARK

GRINDING WHEELS

Specify Borolon when wheels are required for grinding materials of high tensile strength such as steel, annealed malleable iron, etc. Electrolon is best suited for low tensile materials such as cast iron, unannealed malleable iron, brass, bronze, aluminum, etc. Both Borolon and Electrolon Grinding Wheels are manufactured by the following processes:

VITRIFIED SILICATE ELASTIC RUBBER

Use Borolon (TRADE MARK) Grain For Your Polishing Requirements

ABRASIVE COMPANY

BRIDESBURG, PHILADELPHIA, PA., U. S. A.

Chicago Branch: 566 West Washington Boulevard

Fully Equipped!

Thompson Universal Grinding Machines provide for emergencies. Easily changed for handling internal, external or surface grinding operations in turn, they are ideal tool-room grinders. Accurate construction and many operating conveniences make them equally profitable as straight manufacturing equipment.

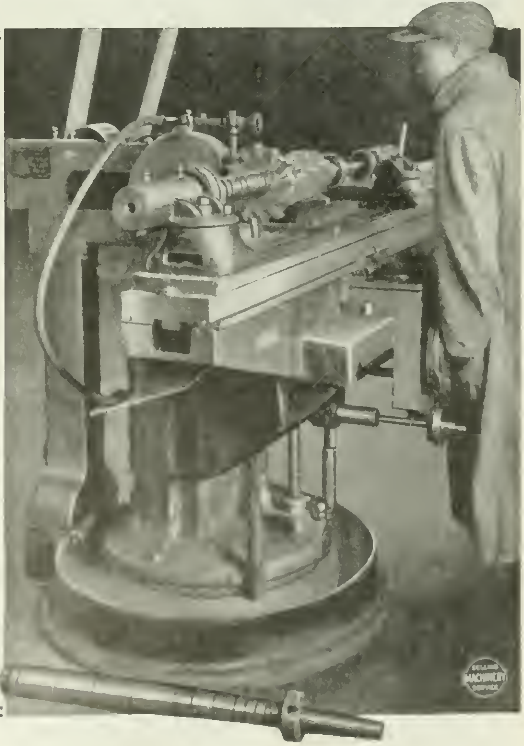
The cut shows a cutter grinding operation in the tool-room of a large machine tool building plant.

Bulletin 13 Gives the Details.

The Thompson Grinder Co.

SPRINGFIELD, OHIO, U. S. A.

DOMESTIC Motch & Merryweather Mchy Co., Cleveland, Ohio. Manning, Maxwell & Moore, Inc., New York, Philadelphia, Pittsburgh, Buffalo, Cincinnati, St Louis, Seattle. Hill Clarke & Co Boston Mass. Kemp Machinery Co., Baltimore, Md. Riverside Machinery Depot, Detroit, Mich. Coghlin Kirkby Machinery & Supply Co. Toledo, Ohio. Wayne Machinery Co., Fort Wayne, Ind. Dayton Ohio. Hill, Clarke & Co., Chicago, Ill. F. E. Satterlee Co., Minneapolis, Minn. F. G. Stallman Supply Co., San Francisco, Los Angeles, Cal. FOREIGN Bevan & Edward Pty Ltd Melbourne, Sydney. Selson Engineering Co. London, Belgium, France, Italy

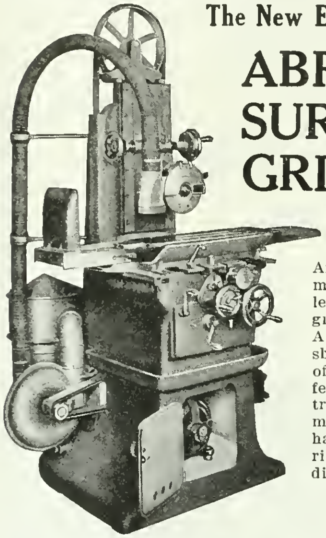


FRASER GRINDERS

Six Standard machines—Plain Grinders, High-powered Universal Grinders, High-powered Self-contained Universal Grinders, Universal Convertible Grinding Machines, Semi-automatic and Automatic Grinding Machines—Special Machines developed to meet your particular grinding needs.

Send for circulars.

WARREN F. FRASER CO.
WESTBORO MASS., U. S. A.



The New Exhaust Unit for

ABRASIVE SURFACE GRINDERS

An efficient attachment that takes up at least 90% of the grinding dust. The Abrasive Grinder shown has a capacity of 22" longitudinal feed, automatic; 8" transverse feed, automatic; 12" vertical hand adjustment; carries wheels to 8" diameter by ¾" thick.

Get the Details of Abrasive Grinders and Attachments.

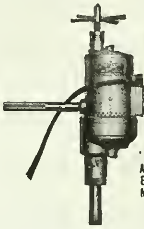
ABRASIVE MACHINE TOOL CO., E. Providence, R. I.

F. N. MacLEOD, President and General Manager

FOREIGN AGENCIES: Andersen, Meyer & Co., Ltd., of China, Shanghai, China; Aux Forges de Vulcain, Paris, France; Burton, Griffiths & Co., London, England; Ateliers Demoor, Brussels, Belgium; Casamitjana Hermanos, Barcelona, Spain; J. Lambercier & Company, Geneva and Zurich, Switzerland; Parke & Lacy Co., Ltd., Sydney, New South Wales; Selson Engineering Company, Milan, Italy; Wilh. Sonesson & Company, Malmo, Sweden; A. R. Williams Machinery Company, Toronto, Canada.

"WILLEY" PORTABLE ELECTRIC TOOLS

Convenient and Durable



Patented

"WILLEY" TOOLS All-Ways Correct Electrically—Mechanically

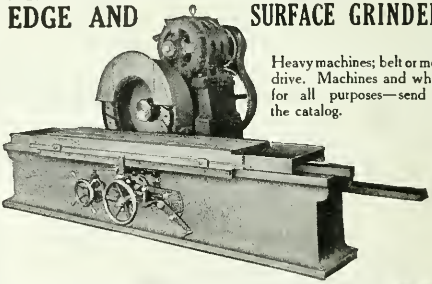
Drills, grinders, buffers; carefully constructed and thoroughly dependable; a shop necessity in every class of work; operate on any current.

Send for Catalog 28, it lists the entire line.

Jacobs Chucks used on all drills as regulor equipment.

JAMES CLARK, Jr. ELECTRIC CO., Inc.
522 West Main Street Louisville, Ky.

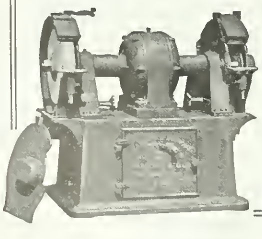
BRIDGEPORT SECTIONAL WHEEL EDGE AND SURFACE GRINDERS



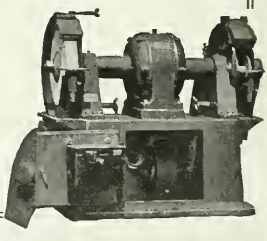
Heavy machines; belt or motor drive. Machines and wheels for all purposes—send for the catalog.

The Bridgeport Safety Emery Wheel Co., Inc. 83 Knowlton St. Bridgeport, Conn.

MARSCHKE FOUR-BEARING, HEAVY DUTY GRINDERS



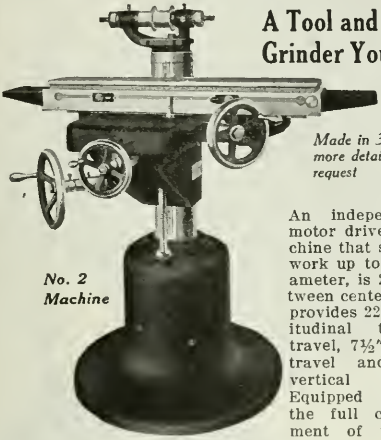
Fully self contained machines, well constructed throughout, with exclusive advantages that make them economical both to use and maintain. Wheel housings automatically adjust gap between hood and wheel as wheel wears down; all starting devices are mounted inside base, on door; motor is entirely enclosed, has large SKF bearings and removable stator. Outboard bearings have ⅞" ball bearings. All removable parts are built without shims and large dowels are used throughout. Let us tell you all about these machines.



MARSCHKE MANUFACTURING CO., Indianapolis, Ind., U. S. A.

WOODS "UNIVERSAL"

A Tool and Cutter Grinder You Need



No. 2 Machine

Made in 3 sizes; more details on request

An independent, motor driven machine that swings work up to 9" diameter, is 22" between centers and provides 22" longitudinal table travel, 7½" cross travel and 10" vertical travel. Equipped with the full complement of wheels and attachments necessary for general tool-room use. The box type knee entirely surrounds the column; the base has a large floor bearing and the table is supported for the full extent of its travel. Head swivels 180°, table swivels on pivot and is graduated at the end to 1/16" taper per foot.

WOODS ENGINEERING CO.

Alliance, Ohio, U. S. A.

BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT

Builders of

Hole Grinders
Hole and Face Grinders
Deep Hole Grinders

BRYANT
Reg. U. S. Pat. Off.

Grind Your Welds With

THE STOW PORTABLE GRINDER

No welding job is finished unless properly ground. The Stow is handy to use. and not fatiguing. Any speed—instantly. Write.

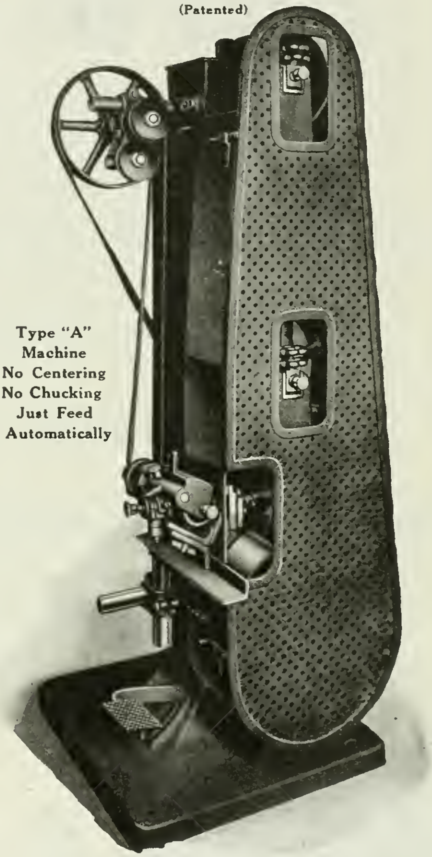
Stow Manufacturing Co., Inc.
Binghamton N. Y.
Oldest Portable Tool Manufacturers in America
London Stock:
85 Queen Victoria St.

"PRODUCTION"

POLISHING AND FINISHING

MACHINES

(Patented)



Type "A" Machine
No Centering
No Chucking
Just Feed
Automatically

A Really Worth While Saving

Production Polishing and Finishing Machines are extremely inexpensive to purchase and to run. Unskilled labor soon learns the few simple movements required to operate them. In the machine shown there is no centering or chucking; it has automatic feed, and polishes cylindrical pieces of various lengths and any diameters up to 4". Gives a fine mechanical finish on metal, fibre, rubber and other materials. The "Production" Type "A" Centerless Polishing and Finishing Machine may be the solution of your problems. Let us send you details.

PRODUCTION MACHINE CO.
Greenfield Massachusetts, U. S. A.

ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST NEW YORK U S A

CADILLAC TOOL CO., Dodge Power Bldg., Detroit
FEDERAL MACHINERY SALES CO., Chicago, Milwaukee

VITRIFIED

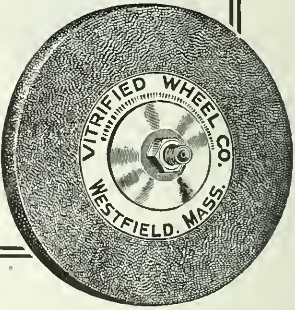
Grinding Wheel Service

Vitrified Service means first of all that experts select the materials from which Vitrified Wheels are made, supervise the manufacturing processes and then apply their knowledge of the wheels toward helping you select the ones most suited to your work. This policy of service is followed further by a return privilege that permits you to try out the wheel we send and—if it is not entirely satisfactory—to return it for another until one is found to absolutely fit your need.

After this, preserve the tag that is on each wheel and reorder by the numbers on it, you will be sure of the right wheel for *that* job as often as you need it.

Send for the Catalog of Vitrified Grinding Wheels of standard shapes, sizes and quality.

VITRIFIED WHEEL COMPANY
Westfield Mass.



Consider What You Get in a

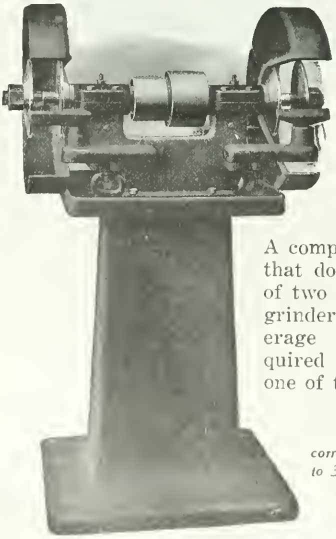
BLOUNT No. 5
TWO-WHEEL GRINDER

Simple
Rigid
Accurate
and
Profitable

A compact machine that does the work of two single wheel grinders on the average power required to operate one of them.

Seven sizes to carry wheels from 8" to 30". Your dealer has "Blount" Catalogs.

J. G. BLOUNT COMPANY, EVERETT MASS.



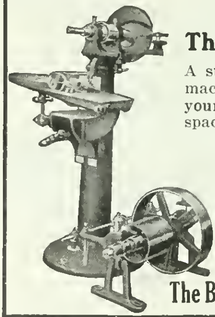
Back To Old Time Prices

$95.00 AGAIN BUYS
The Waterbury Grinder

A strong, rigid, simply constructed machine; just what you want for your tool-room. Has 9" x 18" work space, high carbon steel spindle, and is built with close accuracy.

The Waterbury has everything you want; nothing you don't want. Every dollar you spend for it counts. Write for particulars.

The Blake & Johnson Co. Waterbury, Conn., U.S.A.

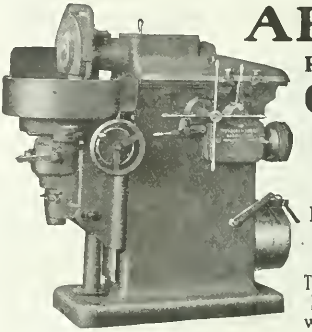


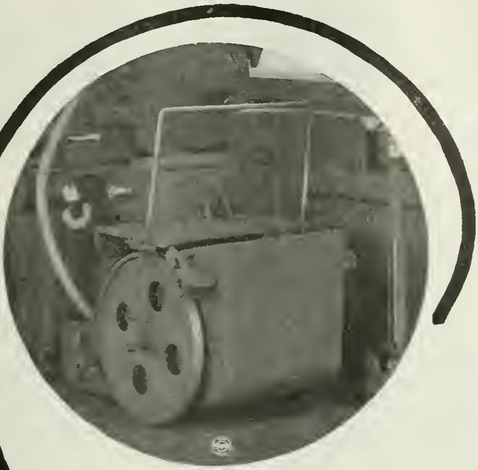
ARTER
Rotary Surface
GRINDER

3 sizes
Regular Models
8"—12"—16"

Piston Ring Grinders

THE PERSONS-ARTER
MACHINE COMPANY
WORCESTER, MASS.



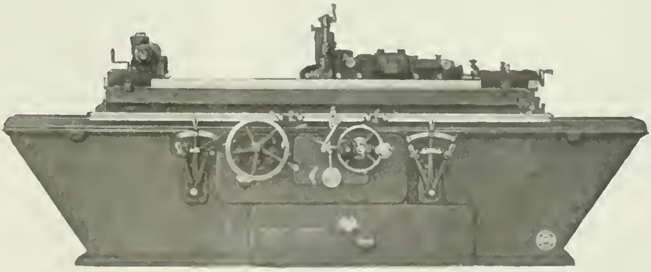


Facts about the Norton "B" Type Grinding Machine

PORTABLE SETTLING TANK

The tank actually is a dump cart mounted on ball bearing wheels. No time is lost in cleaning the tank—a fresh one is merely rolled into place.

TRADE NORTON MARK



NORTON COMPANY
WORCESTER, MASS.

NEW YORK: 151 Chambers St.
CLEVELAND: 412 Engineers' Bldg.
HARTFORD: 49 Pearl St.
DETROIT: 233 W. Congress St
PITTSBURGH: 608 Empire Bldg
INDIANAPOLIS: 304 Pennway Bldg
CHICAGO: 11 No. Jefferson St
PHILADELPHIA: 324 Bulletin Bldg.
SYRACUSE: 206 Keith Theatre Bldg

B 2-3

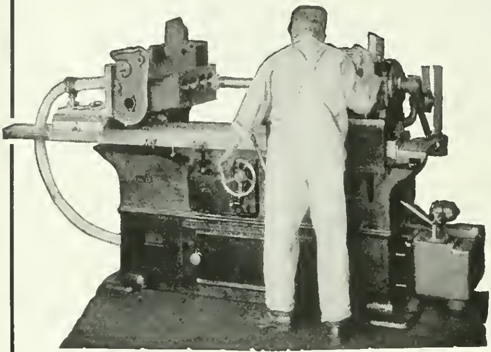
Whitney Cylinder Grinder

For grinding all kinds of gasoline engine cylinders as well as castings too large or too heavy to revolve.

Machines furnished to grind holes from 3″ up to 7″ diameter and 14″ deep.

Also equipped to grind holes as large as 14″ diameter and 20″ deep.

Write for new catalog



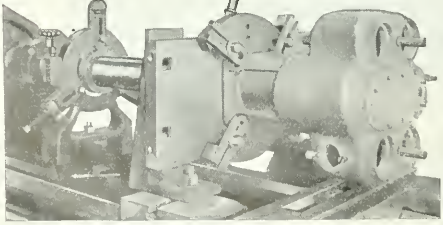
BAXTER D. WHITNEY & SON, Inc.
WINCHENDON, MASS., U. S. A.

All Kinds of Cylinders Can be Bored and Reground with this Device

No repair shop is complete without this combination boring bar and cylinder grinder—especially where there's much motor and engine work to be handled. It pays for itself on the first few jobs handled.

Readily attached to any engine lathe with 14″ or greater swing, self centering, adaptable and easily operated the Perfection Cylinder Grinder has a wider capacity than any similar device on the market and is guaranteed to rough bore and finish grind any cylinder within its range within .0005″ limits.

Let us describe it.
Oversize Piston Service.



Wood & Safford Machine Works
1226 12th Avenue N. Great Falls, Montana

DIAMOND BRAND WHEELS

A Few Words About Special Service

So exacting are the grinding requirements of some manufacturers that even the fine divisions of the "Diamond Brand" will not quite fill the needs. In such cases "Diamond Specials", fabricated to exactly meet specific conditions, can be depended upon. Write for booklet.

GENERAL GRINDING WHEEL CORPORATION, Philadelphia, U.S.A.

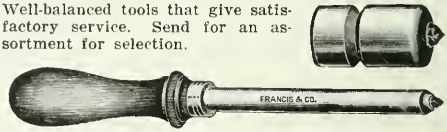
ALUMINOID
FOR STEEL

CARBONOID
FOR CAST IRON

Quality Diamonds Correctly Set

Francis Diamond Hand and Grinder Tools

Well-balanced tools that give satisfactory service. Send for an assortment for selection.



FRANCIS & COMPANY
Established 1799
50 State St. First National Bank Bldg. Hartford, Conn., U. S. A.

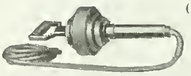
BADGER TOOL COMPANY

Grinding Machinery
Supplies and Accessories

E. B. GARDNER, President R. D. GARDNER, Treasurer
BELOIT, WISCONSIN, U. S. A.

HAND SNAGGING GRINDER

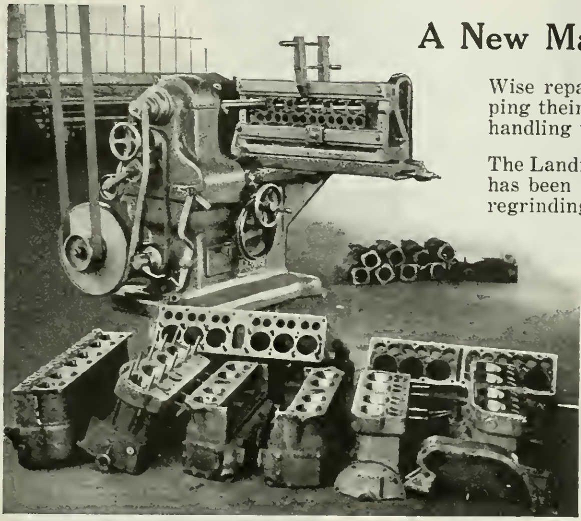
(Electric)



Light Weight,	20 pounds
Large Wheel,	7″ x 2″
High Power,	¾ H. P. Max.

FORBES & MYERS, 178 Union St., Worcester, Mass.

LANDIS No. 5 Cylinder Grinding Machine



A New Machine for your Shop

Wise repairmen and garage men are equipping their shops with the very best tools for handling the on-rush of repair work.

The Landis No. 5 Cylinder Grinding Machine has been recently put on the market for the regrinding of cylinders, single or en bloc.

It is backed by the Landis reputation for simplicity of design and manipulation and garages in which this machine has been installed, report exceptionally high production.

Write for further information; let us also send you circulars on our No. 4-A Special machine for regrinding crankshafts.

LANDIS TOOL COMPANY, Waynesboro, Pa.
NEW YORK OFFICE: 51 CHAMBERS STREET

GRAND RAPIDS

Drill Grinders
Tap Grinders
Universal Grinders

The Grand Rapids Line covers practically all Drill, Tap and Universal Grinding requirements. Easily operated, accurate and economical, Grand Rapids Grinders are designed with the view of maximum accomplishment, and are standard equipment in many representative plants.

Write for the catalog

GRAND RAPIDS GRINDING MACHINE COMPANY
29 OTTAWA AVENUE
GRAND RAPIDS MICH., U. S. A.

Gardner Disc Grinders

There's nothing like "Gardnergrinding" for your flat surface work

GARDNER MACHINE COMPANY
414 Gardner St., Beloit, Wis., U. S. A.

DIVINE BROS. CO.

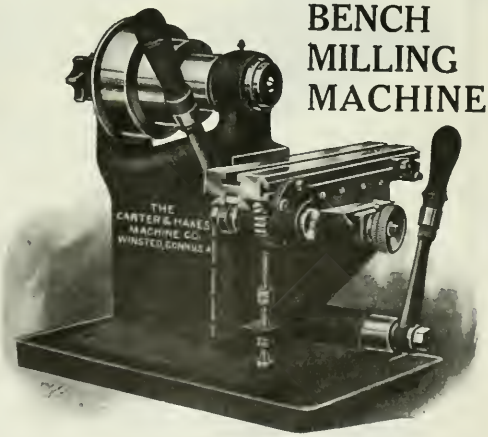
UTICA N. Y., U. S. A.

POLISHING AND FINISHING ENGINEERS

Avail yourself of our Expert Service and bring your methods up-to-date

---

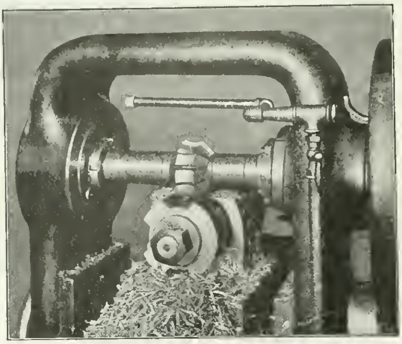
BENCH MILLING MACHINE



For Small Work in Large Quantities

This machine is built with the same care as our larger millers; it is accurate and right in every particular; highly profitable on a wide variety of small work. Can be had with floor column if desired. Ask for complete description.

THE CARTER & HAKES COMPANY
Sterling Place WINSTED, CONN.



Briggs Millers for Speed and Power

The work shown is a special punch, 4¾" O.D., in which four slots are milled—each 2" wide and ½" deep. Time to complete the four, including indexing, was exactly 10 minutes. A typical example of Briggs Milling. Details?

Gooley & Edlund, Inc., Cortland, N.Y., U.S.A.

OVER-SEAS REPRESENTATIVE

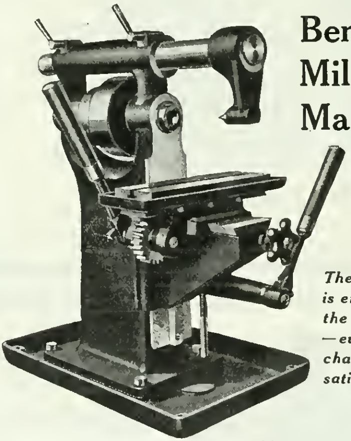
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST. NEW YORK, U.S.A.

Paris, Turin, Zurich, Barcelona, Petrograd

DOMESTIC AGENTS: Vandyck-Churchill Co., New York and New Haven; Monarch Machinery Co., Philadelphia, Pa.; Lynd-Farquhar Co., Boston, Mass.; Syracuse Supply Co., Syracuse, Rochester, and Buffalo, N. Y.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; English & Miller Machinery Co., Detroit, Mich.; Federal Machinery Sales Co., Chicago, Ill.; Vonnegut Machinery Co., Indianapolis, Ind.; Cleveland Tool & Supply Co., Cleveland, O.; Blackman-Hill-McKee Machinery Co., St. Louis, Mo. FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London, Manchester and Glasgow; Andrews & George, Tokyo.

The Burke No. 3

Bench Milling Machine



Price $155

The Machine is efficient, the price fair —every purchaser is a satisfied user.

Vertical Milling Attachment, Slotting Attachment, Index Centers, Stationary or Tilting Head, and other special features give capacity for a wide range of fine milling work.

Catalog shows other sizes of Milling Machines, also Tapping Machines, Drill Presses and Cold Saws.

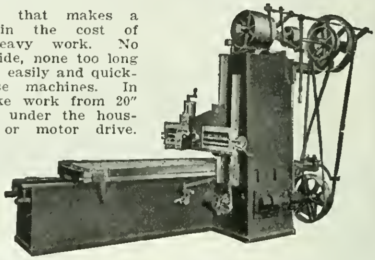
Get the details and prices.

The Burke Machine Tool Co.
516 Sandusky St. Conneaut, Ohio

Dealers in foreign countries, write for addresses.

Cleveland Open-Side Planers

Convenience that makes a difference in the cost of handling heavy work. No work too wide, none too long to be set up easily and quickly on these machines. In sizes to take work from 20" to 72" high under the housing. Belt or motor drive.



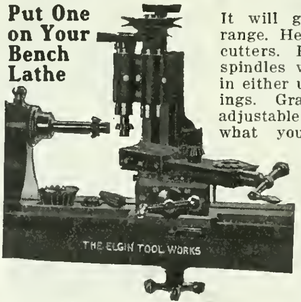
Circular

Established 1900

The Cleveland Planer Co. 3152 Superior Avenue
CLEVELAND, OHIO, U. S. A.

Elgin Milling Attachment

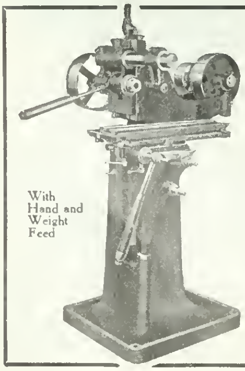
Put One on Your Bench Lathe



It will greatly increase its range. Here it is milling angle cutters. Has interchangeable spindles which may be used in either upper or lower bearings. Graduated swivel head adjustable to any angle. Just what you want for milling taper reamers, bevel gears, gages and small precision work.

Write for particulars

ELGIN TOOL WORKS, Inc.
ELGIN ILLINOIS



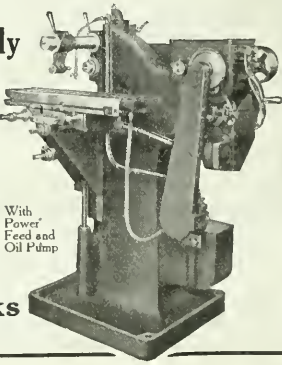
With Hand and Weight Feed

For Milling Small Parts Economically

The "Standard" line of hand and weight feed milling machines has been developed to handle a wide variety of small pieces which do not require the services of a large machine.

At the left is shown the medium sized plain machine, which provides a working surface 7½" by 25", with 17" longitudinal crank feed, 6" hand lever feed and 6" cross feed. Table has 15" vertical adjustment, spindle 4½" and spindle speeds range from 96 to 547 R.P.M.

The machine at the right is provided with both hand and motor drive—a recently designed model which we'll be glad to describe on request.

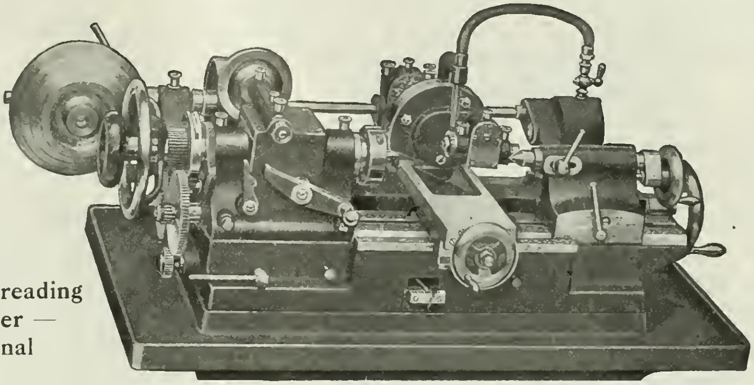


With Power Feed and Oil Pump

Standard Engineering Works
Pawtucket, Rhode Island

The Waltham Thread Miller

For Precision Threading up to 3" Diameter — External or Internal



A semi-automatic machine, designed to cut all kinds of threads either inch or metric pitches. It may be operated in battery by unskilled mechanics, on almost any kind of production work within its range. Universally equipped for use in tool-rooms and experimental laboratories.

Features include a compensating bar to vary the lead of the thread to make allowance for changes in hardening; horizontal swivel to cutter-head for milling square sided threads; provision for adjusting cutter to match threads previously cut; supporting rest attached to carriage and standard taper cutting attachment.

Let us tell you more about it.

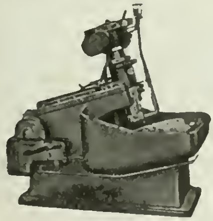
WALTHAM MACHINE WORKS, Newton Street, Waltham, Massachusetts

Small Thread Millers, Gear Cutters and other Small Automatic Machines

---

Ohio Millers OHIO and Grinders

"Tools in Which Every Ounce Works"



Are you looking for methods of reducing production costs without impairing the quality of your product? If so, you'll find the Ohio Trio invaluable.

—*the Ohio 40" Tilted Production Miller*, for straddle milling, keyway cutting, end milling, etc., for the quantity production of automobile parts and similar work on which accuracy and a high production rate are essential;

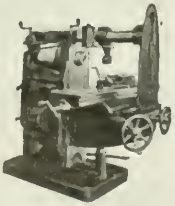
—*the Ohio Universal Miller* for general use in tool-rooms and small shops, for precision milling requiring more than ordinary power and rigidity;

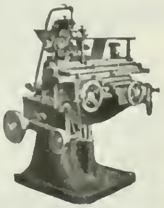
—and *the Ohio Tool and Cutter Grinder* to keep all your tools and cutters in first class working trim and perform a miscellaneous lot of cylinder and surface grinding on the side.

We've been nearly 25 years developing these machines and each one is built and finished as if our whole reputation depended on it alone.

Catalog tells about them.

O. S. Terlein says
Automatic station milling-ram or rotary feed and subsurface milling are outstanding features of the newest "Ohio."





THE OESTERLEIN MACHINE COMPANY

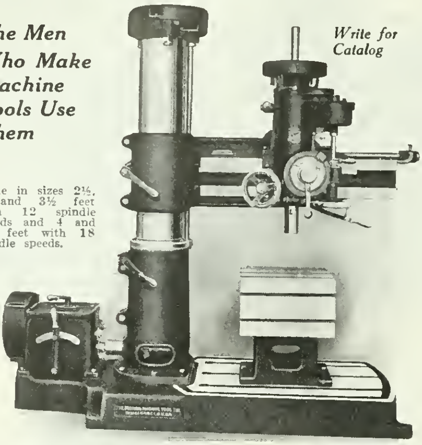
CINCINNATI OHIO, U. S. A.

MORRIS RADIALS

The Men Who Make Machine Tools Use Them

Write for Catalog

Made in sizes 2¼, 3 and 3½ feet with 12 spindle speeds and 4 and 4½ feet with 18 spindle speeds.



After all the most critical judges of machine tools are those who build them. This may be why Morris Radials are so frequently chosen for this super-important work.

The Morris Machine Tool Company
CINCINNATI OHIO, U. S. A.

Represented by The Niles-Bement-Pond Company
111 Broadway, New York, N. Y.

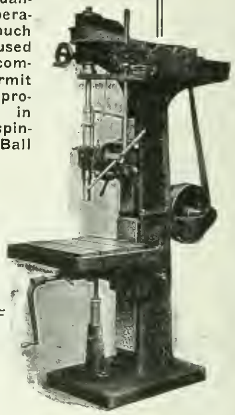
How About This?

Avey

No. 3 Heavy Duty Ball Bearing Driller

How about this machine? Isn't it just what you've been looking for to improve the quality and increase the quantity of your drilling operations? Its high speeds—much higher than ordinarily used for ¾" to 1⅛" holes—combined with fine feeds permit of a possible 50 per cent production increase. Built in combinations up to six spindles, hand or power feed. Ball bearings throughout.

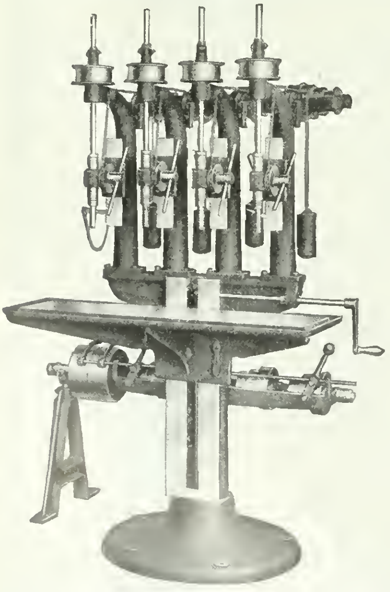
Write for Bulletin



THE AVEY DRILLING MACHINE CO.
CINCINNATI, OHIO, U. S. A.

QUALITY TOOLS

Plain and Ball Bearing — Sensitive Drilling Machines



1—7 Spindles ½" Capacity

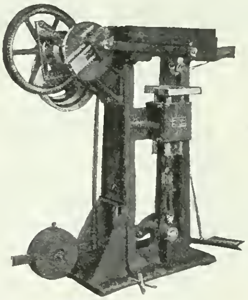
1—6 Spindles ¾" Capacity

1—4 Spindles ½" Capacity Bench.

Power Feeds

FRANCIS REED CO., 43 Hammond Street, WORCESTER, MASS.

Is Your Product Ordered By Name?



Now-a-days most people order by brand. To get repeat orders mark your goods clearly with

Dwight-Slate Marking Machines

Let us handle also your steel lettering and die engraving. Write for literature and get the details and list of users of our machines and dies.

NOBLE & WESTBROOK MFG. COMPANY
19 Asylum St. Hartford, Conn

Cleveland Horizontal Boring, Milling and Drilling Machines

Convenient, Accurate—for precision work

Get the circular now.

The Cleveland Machine Tool Co.
3221 Superior Ave. *Established 1907* Cleveland, Ohio

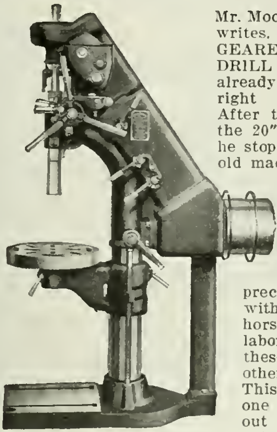
Universal (Horizontal) Boring Machine

"Where accuracy counts, we win"

Designed for
DRILLING, MILLING, BORING, FACING

Universal Boring Machine Company
HUDSON, MASS., U. S. A.

Experience in Spain



Mr. Moos, our agent for Spain, writes. "I sold a 20" ALL GEARED SELF - OILED DRILL to a customer who has already three ordinary upright drills (2—20"—24"). After the first day's run of the 20" ALL GEARED Drill, he stopped work on his three old machines, which he does not need any more, because he found out right away that his 'ALL GEARED' did all the work in his shop with one man, with more speed, precision and efficiency, with a great saving in horse power, belting, oil, labor; the three men on these drills were put to other work than drilling." This shop in Spain is only one of the many throughout the world which has cut labor costs by using our SELF-OILING ALL GEARED Drills and Tappers.

Why use three cone driven drills and three operators when ONE ALL GEARED and ONE operator will do the same amount of work. Better examine into this source of profit.

Catalogue "M" on request

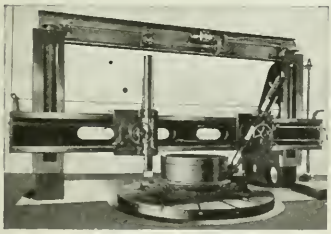
BARNES DRILL CO.

Incorporated 1907

814 CHESTNUT STREET ROCKFORD, ILL., U. S. A.

Agents for Great Britain: Burton, Griffiths & Co., Ltd., London, E. C. **Belgium:** G. & F. Limbourg Freres, Brussels. **France:** R. S. Stokvis & Fila, Paris. **Japan:** Roku-Roku Shoten, Tokyo. **Italy:** Alfred Herbert, Ltd., Milan. **Spain and Portugal:** American Machinery Corporation, S. A. C., Madrid. Sindicato de Maquinaria Americana, Bilbao. **New South Wales:** R. L. Scrutton & Co., Sydney.

Vertical Boring Mills



At Moderate Prices

4 Sizes
16 ft. to 22 ft.
Swing.

Bulletin on request

PULASKI FOUNDRY & MFG. CORP.
2422 Euclid Avenue Cleveland, Ohio

CLEVELAND MILLING MACHINES

Plain and Universal—"With the square over-arm"

The Clark-Mesker Company, Cleveland, Ohio

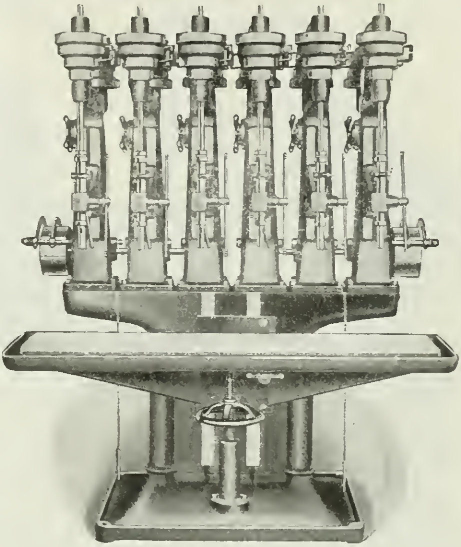
Successors to THE CLEVELAND MILLING MACHINE CO.

The Kingsbury Automatic Ball Bearing Sensitive Drilling Machine

Write for Bulletin

KINGSBURY MANUFACTURING COMPANY
KEENE, NEW HAMPSHIRE

EDLUND DRILLING MACHINES

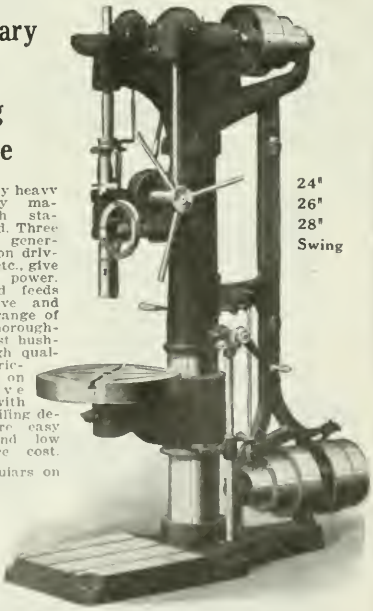


Quick Change—High Speed—Ball Bearing—Sensitive. Made with one to six spindles, with four speed changes and belt shifts operated from either side of the machine. More details?

Edlund Machinery Company, Inc.
CORTLAND Box 57 NEW YORK

Sibley Heavy Pattern

Stationary Head Drilling Machine



24"
26"
28"
Swing

An unusually heavy and stocky machine with stationary head. Three step cones, generous ratios on driving gears, etc., give ample power. Speeds and feeds are selective and cover the range of machine thoroughly. Die cast bushings of high quality anti-friction metal on main drive bearings with improved oiling devices insure easy running and low maintenance cost.

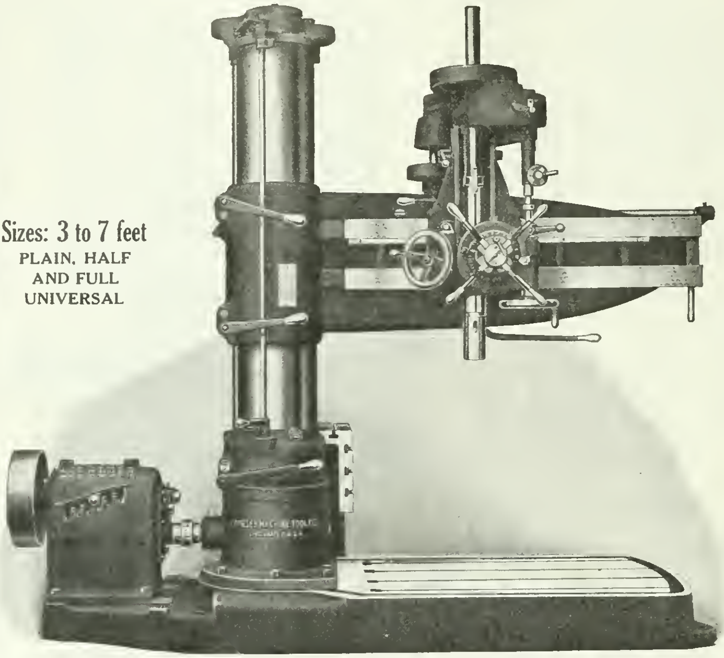
Full particulars on request.

Write for Catalog

SIBLEY MACHINE COMPANY
8 Tutt Street SOUTH BEND, IND., U. S. A.

HIGH DUTY RADIAL DRILLS

Sizes: 3 to 7 feet
PLAIN, HALF
AND FULL
UNIVERSAL



More valuable features than in any other

Get acquainted with ours before you buy

DRESES
MACHINE
TOOL CO.
CINCINNATI, OHIO

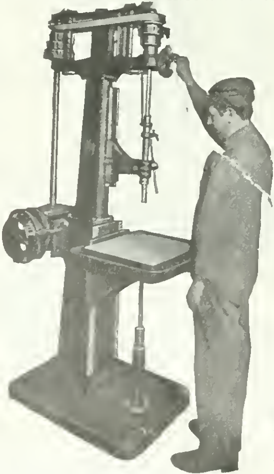
A Few Sipp Facts

We've done away with the quarter turn belt.

Speeds can be changed in two seconds without stopping the machine, by simply swinging a lever on a dial.

Spindle speeds or drill sizes shown on dial in plain sight of the operator.

Belts have been known to last a year.



Endless Belts can be kept in stock and put on in ten seconds.

You'll be interested in the complete story—send for it.

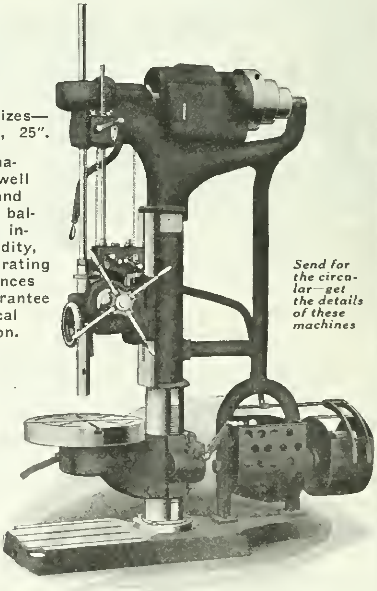
ITS
TRADE A MARK
SIPP

The Sipp
Machine Co.
Paterson New Jersey

WEIGEL DRILLS

Three sizes—20", 21", 25".

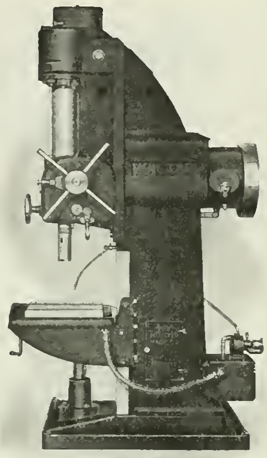
Heavy machines, well braced and carefully balanced to insure rigidity, with operating conveniences that guarantee economical production.



Send for the circular—get the details of these machines

THE WEIGEL MACHINE TOOL CO.
PERU INDIANA, U.S.A.

You can Go the Limit with a
Minster Hi-Duty Drill



Big carefully balanced machines with plenty of power to easily handle the toughest job within their capacity. Versatility that gives unusually wide range for machines of this size, operating conveniences that simplify production difficulties make Minster Drills leaders in many big shops where the economy of modern methods and equipment is recognized.

Made in three sizes 2″, 2½″, 3¼″; all sizes have 12 changes of speed and feed, high carbon steel spindle, flood lubrication and ball bearing construction.

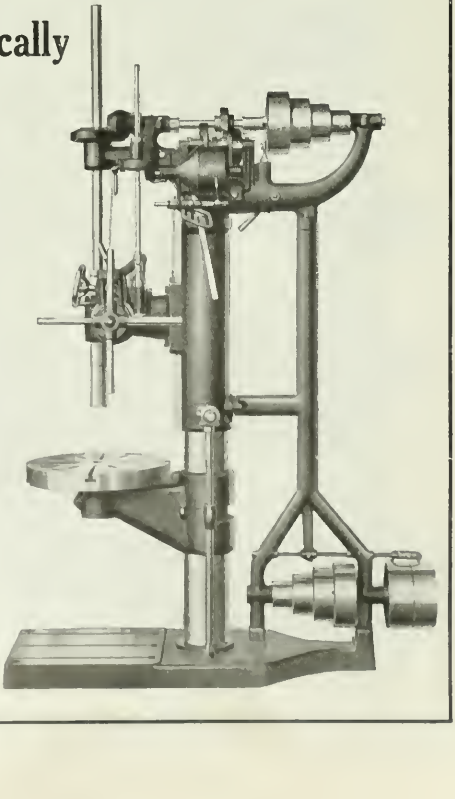
Remember "Minster Drilling is Limit Drilling" and look over these big machines.

THE MINSTER MACHINE COMPANY, Minster, Ohio

LIST OF AGENTS:

DOMESTIC: Vandyck-Churchill Co., Singer Bldg., New York, N. Y., Philadelphia, Pa.; J. S. Miller Machinery Co., Pittsburgh, Pa.; Saxer Machinery Co., Erie, Pa.; Cleveland Tool & Supply Co., Cleveland, Ohio; E. A. Kinsey Co., Cincinnati, Ohio, Indianapolis, Ind., Columbus, Ohio; W. J. Baird Machinery Co., Detroit, Mich.; McMullen Machinery Co., Grand Rapids Mich.; Federal Machinery Sales Co., Chicago, Ill., Milwaukee, Wis.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; Herberts Machinery & Supply Co., San Francisco, Cal., Los Angeles, Cal.; Wilcken-Schenck Co., Seattle, Wash.; Zimmerman-Wells-Brown Co., Portland, Oregon; Savage & Winter Co., St. Paul, Minn., The Walraven Co., Atlanta, Ga.; Manufacturers Selling Agency, Birmingham, Ala.; Oliver H. Van Horn Co., Inc., New Orleans, La.; Archenhold Automobile Supply Co., Waco, Texas. FOREIGN: Henri Benedictus, Brussels, Belgium, Coats Machine Tool Co., London, England; Pedro Merlini, Buenos Aires, Argentina; Quinones Hardware Corp., Havana, Cuba; R. S. Stokvis & Zonen, Inc., Paris, France. CANADIAN: Williams & Wilson, Ltd., Montreal, Quebec, A. R Williams Machinery Co., Ltd., Toronto, Ont.

The 26" Rockford Drills Economically



It belongs to a line of machines noted for strength, rigidity and power; buyers looking for equipment capable of standing severe service and of handling a wide variety of work rapidly and accurately find the Rockford 26″ Sliding Head Drilling Machine a profitable investment.

It is accurately balanced, easy to operate, greatest distance, spindle to base, 51″, spindle to table, 37″. Table travel on column 20″, spindle travel 11″, sliding head travel, 20¾″. There is a large quantity of drilling and tapping within the range of this machine. It will pay you to investigate its advantages.

Let us send you booklet with full description.

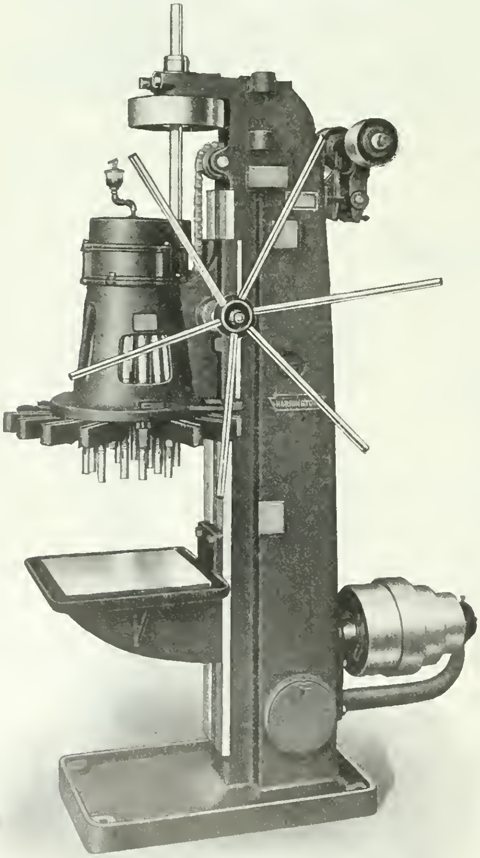
THE
ROCKFORD
DRILLING MACHINE Co
· ROCKFORD ·
ILL., U.S.A.

Harrington Multiple Spindle Drills

Quality drilling equipment insures a higher grade of work, with less interruption and delay, and consequently less expense of operating.

Edwin Harrington
Son & Co., Inc.
Philadelphia, Pa.

Harrington Drills are Quality Drills



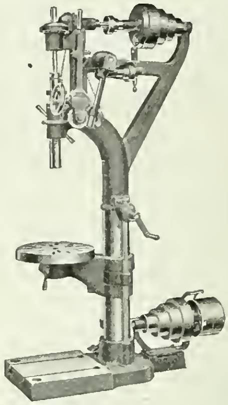
Silver Upright Drilling Machines

Two sizes—20" and 25"—arranged singly or in gangs. The cut shows the Silver 20" drill with the changes recently incorporated in its design to increase its capacity and general efficiency.

Circular gives comparative tables of old and new machines.

Send for it.

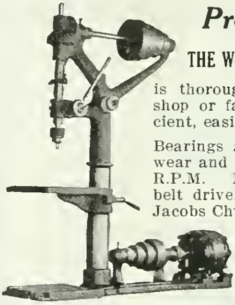
SILVER
TRADE MARK
Salem, Ohio USA



The Silver Manufacturing Co.

385 Broadway SALEM, OHIO
LONDON PARIS BRUSSELS
NEW YORK GENOA SYDNEY CAPE TOWN

A Step Forward in the Field of Production Drilling



THE WINTERHOFF 10½" BENCH DRILL

is thoroughly satisfactory for either shop or factory. It is sensitive, efficient, easily operated and durable.

Bearings are ball thrust adjusted for wear and end play. Runs up to 2,400 R.P.M. Made with either motor or belt drive. Regularly equipped with Jacobs Chucks.

0" to ½" capacity. Write for details.

WINTERHOFF TOOL & MACHINE CO.
ELKHART INDIANA

"HOLE HOG" DRILLS REAMS BORES HOLES IN LINE

MOLINE TOOL COMPANY, Moline, Ill.

THE WESTERN

(*low hung drive*) **Radial Drill**

Driven by a set of gears at the **lower** end of the spindle, close to the work.
This feature practically eliminates all torsional strain and vibration. It permits deeper, heavier cuts to be made faster and better.

Literature on request
WESTERN MACHINE TOOL WORKS
Holland, Mich., U. S. A.

Woodward & Powell Planer

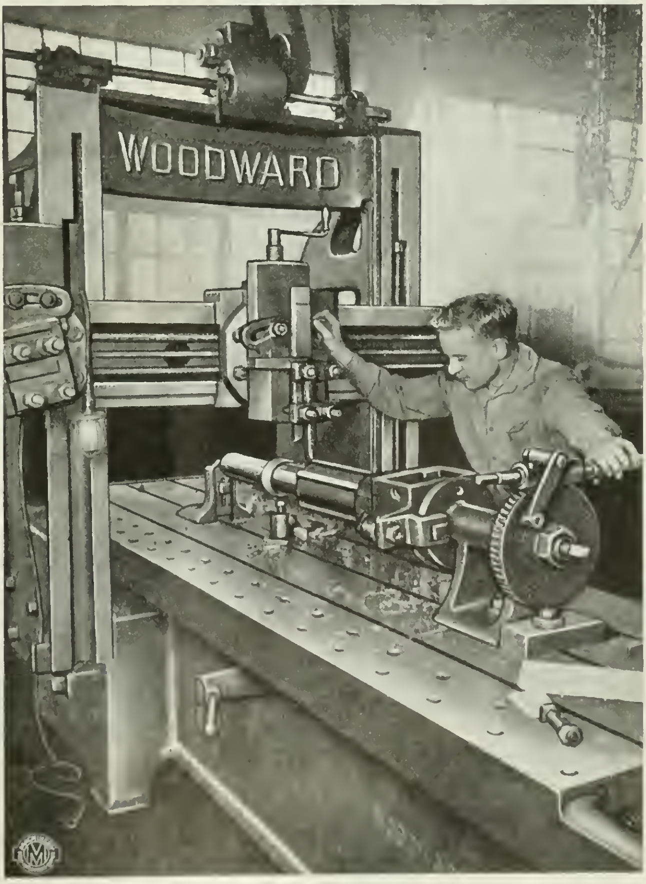
A Close Limit Job Handled Without Difficulty on This Versatile Machine

This photograph taken at one of our large Arsenals shows the Woodward & Powell Planer on a finishing operation that is held to extremely close limits.

The piece is part of a 2.24″ taper gun, the part being machined is the jacket shrunk into the gun barrel; this jacket fitted into another member splined to receive it, forms a bearing on which the gun slides as it recoils.

The operator is planing four sectors on this jacket so as to form four solid keys which, when finished will be .999″ wide by ¼″ high and 12½″ long.

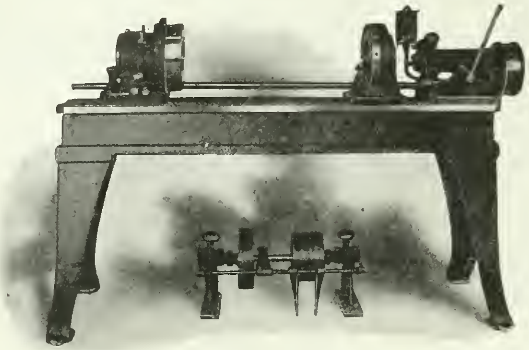
For this operation the gun is mounted on centers and the index head revolved slightly after each cut. Accuracy is all important here—production is a minor matter; here again the Woodward & Powell Planer does its work satisfactorily.



Whether the demand is for speed or heavy work, or super accuracy on a delicate operation these big machines will meet it easily and economically. Let us tell you more about Woodward & Powell Planers.

WOODWARD
& POWELL
PLANER
COMPANY
WORCESTER
MASS., U. S. A.

THE WHITON
Revolving Centering Machine



For Accurately Centering Finished Shafts

The cut shows new *Revolving Centering Machine*—a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machines and embodies all the special features.

Circulars and prices sent upon application.

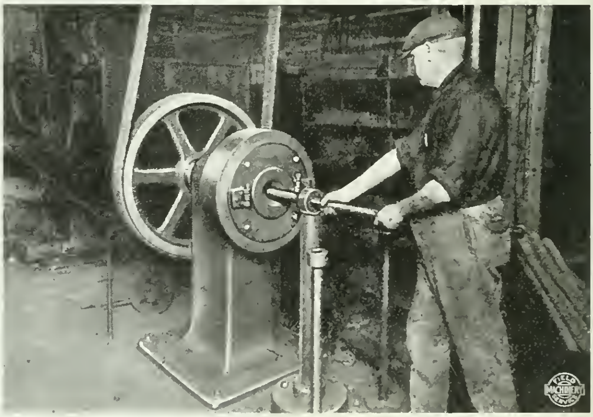
THE D. E. WHITON MACHINE COMPANY
NEW LONDON, CONNECTICUT, U. S. A.

DAYTON SWAGING

Reducing Pipe Ends to Uniform Size

"The Best Way Twenty Years Ago—The Best Way Now"

A manufacturing process that has survived in an up-to-date metal working shop for twenty years is worth notice in these days of ever changing methods and production standards. The three Dayton Swaging Machines at the Ingersoll-Rand Company, Phillipsburg, N. J., installed 18 to 20 years ago, have given uninterrupted service during all these years. The job shown is typical—reducing the ends of wrought iron pipe from 1⅝″ outside diameter to fit holes 1.625 in diameter—snug fit required. They found out here about a generation ago that "Dayton Swaging Pays"—and they've been reaping the profits of their foresight ever since.



The principle is right, the method can scarcely be improved on, the machines are built to last. Ask for details.

THE TORRINGTON CO., Excelsior Plant, 57 Field Street, Torrington, Conn.
SUCCESSORS TO EXCELSIOR NEEDLE COMPANY

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

ATKINS

METAL CUTTING SAWS

ECONOMY

The cutting of one metal by another is not a difficult process with

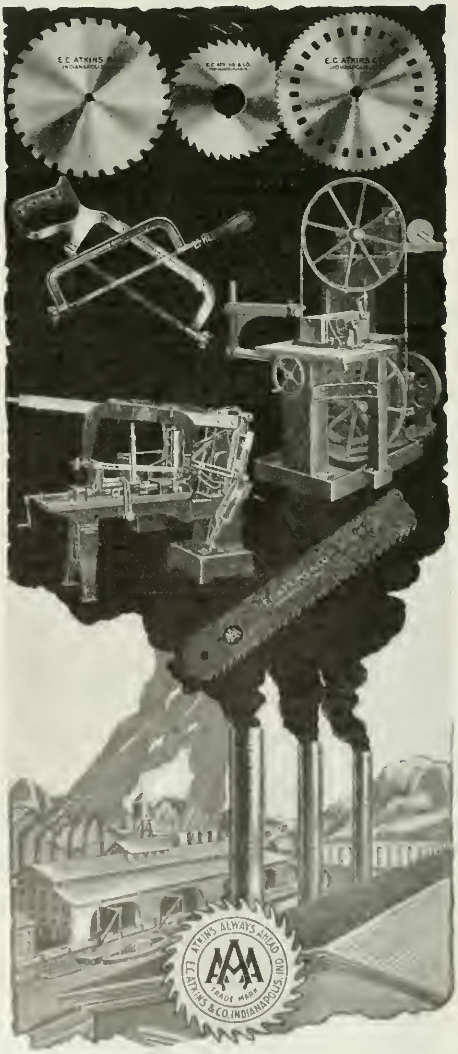
Atkins Metal Cutting Saws

They are made to withstand the constant wear and tear of heavy duty. They possess to the highest degree both toughness and ductility, which minimize breakage of the teeth and even the blades themselves.

By using Atkins quality saws in your various cutting operations you can get maximum results with minimum expense, thus saving money.

Ask for literature on any of the following: *Atkins AAA Non-Breakable Hack Saw Blades and Frames, Circular Metal and Slitting Saws, Hot Saws, Cold Saws, Kwik-Kut Hack Saw Machines and Blades and Metal Band Saw Machines.*

"A Better Saw for Every Use"



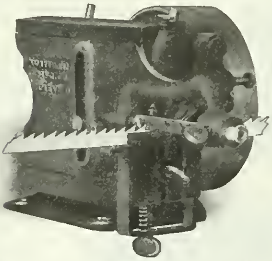
E.C. ATKINS & CO.

ESTABLISHED 1857 THE SILVER STEEL SAW PEOPLE
Home Office and Factory, INDIANAPOLIS, INDIANA
Canadian Factory, Hamilton Ontario
Machine Knife Factory, Lancaster N.Y.

Branches Carrying Complete Stocks In The Following Cities:

Atlanta
Memphis
Chicago
Minneapolis
New Orleans
New York City
Portland, Ore.
San Francisco
Seattle
Paris, France
Sydney, N. S. W.
Vancouver, B.C.

AUTOMATIC MACHINES FOR SHARPENING WOOD-WORKING BAND SAWS



Model S files all Band Saws up to 1" wide. 3 to 15 teeth to 1".

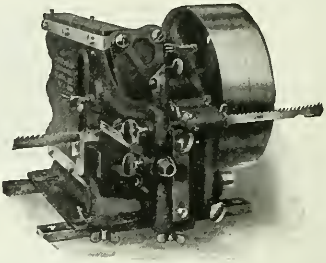
\$36.00 or \$125.00

Machine Sharpened Saws Cut Faster and Longer. Breakage is Less. Write us and learn why.

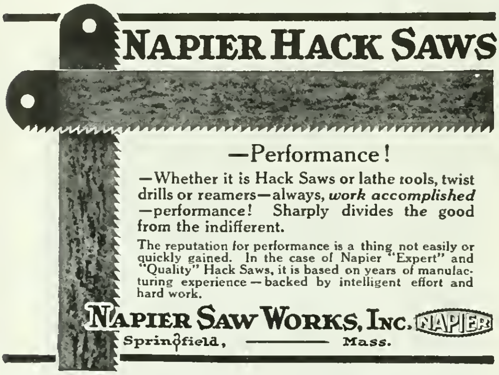
The Wardwell Mfg. Co.

Specialty Manufacturers
Circular Saw Filers, Band Saw Grinders, Stretchers, Lap Grinders, Setters, etc.

108 Hamilton Avenue, Cleveland, Ohio



Model K files, sets and joints all Band Saws in one operation, ⅛" to 2" wide. 2 to 15 teeth to 1".



NAPIER HACK SAWS

—Performance!

—Whether it is Hack Saws or lathe tools, twist drills or reamers—always, *work accomplished* —performance! Sharply divides the good from the indifferent.

The reputation for performance is a thing not easily or quickly gained. In the case of Napier "Expert" and "Quality" Hack Saws, it is based on years of manufacturing experience — backed by intelligent effort and hard work.

NAPIER SAW WORKS, INC. NAPIER
Springfield, Mass.

The

HIGLEY

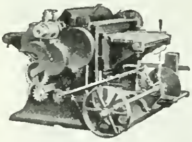
COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.

New York Philadelphia New Haven

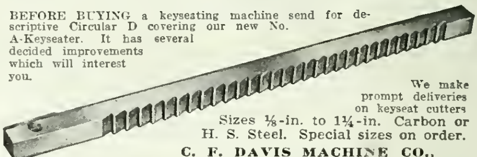
Crescent Wood Working Machinery



is popular because the machines are durable and always please our customers. The time will come when you will need additional equipment to help you speed up production so you had better get a little ahead of your requirements and ask for catalog today describing band saws, jointers, saw tables, planers, planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood workers, hollow chisel mortisers, universal wood workers, table cut off saw.

THE CRESCENT MACHINE CO.
56 MAIN STREET LEETONIA, OHIO

BEFORE BUYING a keyseating machine send for descriptive Circular D covering our new No. A-Keyseater. It has several decided improvements which will interest you.



We make prompt deliveries on keyseat cutters

Sizes ⅛-in. to 1¼-in. Carbon or H. S. Steel. Special sizes on order.

C. F. DAVIS MACHINE CO.,
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PITTSBURGH SIMPLEX SAWS

Have Correctly Designed Teeth

STRONG—SIMPLE—TIME-SAVING—TROUBLE PROOF

The Pittsburgh Saw & Manufacturing Co.
Pittsburgh Penna., U. S. A.

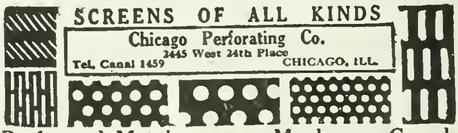
STERLING
HACK SAW BLADES

Sterling Hack Saw Blades are made from the finest grade, rolled, high tungsten alloy steel; are uniform in quality and thoroughly dependable. Recognized throughout the mechanical world as efficient factors in increasing quantity and improving quality.

Sterling Hack Saw Blades, Frames and Machines. Ask for them everywhere.

Diamond Saw & Stamping Works
357-361 Seventh St. BUFFALO, N. Y.

BARNES
SAWS FOR METAL
BAND MANUFACTURED BY **HACK**
DETROIT **W.O.BARNES CO.** MICHIGAN

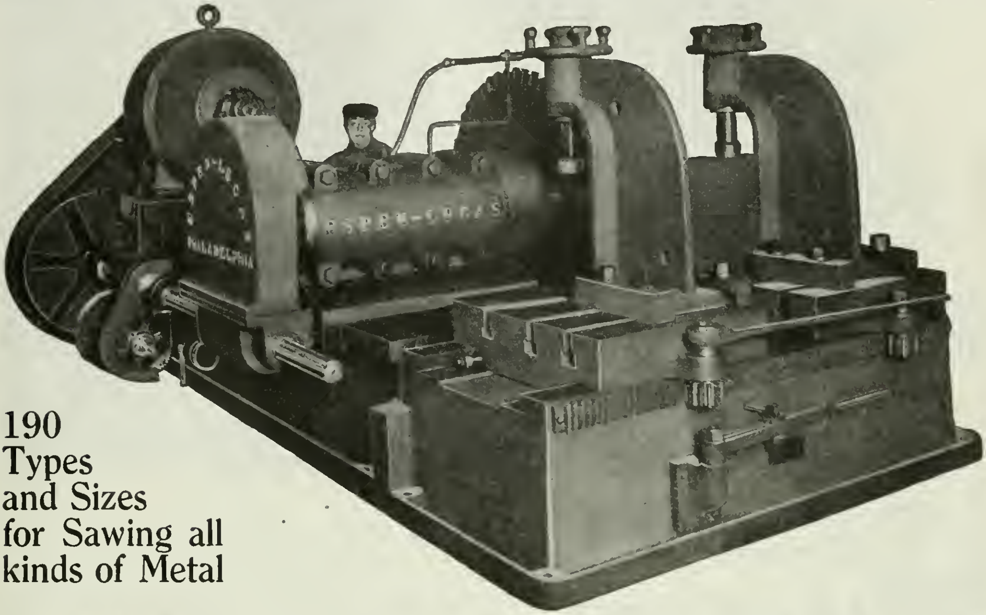


SCREENS OF ALL KINDS

Chicago Perforating Co.
2445 West 24th Place
Tel. Canal 1459 CHICAGO, ILL.

Perforated Metal Machinery Guards

One of the Fastest Cold Sawing Machines in the World



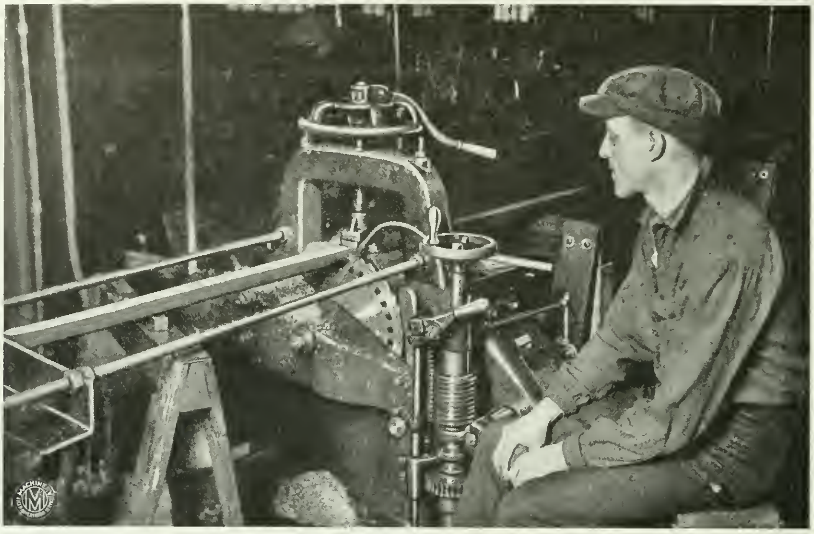
190
Types
and Sizes
for Sawing all
kinds of Metal

THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues
PHILADELPHIA, PA.

We always welcome a comparative test between Star Saws and any other make. You can find out more about Star Saws by actual use than we could tell you in ten times this space.

STAR HACK SAWS

Now Sold by
CLEMSON BROS. INC.
MIDDLETOWN, N.Y.
Makers Since 1883



Photographed at the Gilbert & Barker Manufacturing Company, Springfield, Mass. Manufacturers of Oil and Gasoline Tanks and Pumps.

LEA-SIMPLEX Cold Saws

Put Stock Cutting on a Profitable Production Basis

A cutting-off saw is frequently a "machine of all work," run by everybody in the shop and its efficiency is gauged largely by its simplicity, ease of operation and capacity for conveniently handling a wide variety of work.

The Lea-Simplex Cold Saw—by virtue of just these factors one of the most popular machines of its class—has in addition, production possibilities that give it exceptional value as straight manufacturing equipment.

An example of production is the work shown—cutting off 1″ steel stock—four pieces at a time—for racks for gasoline pumps. These pieces are put through in lots of 5000; the cut is clean and straight and production is maintained at the rate of 80 pieces, 20 cuts per hour. There are two Lea-Simplex Cold Saws in this plant, both profitably busy on production work of many kinds. If you are interested we'll be glad to tell you more about the work they do and the results obtained.

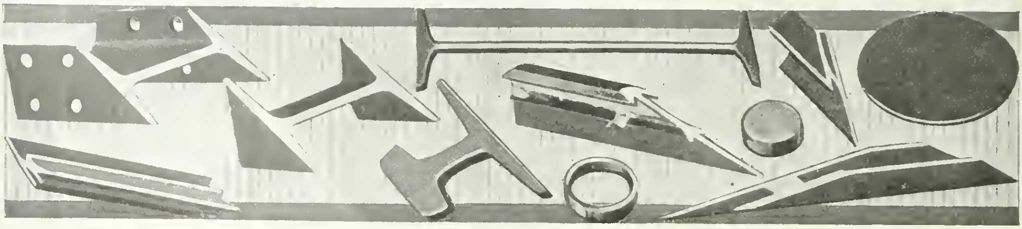
Ask for our booklet "Economy in Cold Sawing"

THE EARLE GEAR & MACHINE COMPANY

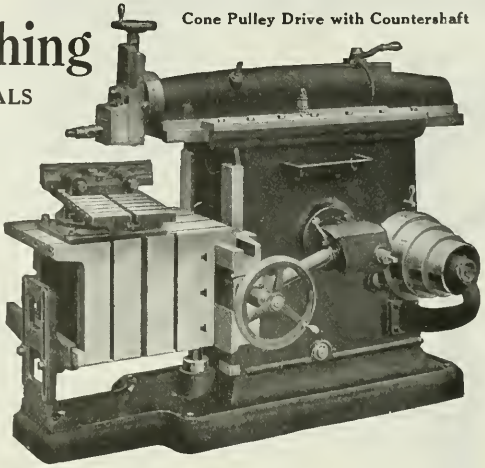
Stenton and Wyoming Aves. Philadelphia, Pa., U. S. A.

Also Manufacturers of Cut Gears, Special and Bridge Operating Machinery and Earle Centrifugal Pumps

Domestic Agents: Charles A. Strelinger Co., Lower Peninsula of Michigan. Harron, Rickard & McCone, San Francisco and Los Angeles, Calif. The Fairbanks Co., New York, N. Y. Branch Houses: Albany, Baltimore, Birmingham, Boston, Bridgeport, Buffalo, Chicago, Cleveland, Hartford, Newark, New Orleans, Paterson, Philadelphia, Pittsburgh, Providence, Rochester, Scranton, St. Louis, Syracuse, Utica, Washington. Foreign Agents: Andrews & George Co., Tokyo, Japan. Andrews & George Co., New York City. Bevan & Edwards Pty., Ltd., Melbourne, Australia. I. C. Raffenberg, Copenhagen, Denmark. Sociedad General de Representaciones, Madrid, Spain. Post Van Der Burg & Co., Rotterdam, Holland. Selson Engineering Co., New York City. Selson Engineering Co., London, England. Selson Engineering Co., Paris, France. Selson Engineering Co., Turin, Italy. Societe Anonyme Belge Selson, Brussels, Belgium.



Something for Nothing



Cone Pulley Drive with Countershaft

HARDENED AND GROUND JOURNALS
RING OILING BUSHINGS

THERE IS less friction on a HARDENED JOURNAL: especially, when lubrication is ample and constant; if there is less friction, there is much less wear. YOU would not buy an automobile with soft journals—squirt can lubricated; WE conserve power and guarantee on heavy duty, 25% or more reduction with the same input power.

BUT, the QUEEN CITY is not a one feature shaper: it has EVERY ESSENTIAL for the FAST PRODUCTION of GOOD WORK, viz; ALL HELICAL DRIVING GEARS, SEMI-STEEL CASTINGS, HYATT ROLLER BEARINGS in C/S, SELF-ADJUSTING, SELF-ALIGNING TABLE SUPPORT, and QUEEN CITY QUICK CHANGE FEED. (Patent applied for.)

CRANK BLOCK and CRANK PIN ARE HARDENED and GROUND. BULL GEAR JOURNAL IS GROUND and ALL THESE have constant lubrication, immediately machine is started, assuring quiet, easy running and precluding stuck journals.

ALL flat-wearing surfaces are of extreme area. Note simplicity of design.

Furnished with Single Pulley (Gear Box) and Constant or Adjustable Speed Motor Drives; Single Screw Vise optional; sizes cover every requirement for Tool-room and Die Makers up to the heaviest for Railroad and Forge Shops. Send for the dope.

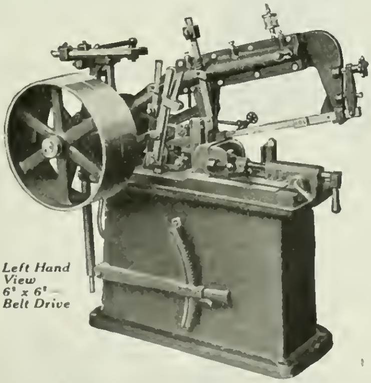
Queen City Machine Tool Co., (Station V) **Cincinnati, Ohio**

FOREIGN AGENTS: Alfred Herbert, Ltd., for Great Britain, France, Belgium, Spain and India.

Also Queen City Plain Cylindrical Grinding Machines

Peerless HIGH SPEED HACK SAW MACHINES

Meet the needs of any shop for sawing soft or hard materials as well as large or small sections.



Left Hand View 6" x 6" Belt Drive

The saw frame and guide on all Peerless High Speed machines is overbalanced. Feed pressures from 6 pounds to 170 pounds by 6 pound steps may be applied to the blade by raising lever shown on left side of the machine. Sizes 6" x 6", 9" x 9", 13" x 16". Motor mountings or six-speed boxes may be applied to all machines.

PEERLESS MACHINE COMPANY

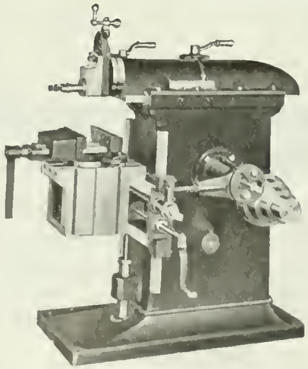
1611 Racine Street RACINE, WISCONSIN

"It's a Mighty Fine Little Machine"

Said a prominent manufacturer, referring to the new 12" Whipp Shaper; "and the extremely low price you are asking should tempt many concerns to install it."

The New 12" Single Geared WHIPP SHAPER

(WITH 14" STROKE)



Whipp Shapers come in sizes 12-14-16 single geared; 16-20 back geared. Ask about our 26" Combined Open-side Crank Planer and Shaper. Prices and particulars on request.

THE WHIPP MACHINE TOOL CO.

SIDNEY OHIO, U.S.A.

Shapers

and Gear Cutting Machines

Single Pulley Shaper Drive, part of the machine, not an attachment.

Speed Gear Box with all heat-treated steel gears.

The right speed for every stroke.

"More strokes per minute"

GOULD & EBERHARDT

"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY
ESTABLISHED 1833 NEWARK, N.J. U.S.A. CHANCELLOR AVE.

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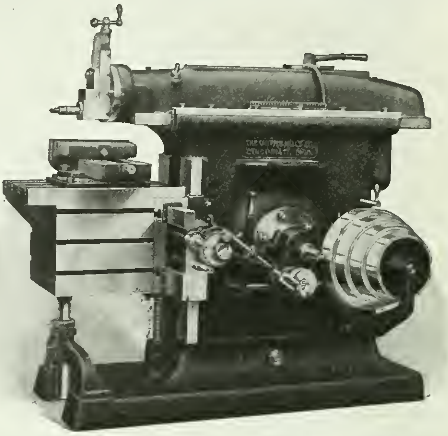
WE CONFINE OURSELVES TO BUILDING

Shapers Exclusively



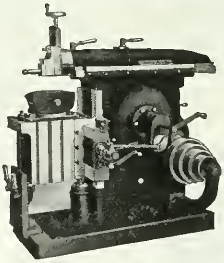
Crank Sizes: 12", 14", 16", 20", and 25"—Either Cone Driven or through Speed Box, 28" and 28/32" B.G. All Geared Single Pulley Drive

The Smith & Mills Company

CINCINNATI OHIO, U. S. A.

FOREIGN AGENTS: G. & F. Limbourg Freres, Brussels, Belgium; Burton, Griffiths & Co., Ltd., London, England; Van Rietachoten & Houwens, Rotterdam, Holland; Reid Brothers (Johannesburg) Ltd., Johannesburg, South Africa; J. Lambercier & Co., Geneva, Switzerland; Zurich, Switzerland; V. Lowener, Copenhagen, Denmark; Christiania, Norway; Stockholm, Sweden; H. P. Gregory & Co., Sydney, N. S. W.; Rene Berndes Co., Havana, Cuba; Horne Company, Ltd., Tokyo, Japan; Daniele Stussi, Milan, Italy.

STEPTOE SHAPERS and MILLERS



Should be your first consideration in equipping your machine shop.

Seventy-six years of experience in the manufacture of high-grade tools is a recommendation that you should not overlook.

Send for a copy of our catalogue showing the entire line of STEPTOE shapers and milling machines.

THE JOHN STEPTOE COMPANY 2951-61 Colerain Ave.
CINCINNATI, OHIO

Broaching Machines and Broaches

Our years of experience in the successful manufacture of broaching equipment assures you of the most up-to-date and progressive methods.

May we not quote? Write for catalog

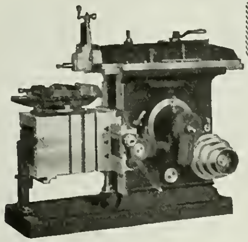
J. N. LAPOINTE CO. *of* New London, Conn.

"OHIO" PLANERS SHAPERS

Leaders Since 1887

Address Below or Local Dealer

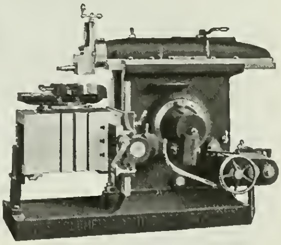
OHIO MACHINE TOOL CO., Kenton, Ohio



Columbia Shapers

The quick-change feed is a typical time-saving feature. Automatically adjusts itself to position of rail. One handle instantly controls the amount, another the direction of the feed. Bevel gear reverse insures feed taking place on return stroke. Feed gears are steel, hardened and running in oil, fully enclosed.

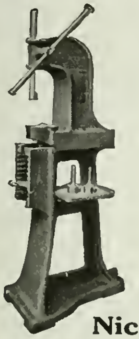
This and other details fully described in Bulletin No. 7. Send for it today.



Cone Drive
16, 20, 24, 28, 32 Inch

The Columbia Machine Tool Company
Hamilton, Ohio

Speed Box, Friction
Clutch and Brake and
Single Pulley Drive



The Nicholson Arbor Press Encourages Better Work

Your workmen will appreciate its ability to save time and labor. Besides pressing out arbors, it's a big help in broaching, punching, bending and similar work. The No. 3 size is capable of instantly exerting a three-ton pressure.

Nicholson Expanding Mandrels

A set of nine of these will replace all your solid mandrels. They save the time lost in calipering solid mandrels or turning them down to size, for they fit any hole, round or square from ½" to 7". And they take up very little space.

Let us send you press or mandrels or both on 30 days' trial, to prove their value to you. Write for free booklets describing these and other Nicholson specialties.

W. H. Nicholson & Co.
112 Oregon St., Wilkes-Barre, Pa.

AGENCIES:

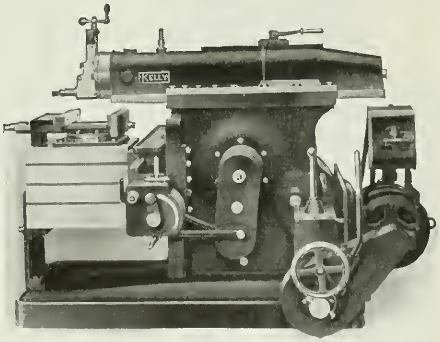
Burton, Griffith & Co., Ltd.,
Ludgate Square, London, E. C.
Burton Fils,
68 Rue des Marais
Paris, France

Monti & Oscuro
Milan, Italy
Andrews-George Co.
16 Takegawa-cho, Kiobashi-ku
Tokyo, Japan.

Kelly Crank Shapers

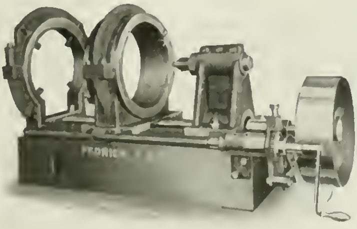
Heavy machines rigid enough to insure their accuracy on the heaviest work within their wide capacity, with operating conveniences that enable them to handle it satisfactorily.

The tilting table, swivel vise, motor drive and other characteristically modern features are fully described in our circular. Send for it.



THE R. A. KELLY COMPANY
XENIA, OHIO, U. S. A.

Pedrick Crank Pin Turning Machine



This handy portable tool is for truing crank pins of stationary engines or locomotives in position.

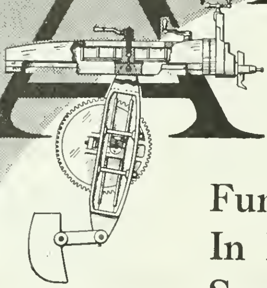
It is a time saver and as accurate as a lathe. Several sizes to meet all dimensions.

Write for details.

Pedrick Tool & Machine Company
3639 N. Lawrence St. PHILADELPHIA

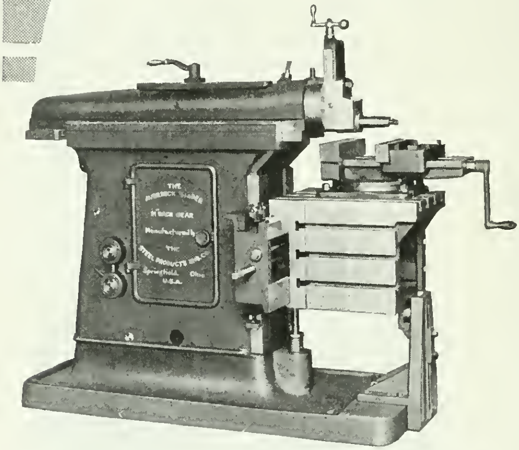
Manufacturers of Portable boring, milling and pipe bending machinery and floor boring machines.

AVERBECK Shapers



Fundamentally Correct In Principle—Hence Smooth in Operation

THE STEEL PRODUCTS ENGINEERING COMPANY
SATISFACTION PRODUCTION EFFICIENCY
WE DESIGN and BUILD • SPECIAL • MACHINERY
SPRINGFIELD OHIO

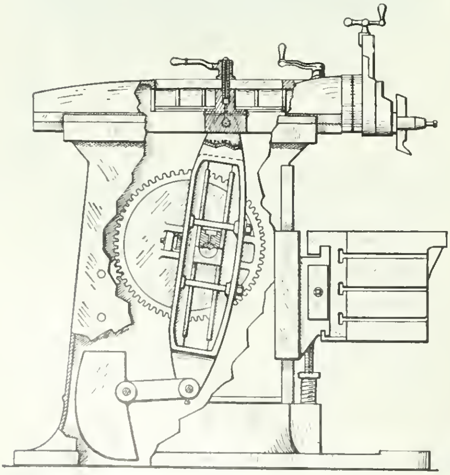


The unusually smooth operation which distinguishes Averbeck 17″ and 21″ Back-Geared Crank Shapers, though due in part to the close limits to which the machines are built, is the chief result of the Balanced Driving Mechanism.

The Balanced Driving Mechanism is a counter-balance which neutralizes the weight of the rocker arm and ram in all positions so that the movement of the latter is accompanied by minimum friction.

This patented mechanism, simple in construction and with few working parts, gives an even cutting stroke with a very quick return of the ram.

The Averbeck Shaper is distinguished for its high production, unusual accuracy and marked economy of operation.



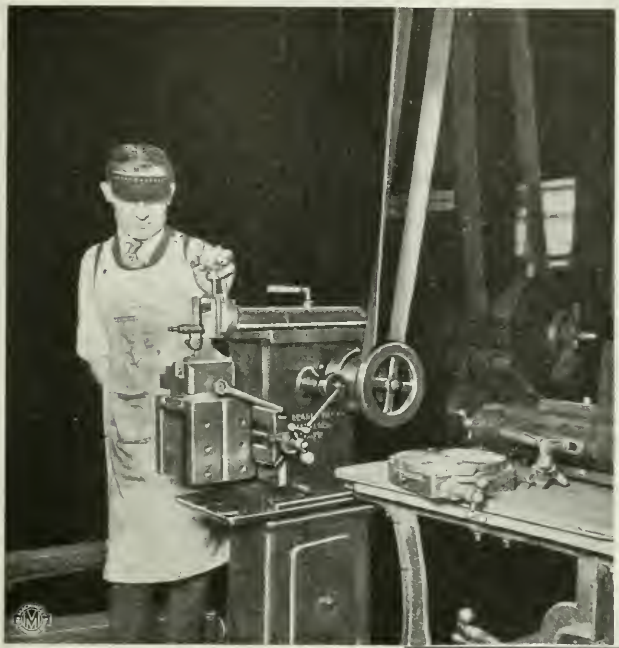
Write for Booklet

STEEL PRODUCTS ENGINEERING COMPANY

Springfield **Ohio, U. S. A.**

Representatives: Hess-Schenck Company, Cleveland, O. J. L. Lucas & Sons, Inc., Bridgeport, Conn. W. H. J. Fitzgerald & Co., Boston, Mass. W. J. Baird Machinery Co., Detroit, Mich. McCoy-Brandt Machinery Co., Pittsburgh, Pa. Scott-Bansbach Machinery Co., Chicago, Ill. Day Machinery Co., Buffalo, N. Y. M. J. Walsh Machinery Co., Milwaukee, Wis.

Rhodes Slotter and Shaper



"Just the Machine for us" says this Company

For concerns which make a specialty of difficult die work—where complicated contours and close limits are the rule—the Rhodes Combination Slotter and Shaper is a real asset.

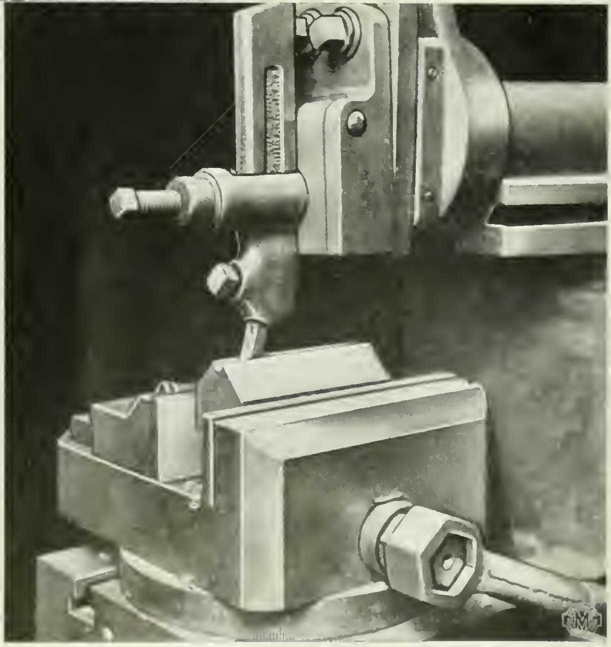
The Metalform Tool & Stamping Company of Philadelphia, for instance, tells us that for making tools and dies the Rhodes can't be beaten.

"The Rhodes is just the machine for us," says this company. "On small slotting and shaping jobs it is both accurate and sensitive—it has the necessary 'feel' essential to this type of work."

Photograph shows the Rhodes set up as a shaper machining a slot in a die section to a 1/8″ radius.

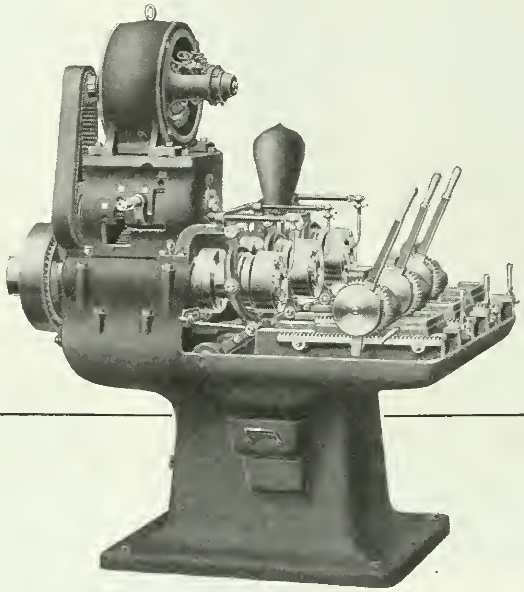
The "Rhodes" is supplied as a 3½″ slotter, a 7″ shaper, or as a combination machine operating in both the horizontal or vertical planes.

What can we do for you?



The Rhodes Manufacturing Company

Hartford **Connecticut**



NATIONAL BOLT CUTTERS

"Always Cut Accurate Threads"

When set for a given size and locked in the closed position, the National Die Head is as rigid as a solid die, hence, variations in the diameter or hardness of the stock cannot affect the accuracy of the threads. This high degree of accuracy is maintained throughout years of hard service, as lost motion cannot be transmitted to the Dies.

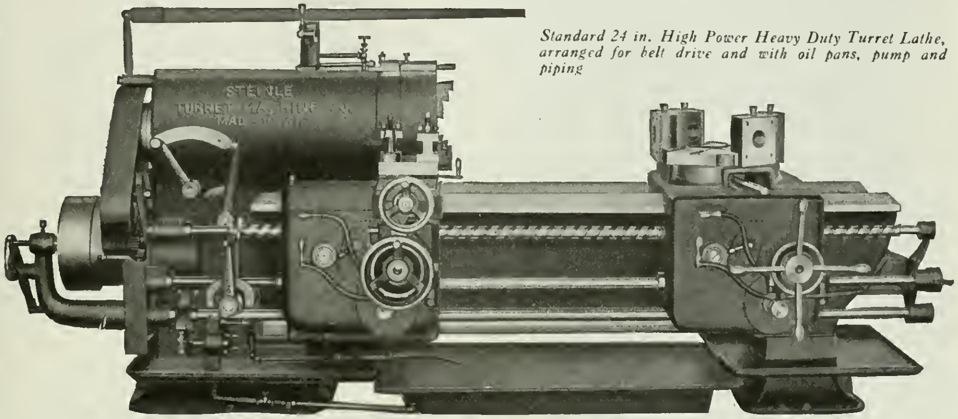
Also, the National Interchangeable Case Die will reduce your die costs 30 to 50 per cent.

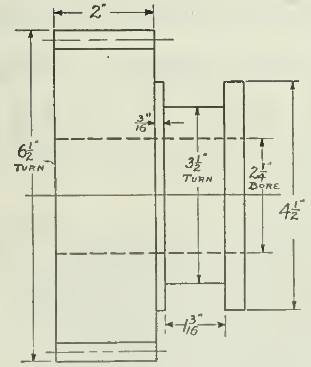
You cannot afford to buy a Bolt Cutter without thoroughly investigating the National.

THE NATIONAL MACHINERY COMPANY, Tiffin, Ohio

STEINLE

Full Swing Side Carriage Turret Lathes


Standard 24 in. High Power Heavy Duty Turret Lathe, arranged for belt drive and with oil pans, pump and piping



Sliding Spur Gear — Steel Forging Finish all over—Two chucking operations. TIME 15 MINUTES.

Just one of a great variety of jobs being turned out on Steinles at one of the truck and tractor plants of the International Harvester Corporation.

Why not send us your blueprints if your requirements call for the installation or equipment of this character? We shall be glad to furnish you with production and tooling estimates, or to have a qualified representative call and take up the question of Steinle methods as applied to your problems.

STEINLE TURRET MACHINE CO.

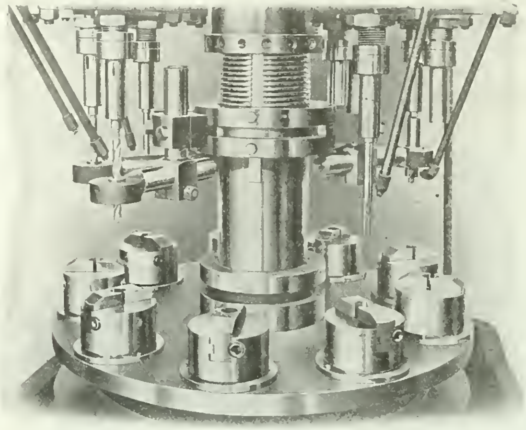
Madison, Wisconsin, U. S. A.

Originators of the Full Swing Side Carriage Turret Lathe

AGENTS—Machine Tool Engineering Co., Singer Bldg., New York City; Cadillac Tool Co., Dodge Power Bldg., Detroit, Michigan; L. G. Henes, 75 Fremont St., San Francisco, Cal., and Title Insurance Bldg., Los Angeles, Cal. FOREIGN—Leo C. Steinle, 53 Victoria Street, London, England.

SUPER-MATIC

More Operations at Less Cost



A Machine That is 300% Faster

The Supermatic combines the best features of the gang drill and the automatic screw machine with other advantages distinctively its own—including a three-way adjustment of each spindle, eliminating costly jigs; only one position for loading; individual speed for each spindle; any number of spindles up to 20 built into the machine; no skill required to operate and no set-up complications.

Drills, reams, counterbores, taps, faces, etc., in a series of progressive operations and *every index means a finished part.*

Estimates from samples or blueprints. Details in catalog.

THE ACME MACHINE TOOL COMPANY
CINCINNATI, OHIO, U. S. A.
Manufacturers of Cincinnati Acme Turret Machinery

Profit by the Example of Others, Install

CINCINNATI-ACME

TURRET MACHINERY

No need to guess or experiment. Simply follow the examples of these well-known companies, all of whom use one or more Cincinnati-Acme Lathes.

Canadian Pacific Ry; Cadillac Motor Car Co; Packard Motor Car Co; Ford Motor Co; Santa Fe R. R.; Bosch Magneto Co; Chalmers Motor Car Co; C. B. & Q. R. R.; Erie R. R. Co; General Electric Co; E. I. Du Pont de Nemours Powder Co; International Motor Co; Illinois Central R. R.; Kelly-Springfield Motor Truck Co; Lincoln Motor Co; Northway Motor Co; Peerless Motor Car Co; Pierce-Arrow Motor Car Co; Pennsylvania R. R., and a long list of other concerns, equally well known.

The photograph shows one of two Acmes on the job in the Detroit factory of the Hinkley Motors Corp. Each machine is keyed up to 30 fixtures per hour. Write for the complete Cincinnati-Acme story.

The Acme Machine Tool Co.
CINCINNATI OHIO, U. S. A.

Agents in all leading cities at home and abroad

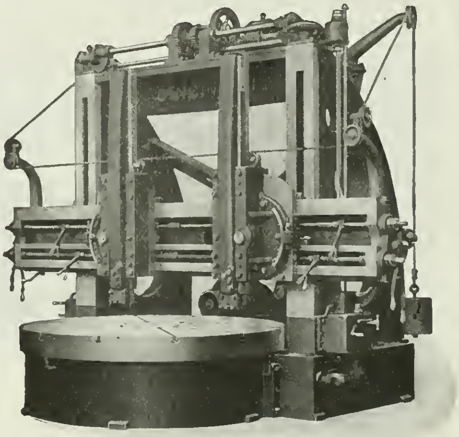
CINCINNATI

PLANERS *Original Thru out* BORING MILLS

For Better Tomorrows

buy Cincinnati Boring Mills—they have Rapid Power Traverse, Selective Speeds, Quick Change Independent Feeds for each head and Centralized Control.

The Cincinnati Planer Co.
Cincinnati Ohio, U. S. A.
Manufacturers of Planers and Boring Mills



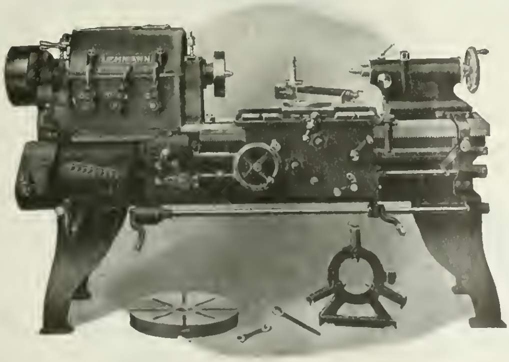
Size 42" to 12'. Cut shows heavy model.

The "Lehmann" Improved Selective Head Lathes

(Patents Pending)

SIZES—14" to 24" Swing

On account of its simplicity of construction, great driving power and rigidity, ample range of speeds, moderate tooth travel of its gears, compact and shapely appearance, the "LEHMANN" Selective Head Engine Lathe stands today in a class *ahead* and *alone*. Some of the features of construction are:—



Sixteen Spindle Speeds in correct geometrical progression obtained with the use of only ten gears.

Improved Friction Clutches (Patents Pending) running in oil, requiring no adjustment and giving forward and reverse control of spindle.

Heat-treated or Hardened Steel gears.

All Shafts, except spindle, running on ball bearings.

Spindle of alloy steel, hardened and ground at the bearings and running in phosphor bronze boxes.

Head Casting forms oil-tight case enclosing all running parts.

In addition these lathes embody all features such as the patent quick change mechanism, the tailstock spindle locking device, the rod and screw shift, etc., forming part of the "LEHMANN" Cone Head Lathes which have acquired an enviable reputation for accuracy and production.

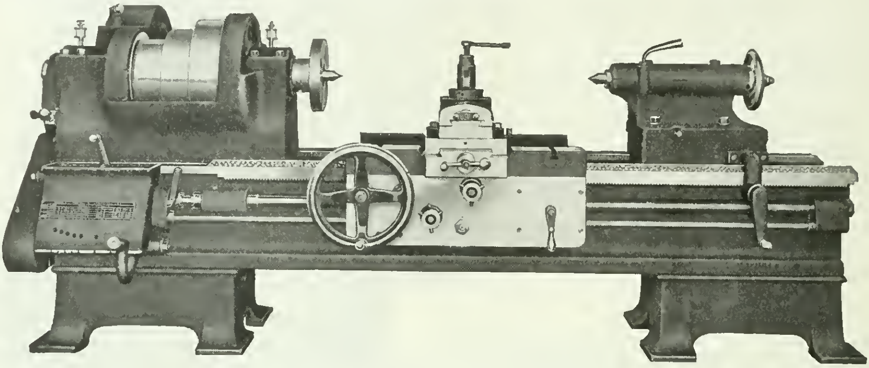
Let us Describe more fully this Exceptional Lathe and its Distinctive Advantages

LEHMANN MACHINE COMPANY, St. Louis, U. S. A.
CHOUTEAU AVENUE at GRAND

FLATHER LATHE

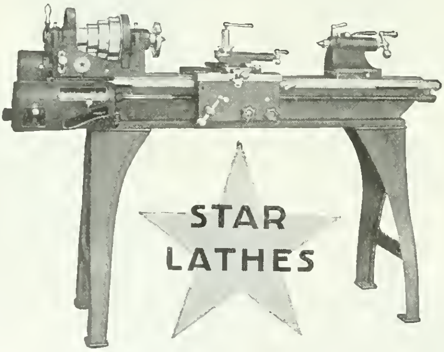
Over fifty years' experience in lathe manufacture enables us to make them exactly the kind of lathes you need. Modern machines, accurate, simple in construction and convenient—made to exacting standards, to meet exacting demands.

Write for circular and more details. Cut shows the Flather Double Back Geared Lathe made in 24" and 26" sizes.



FLATHER & CO., Inc., Nashua, New Hampshire, U.S.A.

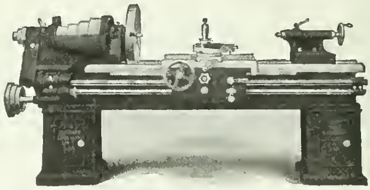
"STAR" LATHES



Pick the "Star" for particular work; for small and average sized work where speed and accuracy are important. "Star" Lathes require very little floorage; use little power; are easily operated and economical to both purchase and run. Let us tell you all about "Star" and "Short-Cut" Lathes, and what they will do for you. Write.

11 in. x 5 ft. "Star" Lathe—Quick Change Gears
Also built in 9", 12" and 13" Sizes
Send for Catalog No. 27

The Seneca Falls Mfg. Co., Inc.
381 Fall Street SENECA FALLS, N. Y.
New York Office and Permanent Exhibit
45 West 18th St., New York City



STANDARD ENGINE LATHES

14", 16", 18" and 20" swing. Beds 6 ft. to 16 ft. A moderate price engine lathe combining simplicity and accuracy with first class workmanship and materials.

"QUALITY WITHOUT FRILLS"

Send for descriptive circular and prices

THE STANDARD LATHE WORKS
2951-61 Colerain Ave. CINCINNATI, OHIO, U. S. A.

Cone 4-Spindle Automatics

Are economical and accurate producers of screw machine parts up to 3½" to 7". They cut costs, increase production, boost profits. Write for particulars.

CONE AUTOMATIC MACHINE CO., Inc., Windsor, Vermont
Agent for Michigan Territory: J. C. Austerberry, 684-690 E. Congress St., Detroit, Mich.

How to Run a Lathe
An 80 page book
For 10c postpaid
Coin or Stamps

SOUTH BEND LATHES

For the Machine and Repair Shop

9" Lathe $215.00 15" Lathe $450.00
11" Lathe $275.00 16" Lathe $525.00
13" Lathe $365.00 18" Lathe $685.00

South Bend Lathes are made in eight sizes, 9" to 24" swing, inclusive.
Established 1906. Free Catalog.

SOUTH BEND LATHE WORKS
420 Madison St. South Bend, Ind.

Porter-Cable Tool-room Lathes

Seven in this Plant

Every worker in the big precision tool shop where this picture was taken is a skilled mechanic, carries his own private kit of small tools and knows and demands the best material and equipment to work with. All are fully satisfied with the performances of the Porter-Cable Tool-room Lathes furnished by the management and like their convenience and versatility, their uniform accuracy and the simple but efficient clutch mechanism which transmits power from the gear box.

Illustrated Bulletin on request

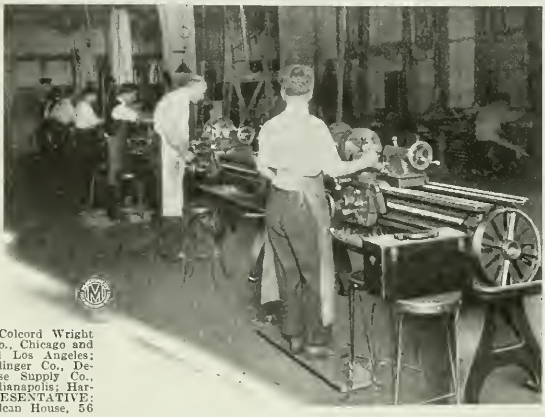
The Porter-Cable Machine Co.

SYRACUSE N. Y., U. S. A.

AGENTS: Carpenter & Woodward, Inc., New York City; Colcord Wright Machinery & Supply Co., St. Louis; E. L. Essley Machinery Co., Chicago and Milwaukee; Pacific Tool & Supply Co., San Francisco and Los Angeles; W. E. Shipley Machinery Co., Philadelphia; Charlea A. Strelinger Co., Detroit; Strong, Carlisle & Hammond Co., Cleveland; Syracuse Supply Co., Syracuse, Buffalo and Rochester; Vonnegut Machinery Co., Indianapolis; Harold A. Wright, 40 Court Street, Boston. EXPORT REPRESENTATIVE: Benjamin Whittaker, Inc., 21 State St., New York City; Vulcan House, 56 Ludgate Hill, London, E. C.

Porter-Cable Tool-room Lathes are made with 12″ or 14″ swing and 4′, 5′, 6′ or 8′ bed. Lead screw is not splined, has no gears attached to it and is used only for thread chasing. All gears are of steel, all important bearings are bronze-bushed and 47 feed changes are instantly available.

Relieving attachment is designed to be used on straight or taper work and the taper attachment will turn 10¾″ at one setting with a taper of not more than 4″ per foot.

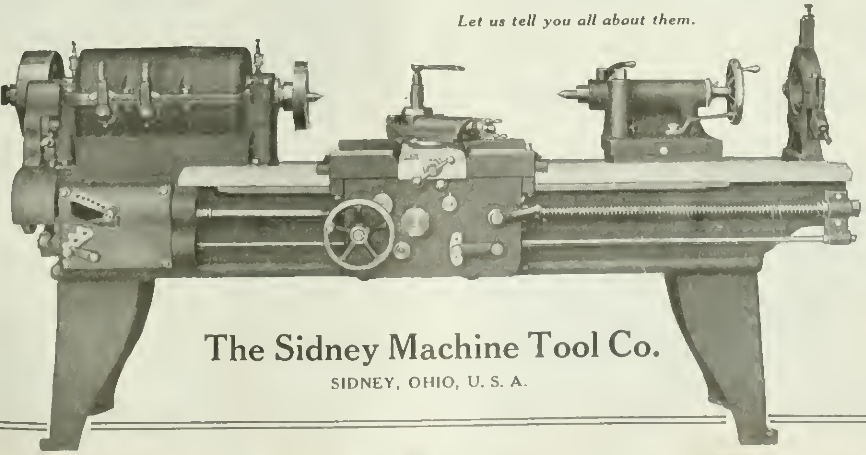


THE SIDNEY MACHINE TOOL COMPANY

"Sidney-for-Service" Lathes of Real Quality

The Sidney line is complete—the development of years of practical experience—and meets every modern shop requirement. Made of best material throughout and guaranteed to bore straight and turn true within .001″ limits. Each lathe is designed for a particular class of service and equipped with exclusive advantages which facilitate the performance of a wide variety of operations.

Let us tell you all about them.



The Sidney Machine Tool Co.

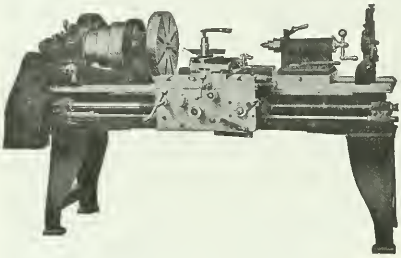
SIDNEY, OHIO, U. S. A.

For close limit special operations in the tool or contract shop; for rapid production manufacturing work; and for all the many jobs between these two extremes there is always the right

BRADFORD LATHE

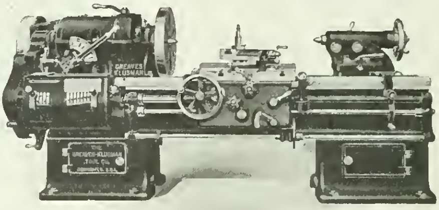
Convenient, practical, thoroughly modern machines made in sizes from 14″ to 42″ swing.

Let us send you circulars of the entire line.



Bradford Machine Tool Co.
Cincinnati Ohio, U. S. A.

Greaves-Klusman Lathes



Some Points Well Worth Noting

The numerous G-K "betterments" which distinguish this Heavy Quick Change Geared Head Type Lathe are well worth your attention. Note the reinforced bed and carriage; the patent tailstock. Observe that the spindle center is back of center line of bed, and that feed rod and lead screw are supported at both ends of apron, the latter being of double plate box form. Steel friction gears in apron have cast-iron frictions bolted on, and transmission gears are scientifically hardened and heat-treated.

Write for catalog and name of nearest agent

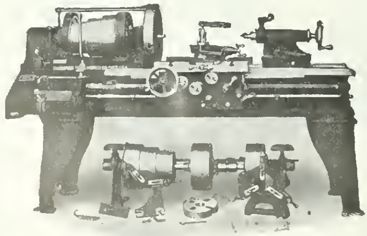
The Greaves-Klusman Tool Co.
CINCINNATI OHIO, U. S. A.

CHAMPION LATHES

Four sizes—12″, 14″, 16″ and 18″, single or double back gear—standard or quick change, taper attachment, motor drive, collet chuck, oil pans, etc.

These machines are made of best materials obtainable under exacting conditions. They are quality lathes as attested by the many large reputable users in all lines of industry. Consistent with quality and design, price is not the lowest, but if you need a good tool, medium priced, you should not overlook the Champion.

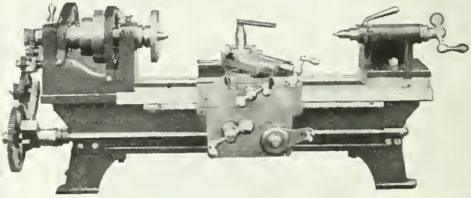
Our complete catalogue on request



CHAMPION TOOL WORKS
4955 Spring Grove Ave., CINCINNATI, OHIO

GOING—
GOING—
GONE!

$185.00 takes it—
Including Countershaft

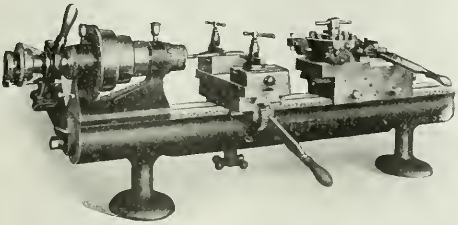


Johnston Lathe

If you stood up in an auction room and saw the Johnston Lathe going for $185.00, you'd be mighty glad to snap it up even if it were a bit "shop soiled." Yet here it is fresh from the hands of its builders at that price. The Johnston Lathe is designed for heavy and accurate work, and hasn't a superior for a machine of its size. Just what's wanted for machine shops, garages, manual training schools and the home. Actual swing 9½″, between centers 17½″, hole in spindle ¾″. Write for more information.

The Johnston Manufacturing Co.
Arlington New Jersey, U. S. A.

Potter Bench Lathe



A Machine Shop in Miniature

The Potter 7" Precision Bench Lathe is equipped with double cross-slide, lever tailstock, large and small turrets, improved lever chuck closer and internal and external grinding attachments. A two- or three-speed grinding countershaft is supplied, in addition to thread cutting and milling attachments. Durably constructed, well balanced, easily controlled; the Potter can safely be speeded up for the highest type of precision production.

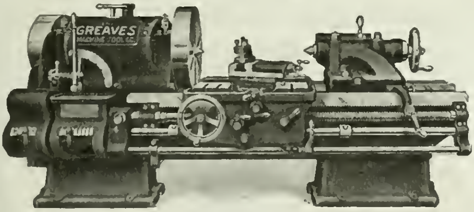
Write for Catalog No. 10.

S. A. Potter Tool & Machine Works
77 E. 130th Street New York City

Why Have a Multiplicity of Levers for Making Speed Changes, When the Same Can Be Accomplished By One?

Levers confuse the operator, besides making a machine complicated. GREAVES GEARED HEAD LATHES Start, Stop, Reverse, and make Speed Changes by means of one lever.

Drop us a line and let us tell you more about them.



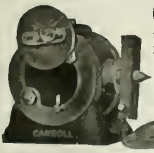
THE GREAVES MACHINE TOOL COMPANY
2116-22 Colerain Avenue Cincinnati, Ohio, U. S. A.

The Automatic Machine Company

BRIDGEPORT CONNECTICUT

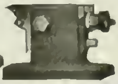
Makers of

AUTOMATIC THREADING LATHES
AUTOMATIC HOB THREAD MILLERS
COULTER MULTIPLE SPINDLE PROFILERS
COULTER SHAPING PLANERS
SPECIAL MACHINE TOOLS



CARROLL 10½' UNIVERSAL INDEX CENTERS

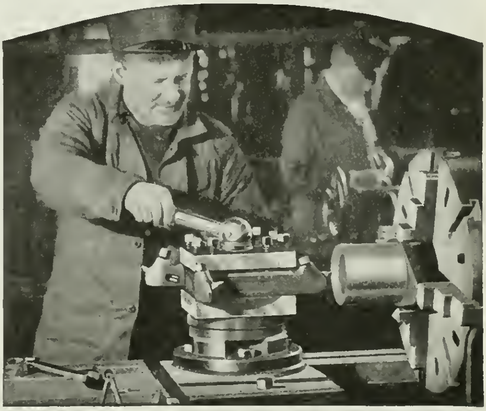
Used on Leading Milling Machines. For all requirements Strong-Rigid-Quick-Accurate. We can furnish this tool either Right or Left Hand type. All parts are interchangeable. Write us to-day for details.



WM. CARROLL & SON
Manufacturers
4220 Main Avenue
(Norwood) Cincinnati, O.

PHOENIX

TURRET ATTACHMENTS



Tipping or Shearing Positively Prevented

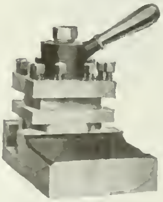
Phoenix Turret Tool Posts represent the standard of value in turret attachment for engine lathes. This is not alone based on the quality of materials and workmanship but also by the dependable service they render and the strictest shop economy they make possible.

One of many important exclusive Phoenix features is the ease with which each Pheonix Turret Tool Post is attached to the engine lathe and the rigid locking device which positively prevents any tipping or shearing of the attachment.

Satisfy Yourself -- Get the Facts

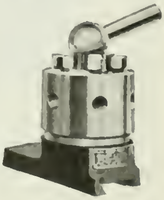
Prove to yourself that your engine lathes equipped with Phoenix Turret Tool Posts will give you turret lathe efficiency at engine lathe cost. Send today for new, illustrated folder which gives you all the facts and shows every style post we manufacture.

PHOENIX MANUFACTURING COMPANY
WORKS: EAU CLAIRE, WISCONSIN

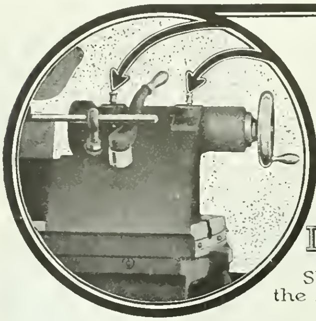


Dept. M8

There is a size and style Phoenix Turret Tool Post to suit all lathes and purposes.

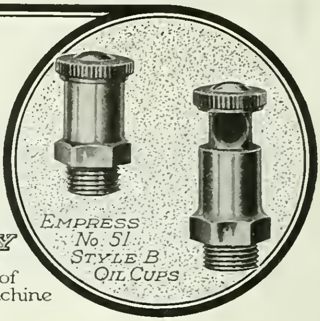


Known & Trusted Since 1861



Standard Factory Equipment
on the
Cylindrical Grinding Machines
Built by the
LANDIS TOOL COMPANY

Shown here as used on the tail stock of
the Landis No. 2 Universal Grinding Machine



Empress
Grease and Oil Cups

Provide a dominant factor for better lubrication and go far toward the satisfactory and reliable operation of Landis Grinding machines.

EMPRESS No. 51
STYLE B OIL CUP

This cup is particularly well suited to several phases of machine tool lubrication; it is self closing, cannot be left open, and is absolutely dust-proof when closed. The revolving top makes it possible to fill the cup from any direction. Its bright finish makes it so conspicuous that the operator cannot readily overlook it and fail to keep his machine well lubricated. Made in eight sizes, two finishes.

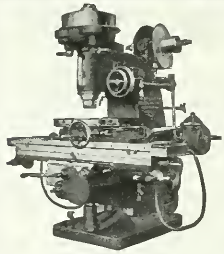
Write for Catalog-1

REG. U S PAT OFF Empress

Bowen Products Corporation

Manufacturing and Sales Divisions
Auburn Div., Auburn, N. Y. Winkley Div., Detroit, Mich.
Cleveland Div., Cleveland, Ohio.
Minneapolis Div., Minneapolis, Minn.

Branch Sales Offices
New York, 220 Broadway. Chicago, 1607 Otis Bldg.
San Francisco, Monadnock Bldg.
Boston, 453 Washington St.
Richmond, Va., 311 Am. Natl. Bank Bldg.



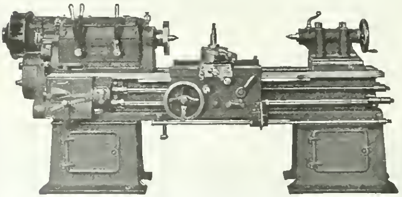
Becker Milling Machine

Lathes—Radial Drills—Planers

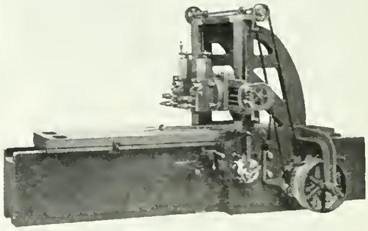
Milling Machines—Milling Cutters—Portable Shapers

The combined knowledge and experience of three long established firms is concentrated on providing the greatest and most economical production in each class.

Have you our catalogs?



Reed-Prentice Geared Head Lathe



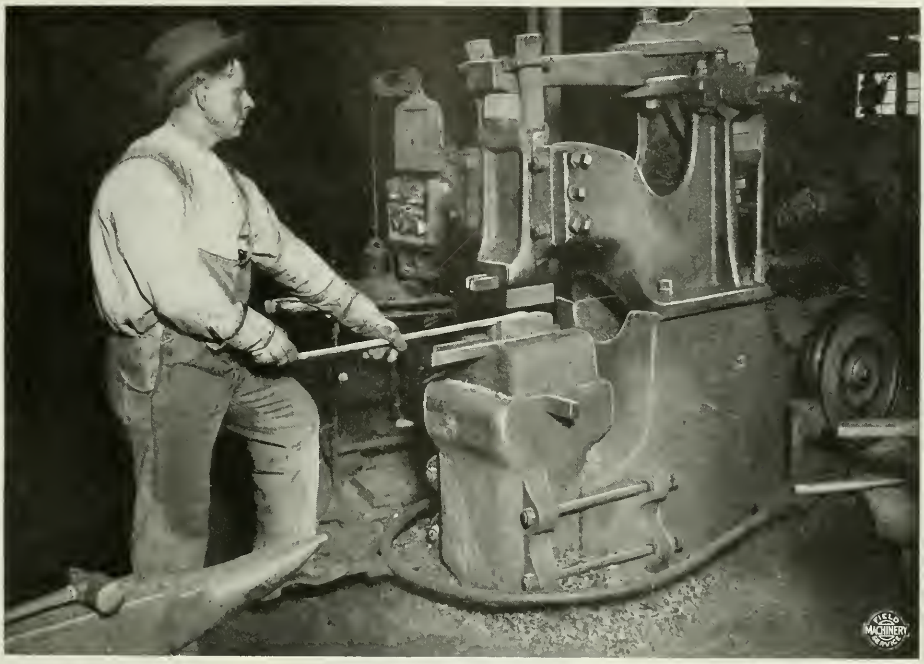
Whitcomb-Blaisdell Planer

BECKER-MILLING MACHINE COMPANY   REED-PRENTICE CO.   WHITCOMB-BLAISDELL MACHINE TOOL CO.

677 CAMBRIDGE STREET, WORCESTER, MASS.

SALES OFFICES: Cleveland, Indianapolis, Detroit, New York. AGENTS Dale Machinery Co., Chicago, Ill.; Normoyle & Lapp, 514 Liberty Bldg., Philadelphia, Pa.; M. D. Larkin Supply Co., Dayton, Ohio; O. R. Adams, Buffalo and Rochester, N. Y.; H. A. Smith Machinery Co., Syracuse, N. Y.; W. M. Pattison Supply Co., Cleveland, Ohio; Whitcomb-Blaisdell Agents only. Fairbanks Co., Pittsburgh and St. Louis; Badger Packard Machinery Co., Milwaukee, Wis. Becker Agents only: McCoy-Brandt Mchy. Co., Pittsburgh, Pa.; F. E. Satterlee Co., Minneapolis, Minn. Reed-Prentice Agents only: McCoy-Brandt Mchy. Co., Pittsburgh, Pa. Cutter Agents: George T. Aitken, Associated Service Bldg., Buffalo; J L. Stone-Leidy Co., Machinery Hall, Chicago; M D. Larkin Supply Co., Dayton, Ohio.

Sales Offices and Agents have Stock of Cutters for prompt deliveries.



BRADLEY-FORGING

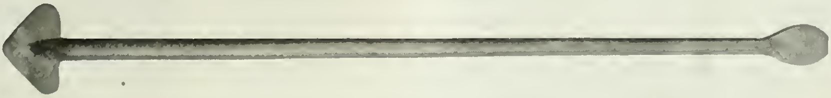
Automobile Fender Irons — 150 Per Hour

The Metal Auto Parts Company, of Indianapolis, Indiana, specialize in manufacturing automobile hoods and fenders and use this 150 pound Bradley Hammer exclusively for forging automobile fender irons from 7/8″ wrought iron rod.

These pieces are forged at both ends with the Bradley Hammer—a whole batch being finished on one end before the dies are changed to the form for the other end. When photographed the round end was being forged at the rate of 150 per hour. Bradley-Forging has a wide application to modern manufacturing.

Let us demonstrate on your own work

“Forge Ahead with a Bradley Hammer”

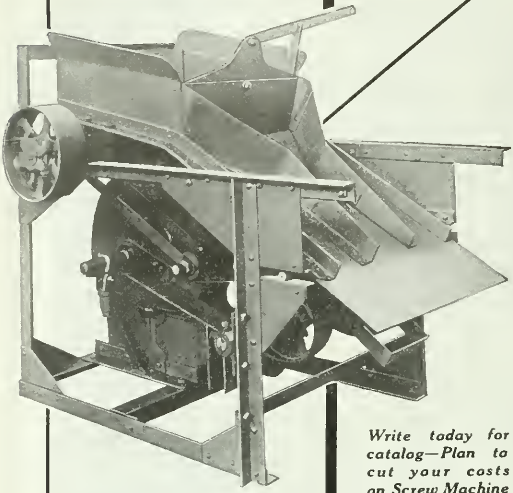


C. C. BRADLEY & SON, Inc., Syracuse, New York

Established 1832

WE MAKE
The Bradley Cushioned Helve Hammer
The Bradley Upright Strap Hammer.
The Bradley Upright Helve Hammer
The Bradley Compact Hammer.
Equipped for either belt or Motor Drive.
Forges for Hard Coal or Coke.

FOREIGN AGENTS England—Buck & Hickman, Ltd., London. France—Fenwick Freres & Co., Paris, Lyons, Rhone. Italy—Fenwick Freres & Co., Turin Belgium—Fenwick Freres & Co., Liege. Brazil—Fenwick Freres & Co., Rio de Janeiro Switzerland—Fenwick Freres & Co., Zurich. Spain—Fenwick Freres & Co., Barcelona Portugal—Fenwick Freres & Co., Lisbon. Alsace-Lorraine—Fenwick Freres & Co., Luxembourg China—Andersen, Meyer & Co., Shanghai. Norway, Sweden and Denmark—Chr. A. Herstad, Copenhagen, Denmark.



Early Recovery of Business Predicted By Chas. M. Schwab

but he advises ECONOMY. In a recent public statement, the noted industrial leader says "this is a time for encouragement, a time to be optimistic." Yet he sounds a warning note as to ECONOMY.

Ideal

Pneumatic Chip Separators Are Economical

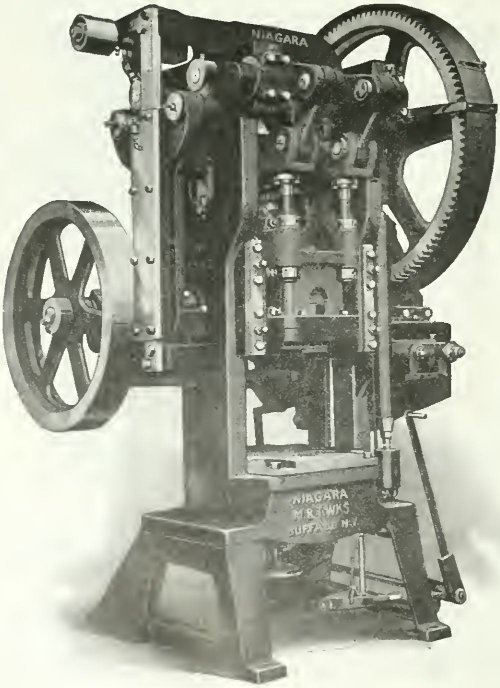
because they separate six times as fast as by hand; twice as fast as by riddle. The Ideal handles the long, stringy chips which the riddle can't handle, and which must be separated by hand.

Write today for catalog—Plan to cut your costs on Screw Machine work.

Operation:

The work is put into the hopper as it comes from the machines. The chips go over the slide, and the work drops into a tote box placed in front of the machine. No jamming, even if machine is overloaded.

The Ideal Concrete Machinery Co.
1325 Monmouth St. Cincinnati, Ohio



"NIAGARA"

Toggle Presses

Specially designed for seamless drawn sheet metal articles. Blank cutting, embossing or stamping can be combined with the drawing operation.

Our Engineering Department is at your service.

Large additional facilities enable us to make extremely interesting deliveries.

Send for Catalog No. 54.

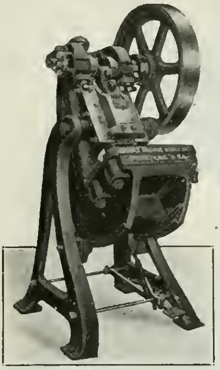
Niagara Machine & Tool Works
Buffalo, N. Y., U. S. A.

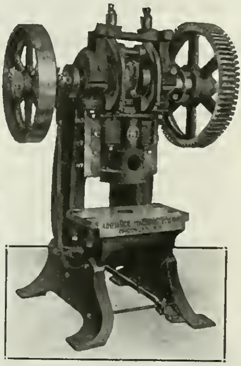
THE WORLD'S STANDARD

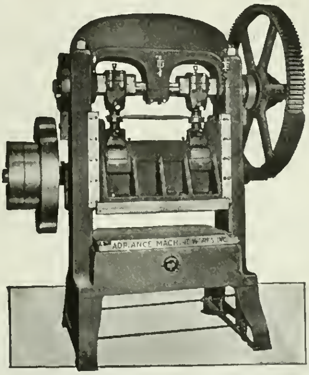
"BUILT TO ENDURE"

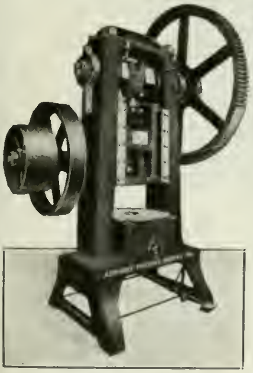
TRADE MARK

ADRIANCE

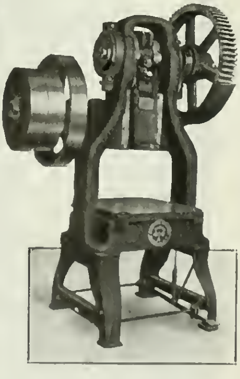

"Adriance" No. 4
Inclinable Open Back Press


"Adriance" No. 46
Double Action Cam Press
with Positive Lift


"Adriance" No. 58
Double Crank Press


"Adriance" No. 67A
Straight Side Press

Builders of Power Presses, Dies, Seamers, Slitters and Shears, Horning and Wiring Presses, Automatic Screw Machines, Strip Feeds, Stagger Feeds, Roll Feeds, Dial Feeds, Rectilinear Feeds, Bottle Cap Making Machines, Automatic Can Making Machinery and all the necessary automatic equipment required in the working of sheet metal.


"Adriance" No. 406A
Arch-Power Press

ADRIANCE MACHINE WORKS, Inc.

Established 1888 **78 RICHARDS STREET, BROOKLYN, N. Y.** *Incorporated 1913*

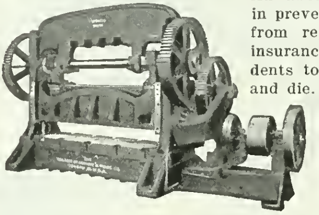
THE "TOLEDO"

DOUBLE CRANK PRESSES

All Sizes—All Weights—for All Purposes

The cut shows a press of this type especially designed for narrow channel blanking and forming; this machine can be fitted with power elevator for raising and lowering the sides.

All Toledo Power Presses equipped with automatic clutch can be fitted with a special Positive Automatic Safety Lock. An absolute safeguard in preventing the press from repeating—safety insurance against accidents to both operator and die.



No matter what your stamping work, there's a Toledo Press to do it.

The Toledo Machine & Tool Company

Toledo, Ohio, U. S. A.

Chicago Office: Room No. 608 Machinery Hall, 549 West Washington Boulevard.

An Arbor Press

of Unusual Power and Range

Price $31.00

Details on request

You can see at a glance that this No. 3 press is rugged and strong; that the throat is deep (13") to accommodate large work, the ram extra large and heavy—1½" by 1½" by 17"—and the lever amply long to obtain leverage. We build only the one size (in bench and pedestal types) and concentrate all our efforts on making it right in every way.

K. R. WILSON

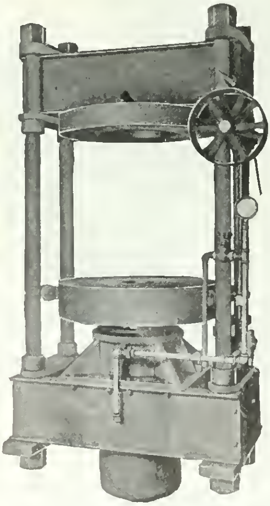
10 Lock Street Buffalo, N. Y.

Hydraulic Presses

FROM

100 to 300 TONS

CAPACITY



Rochester Helve Hammers

West Hydraulic Tire Setters

THE WEST TIRE SETTER CO.

Rochester, New York

FERRACUTE

PRESSES

FOR

Cutting,

Forming,

Drawing,

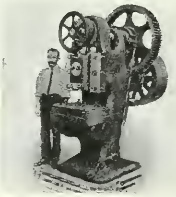
Punching,

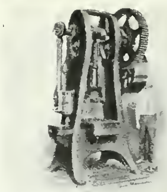
Shearing,

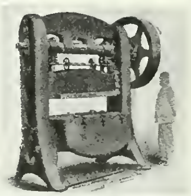
Coining and

Embossing

METALS







FERRACUTE MACHINE CO., BRIDGETON, NEW JERSEY

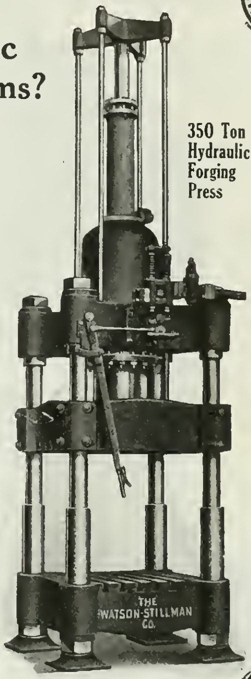
Have You Ever Considered Hydraulic Pressure for Your Manufacturing Problems?

Do you know that many of the operations you are now doing with Drop Hammers, Toggle Presses, Screw Presses and Other Methods can be done best on an Hydraulic Press?

Because of the

- Low cost of upkeep
- Can be installed in small space
- No heavy foundations required
- No jar in operation
- Safety in operation
- No gears to break
- No bearings to wear out or replace
- Accurate pressure and known pressure being exerted by means of the pressure gauge
- Wide range of pressure possibilities without adjustment

Write us for details, send in your problem and let our engineers advise how best to accomplish results. We build everything necessary to the complete installation of an hydraulic press installation.



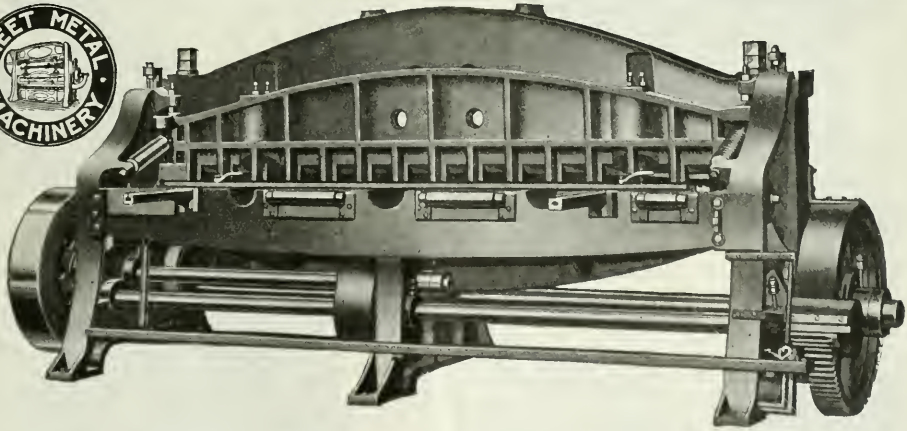
350 Ton Hydraulic Forging Press

The Watson-Stillman Company

Engineers and Builders of Hydraulic Machinery

192 FULTON STREET NEW YORK

Chicago, McCormick Bldg. (452)



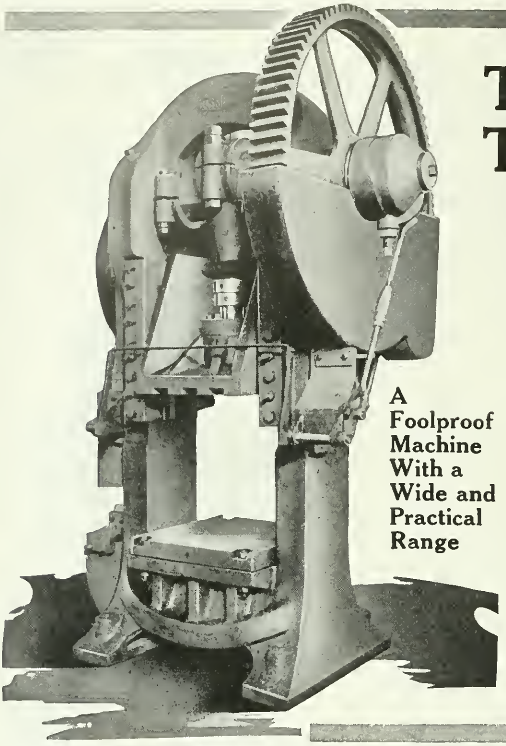
L & N Squaring Shear

NO. 3010
CAPACITY 3/8 IN.

The Machine You Need to be Fully Equipped

Ranking first in importance of all sheet metal working machines the Squaring Shear should be chosen with unusual care. If your plant is handicapped by shearing machines which give you neither the necessary speed nor accuracy, investigate the L & N line; many well-known concerns would not consider their plants properly equipped without it. Loy & Nawrath Squaring Shears have eight unique features, all of which are vital to efficient operation. Let us tell you what they are.

Loy & Nawrath Company, 21 Runyon St., Newark, N. J.



THE MASSILLON TRIMMING PRESS

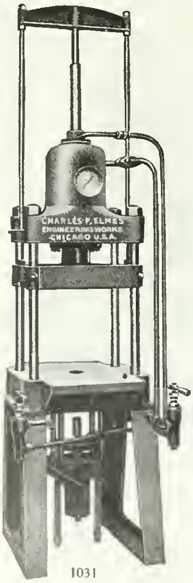
A Foolproof Machine With a Wide and Practical Range

The most interesting feature of this new machine is the clutch mechanism, which is guaranteed foolproof, *i. e.*, never repeats or fails to operate. It is entirely enclosed by the clutch case and runs in a bath of oil; is operated by a tripping lever or foot-treadle; the jaws on both members are made of hardened steel.

Frame and legs of this powerful machine are of semi-steel, cast in one piece; main gears and pinions of open-hearth steel with machined teeth and its capacity fully equals any drop-hammer built or building.

Let us tell you more about it.

The Massillon Foundry & Machine Co.
MASSILLON OHIO



1031

Inverted Type with Knockout

FAST HYDRAULIC PRESSES

FOR
METAL FORMING
AND
PLASTIC MOULDING

ELMES CHICAGO

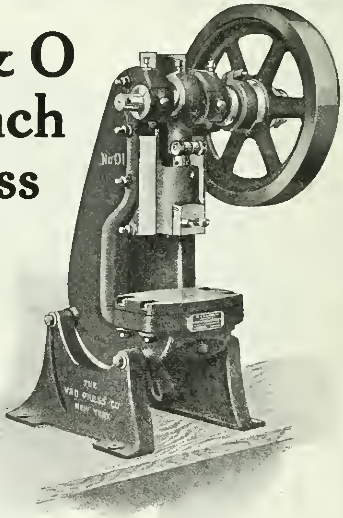
Hydraulic Presses, Pumps and Accumulators

Send for Catalogs.

Charles F. Elmes Engineering Works
222 N. Morgan St. CHICAGO, U. S. A

V & O Bench Press

Built with V & O Double Length Slide



Fast—Efficient—Accurate

Especially suitable for precision work such as Computing Machine Parts, Typewriter Parts, Snap Fasteners, etc. Write for descriptive Catalog.

THE V & O PRESS COMPANY
100 Dry Harbor Road (Glendale) BROOKLYN, N. Y.
Permanent Exhibit, Central Square Bldg., Lexington Ave. and 46th St.

SWAINE

Metal Working Machinery

Strong—Speedy—Safe

Swaine Presses are particularly noted for their strength, speed and safety. Designed by skilled engineers with the cumulative manufacturing experiences of half a century behind them, they are recognized as the last word in metal working equipment.

Among their important features are vanadium steel shaft and clutch parts, self-oiling bearings, automatic safety lock and improved slide adjustment graduated to .001″.

Swaine Metal Working Machinery is made for a multitude of purposes.

Write for particulars.

Fred. J. Swaine Mfg. Co.

Seventh and O'Fallon Streets
ST. LOUIS MISSOURI

ACME ROLL FEEDS

What is Everybody Looking For?

Lower costs, of course, and we're going to tell you one way of finding them. Here's an appliance which will pay for itself in ninety days; after that it will pay you.

The Acme Roll Feed and Scrap Cutter will turn your hand fed punch press into a modern automatic—will double or treble your production.

With the Acme Roll Feed attachment one man will look after as many as three presses, and the Scrap Cutter will save him the trouble and danger of keeping the tables clear of waste stock.

If you handle ribbon stock the Acme Roll Feed will revolutionize your production. Put yourself in possession of the full facts.

F. J. LITTELL MACHINE CO.
SUCCESSORS TO
ACME MACHINE WORKS
4125 Ravenswood Avenue Dept. B CHICAGO, ILL.

Hydraulic Presses

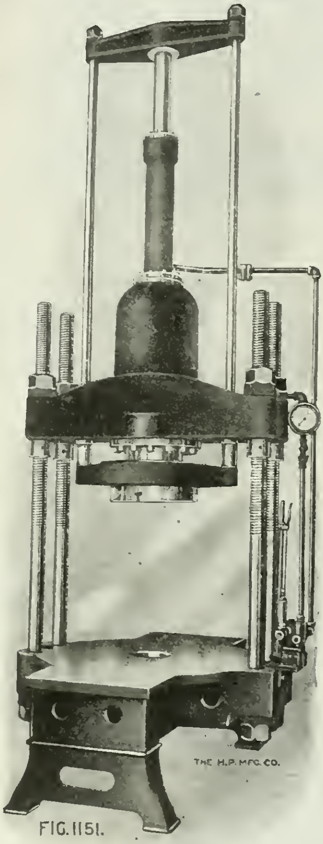


FIG. 1151.

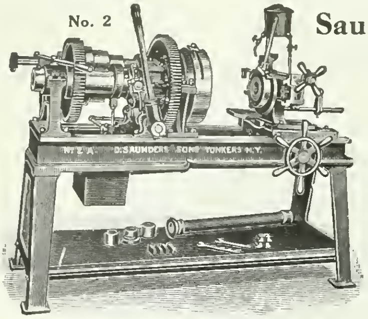
A Forty-four Year Record of Satisfactory Service

The advantages of the Hydraulic Press over all other types are so apparent and established that comparisons are superfluous. Since 1877 we have been designing and perfecting Hydraulic Machinery and adapting it to the needs of hundreds of industries. We make Hydraulic Presses and Machinery for every conceivable purpose. Our product is in use all over the world and is making good.

Write for our Catalog.

THE HYDRAULIC PRESS MANUFACTURING CO.
America's Authority on Hydraulic Machinery
Mount Gilead, Ohio, U. S. A.
New York Buffalo Detroit Cleveland San Francisco

"For Your Pressing Needs"



Complete description in Catalog "P"

Saunders' Machines—O. K. for Threading and Cutting Off Pipe up to 18" Diameter

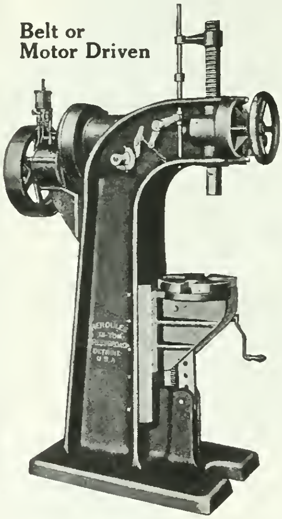
Every machine of the Saunders' line is a big producer—simple, convenient, well-constructed and provided with exclusive advantages for handling all classes of pipe work within its range.

The No. 2A Machine shown is equipped with our patent Lever Gripping Chuck by which pipe is gripped or released without stopping the chuck's rotation. Another feature, the Adjustable Expanding Die Heads, permits the pipe to pass through the cutting head without injuring thread or chasers.

D. SAUNDERS' SONS, Inc., Yonkers, New York

THE HERCULES POWER PRESS BROACH

Belt or Motor Driven



A powerful and productive machine, with three speeds, automatic throughout, removable knee and single lever control. Well adapted for depth, draw or push broaching operations, forcing, bending, straightening, splining, keyseating, etc.

Saves both time and trouble.

More details on request.

Hercules Machinery Company

110 Woodbridge Street DETROIT, MICHIGAN

Forging Rolls
Drop Hammers
Yeakley Hammers
Presses
Plate Shears
Multiple Punches
Multiple Tapping Machines
Punches and Shears, Etc.

WILLIAMS, WHITE & CO.

MOLINE, ILL., U. S. A.

THE BULLDOZERS

PRESSES AND SHEARS

SHEET METAL WORKING MACHINERY

THE D. H. STOLL COMPANY, Inc.

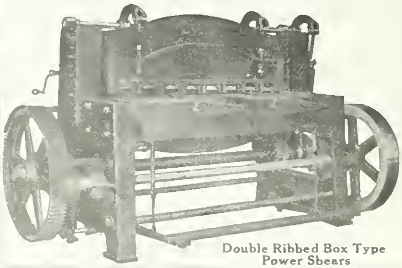
Military Road and Grote Street BUFFALO, NEW YORK

AUTOMATIC BAIRD MACHINERY

PRESSES—Foot and Power.
WIRE FORMING MACHINES—Standard or special.
TUMBLERS—All kinds.
BALL BURNISHING EQUIPMENT.

BAIRD MACHINE CO.
BRIDGEPORT, CONN.

SHEET METAL WORKING MACHINERY



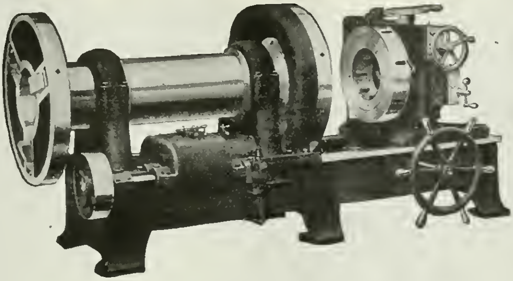
Double Ribbed Box Type Power Shears

Power Squaring Shears	84 Sizes
Power Gap or Splitting Shears	25 Sizes
Corrugating and Crimping Rolls	20 Sizes
Corrugated Curving and Culvert Rolls	6 Sizes
Corrugated Can and Tank Machines	8 Sizes
Forming Presses and Brakes	12 Sizes
Conductor Pipe and Eave Trough Machines	All Sizes

Twenty-five years' experience in designing and building special sheet metal working machinery.

The Streine Tool & Mfg. Company

NEW BREMEN OHIO, U. S. A.



PEERLESS B&K DUPLEX P.D.Q.

Conspicuous By Their Absence

Run your finger down the list of second hand machines and note the absence of B & K Pipe Machines. True, you will find one now and then. Even this now and then machine would be a good buy.

B & K users are so well satisfied they do not want to sell them. When 65 out of 85 firms in one city placed repeat orders there must have been 65 satisfied pipe machine users. The other 20 may have been satisfied, too, but had no need for another machine.

Catalog showing the entire line on request.

BIGNALL & KEELER MACHINE WORKS
EDWARDSVILLE, ILLINOIS

IRON WOOD-SCREW MACHINERY

Since 1858 Cook's Automatic Screw Machines have been the standard machines used for making Iron Wood-Screws.
We specialize in manufacturing machinery and equipment for Wood-Screw Plants.
Estimates and specifications furnished.

RAPID PRODUCTION **QUANTITY OUTPUT** **EVERY SIZE SCREW**

Iron Wood-Screws made on our machines

Write for
HAND-BOOK
D-9

Codes Used
Lieber's
Western Union

Cable Address
"COOK"
Hartford, U.S.A.

The Asa S. Cook Co., Hartford, Conn., U. S. A.
ESTABLISHED 1858

Nos.
1, 2 and 5

Reverse Side of Nos. 1, 2 and 5.

Note Slot for Sheets

Is Your Power Idle?

Here is a line of machines that can produce whether your motors or engines are running or not. The handiest asset with no overhead cost.

Hercules Shears and Rod Cutters

the double purpose machine.

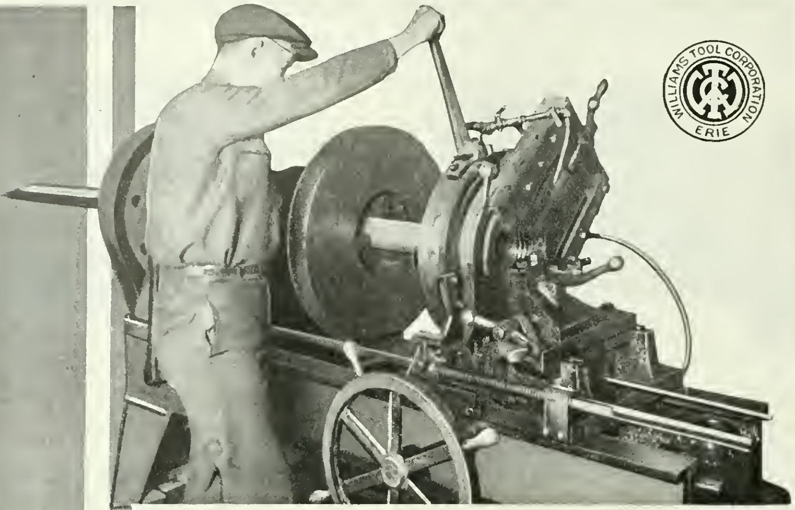
No. 0 cuts 1/16" flats and under.
No. 1 cuts 3/16" flats and under.
No. 2 cuts 1/4" flats and under
No. 5 cuts 5/16" flats and under

No. 0 cuts rods 1/8", 3/16", 1/4" and under
No. 1 cuts rods 1/4", 3/8", 1/2" and under.
No. 2 cuts rods 3/8", 1/2", 5/8" and under
No. 5 cuts rods 1/2", 5/8", 3/4" and under.

Send for Shear Catalog.

MANUFACTURED AND FOR SALE BY **W. M. & C. F. TUCKER, Hartford, Conn., U. S. A.**

FOREIGN AGENTS: Fenwick Freres & Co., Paris, France; Alfred Herbert, Ltd., Yokohama, Japan; Fermer & Co., London, Eng.



WILLIAMS

Pipe Threading Machines

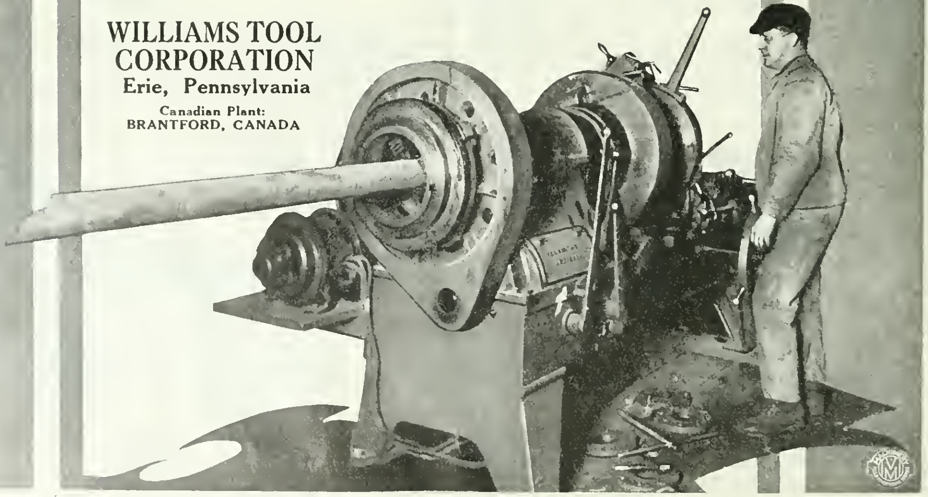
A new way of cutting tapered threads

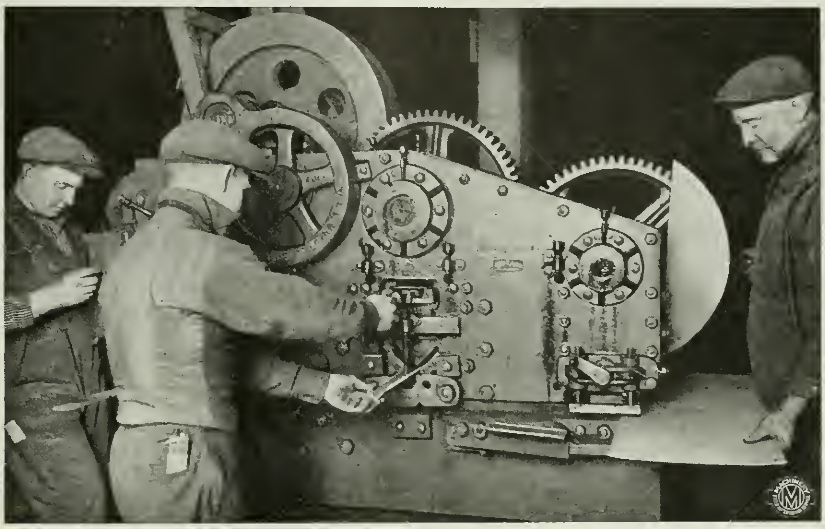
No longer is the length of a thread dependent upon the width of the die. The new Williams automatic taper attachment makes possible any degree of taper to any desired length.

This evolutionary improvement is further evidence of the Williams doctrine "to cut threads better, quicker and at lower cost."

Write for the complete story. It's real news!

WILLIAMS TOOL
CORPORATION
Erie, Pennsylvania
Canadian Plant:
BRANTFORD, CANADA





"Buffalo" Armor Plate Punch, Shear and Bar Cutter

One Small Machine Does All the Metal Cutting Work in this Shop

The man at the left is punching ⅜″ holes in ¼″ machine steel, the center worker is cutting a piece of angle iron and the man at the right is shearing a 3/16″ steel plate. Three independent operations simultaneously performed without inconvenience to the workers or interference with the work.

This small Buffalo "Universal," like its larger brothers, depends on strength—not weight—for its power. It will work to capacity, punching holes up to ¾″ in ½″ steel and shearing steel plates up to ½″ thick as easily and almost as quickly as it handles the work in operation here. Armor Plate construction alone makes possible such compact design, unusual capacity and amazing versatility in a machine of this size.

Installed in the shop of the Contractors Ornamental Steel Company, Buffalo, N. Y., in August 1920; they say of it after one year of service "It is practically indispensable."

Buffalo Armor Plate Punches, Shears and Bar Cutters are made in a large range of sizes and in various combinations. Catalog 325-51 lists them all. Send for it.

BUFFALO FORGE COMPANY, Buffalo, N. Y.

GRANT

RIVETING

Fine Shears

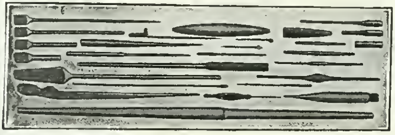
Setting durable rivets that will not work loose or bind; that will guarantee the durability of the shears as long as the blades can be used. Production is good, the finish excellent.

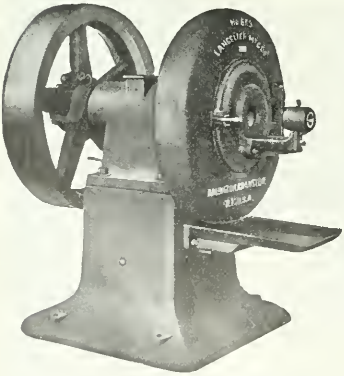
Grant Riveters work easily and almost noiselessly and are rarely out of order. If you set tight or loose rivets in any class of work ask us about these machines.

Grant Manufacturing and Machine Company
BRIDGEPORT N. W. Station CONNECTICUT

ROTARY SWAGING

The MODERN METHOD of Accurately Forming Metal with ECONOMY





The function of these machines is the reduction sizing or tapering of metals of round, square, hexagonal or other section to a circular section either solid or tubular and hot or cold by power actuated dies striking up to as meny as 3000 blows per minute.

Our policy is to equip the machines in every detail with work holders and feeding devices that will enable them to give the most efficient service at low upkeep expense when operated by unskilled labor.

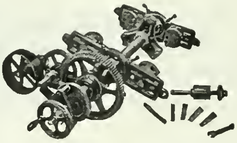
Machines built up to date, have capacities ranging from a pin point up to 2½" diameter on solid stock and up to 5½" on tubing.

LMCo.

LANGELIER MFG. COMPANY
Arlington, Cranston, R. I., U. S. A.

When You Overhaul Your Plant

this year, don't dismantle the engine. You can rebore cylinders, valves, etc., *in place* with the



UNDERWOOD PORTABLE BORING BAR

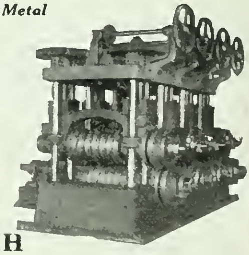
It's one of the handiest of our many handy tools. Write for catalog.

H. B. Underwood Corporation
PHILADELPHIA (Est. 1870) PENNA., U. S. A.

K & R Straightening Machines

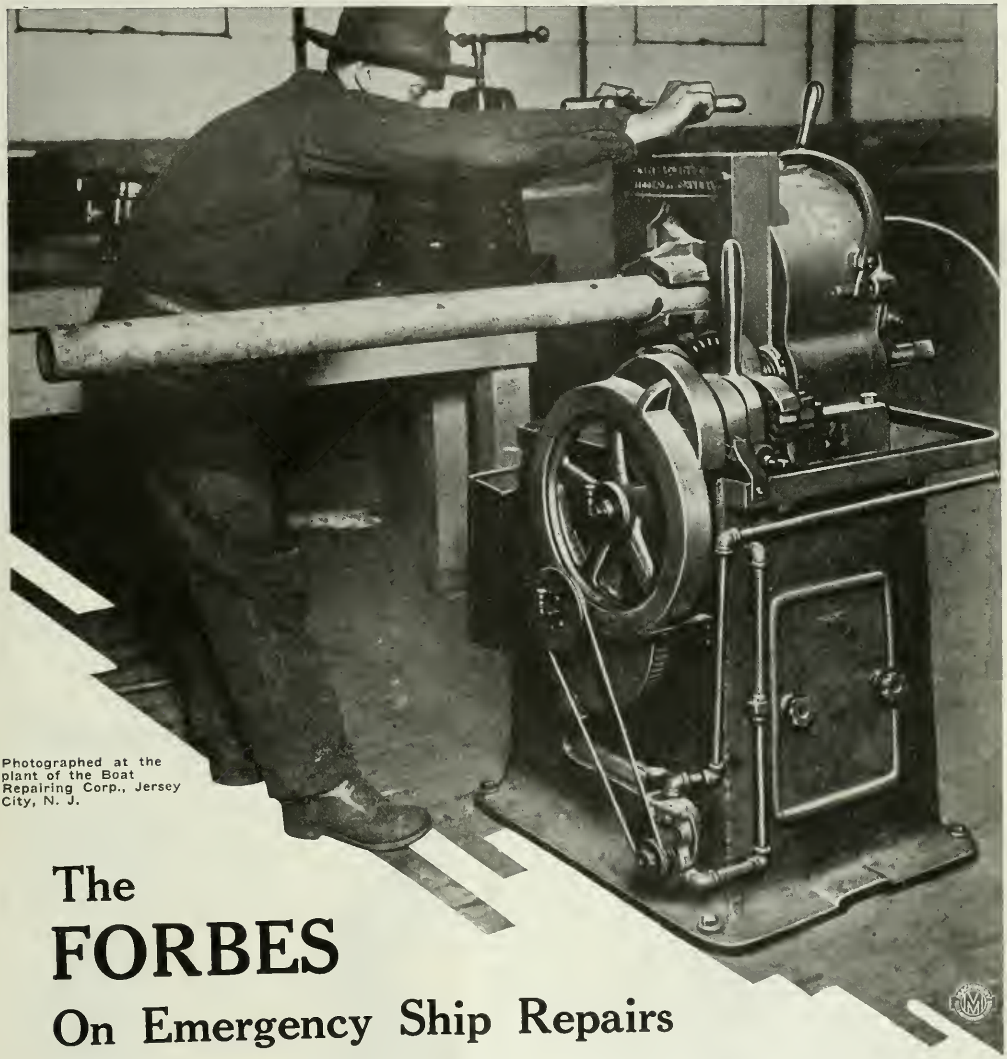
For any size or Shape of Metal

Built in diversified styles and sizes to straighten Rounds, Squares, Flats, Angles, Channels, I-Beams, Tubing, Pipe, Sheets, etc. Also machines for straightening stock from the coil and automatically cutting to lengths. Write for Catalog.



No. 6 Straightener

KANE & ROACH
Syracuse (Est. 1887) N. Y.



Photographed at the plant of the Boat Repairing Corp., Jersey City, N. J.

The FORBES

On Emergency Ship Repairs

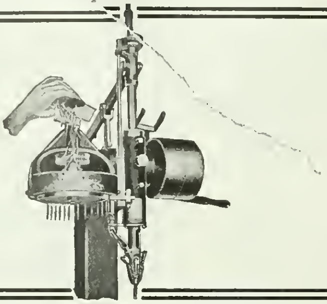
Frequently important, usually in a hurry, repair work on the tugs, barges and other craft that come to this Jersey City shipyard gives plenty of opportunity for this busy Forbes to show its mettle. Simple, compact and self-contained, it is *portable*—and works equally well in its place in the shop or on shipboard, where it can easily be taken to thread and cut the pipe without dismantling the work.

Send for our catalog. Let us tell you how the Forbes works and where the difference lies. Sizes to take pipe 16". Belt or motor drive or hand operation.

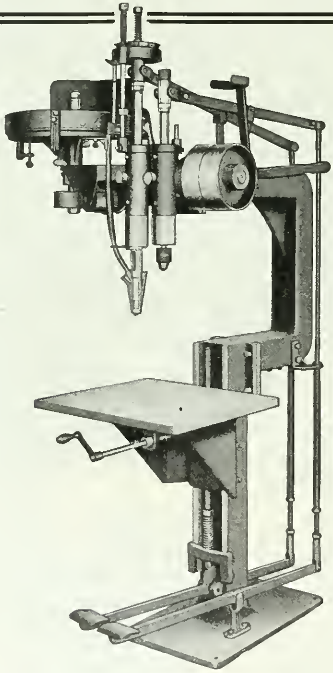
CURTIS & CURTIS COMPANY, 324 Garden St., Bridgeport, Conn.

FOREIGN AGENCIES: Andersen, Meyer & Co., Ltd. of China, Shanghai, China. Horne Company, Ltd., Tokyo, Japan. Aktiebolaget Sigfr. Anderson & Co., Malmo, Goteborg, Scandinavia and Stockholm, Sweden.

Don't Waste Time and Money Driving Screws by Hand



Reynolds Magazine Fed Screw Driving Machine



Drives machine screws, wood screws, stove bolts, hex head or square head bolts, or most anything that can be magazined.

Follow the example of your competitors and install Magazine Fed Screw Driving Machines

The Reynolds Machine Co.
Dept. M (Information)
MASSILLON OHIO, U. S. A.

Hurlbut-Rogers Broaches

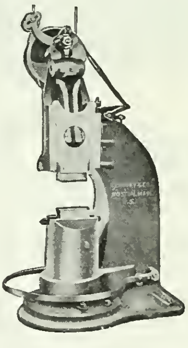
The cutting quality of the broach and the amount of work it will do without regrinding, practically control the costs of the broaching operation.

Hurlbut-Rogers Broaches—made by a special process that insures a tough core and keen cutting edges—give the kind of service that makes broaching profitable.

We make them for all kinds of work and guarantee deliveries.

Send us blue-prints of your work, we'll be glad to quote prices.

The Hurlbut-Rogers Broach Company
HUDSON MASS., U. S. A.



BEAUDRY HAMMERS

For General Forging

Save Fuel, Time and Labor. Cut Forging Costs in Two.

Belt or Motor Driven

BEAUDRY & CO.
Incorporated
45 Bromfield St., Boston 9 Mass.

MERRELL Pipe Threading and Cutting Machinery

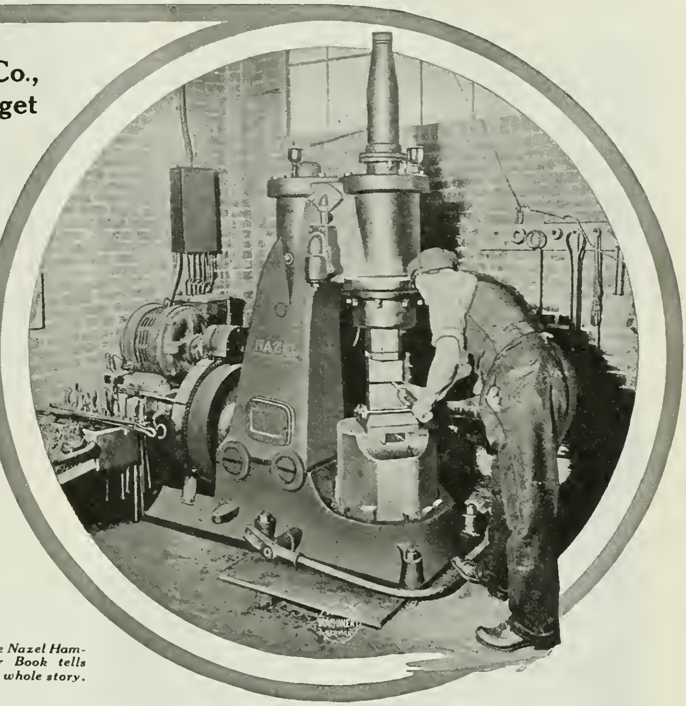
Hand or Power Operated

THE MERRELL MFG. COMPANY
15 Curtis Street TOLEDO, OHIO

CHAMBERSBURG HAMMERS
STEAM DROP—BOARD DROP—SINGLE AND DOUBLE FRAME TYPES
All Sizes for Every Class of Forging Wor
HYDRAULIC MACHINERY
CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa.
Send for Catalog

The Lange Motor Truck Co., of Pittsburgh, "Couldn't get along without" this

NAZEL HAMMER

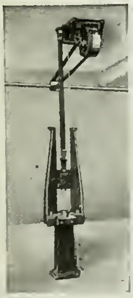


The machine is extensively used in forming wind guard irons, cab stays, headlight brackets, yoke ends and other automobile forgings, as well as for tool dressing.

It's a fully self-contained, one man production unit, motor driven, foot controlled and compresses its own air; is entirely independent of shafting and steam connections. "More blows per beat" is its motto—the blows having a distinctly positive and "clinging" quality which adapts the hammer to a wide range of work.

The Nazel Hammer Book tells the whole story.

NAZEL ENGINEERING WORKS, 4043 North 5th Street **PHILADELPHIA, PA.**



"PECK"

Automatic Drop Lifters

will convert those hand or foot drops and unsatisfactory automatics into

PRODUCTIVE AUTOMATIC DROPS

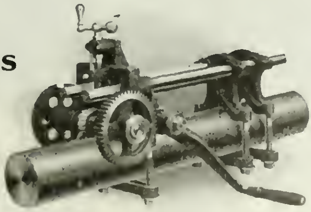
Capacity 15 to 5000 pounds

DROP PRESSES for all purposes

MINER & PECK MFG. CO.
DERBY, CONN.

Cut Keyseats Quickly In Any Position

BURR PORTABLE SHAFT KEYSEATERS

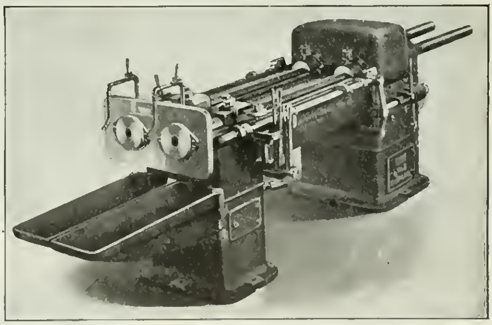


This one cuts accurate keyseats to 12" long in shafting up to 5" in diameter without resetting.

Hand or motor drive.

Catalog gives details and list of sizes.

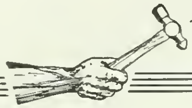
JOHN T. BURR & SON, 432 KENT AVENUE
BROOKLYN, N. Y.



Lapointe Broaching

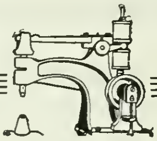
Have you ever thought that broaching might be the "way out" on that intricate shape that threatens to make your new machine too expensive? With Lapointe Machines and Broaches this process is a practical *economical* way to cut duplicate outlines on many classes of work. Ask us about it.

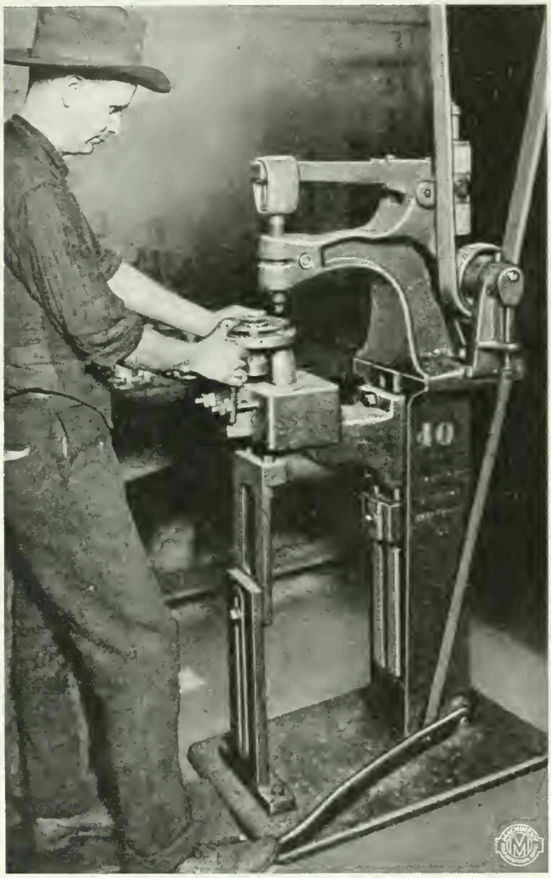
The Lapointe Machine Tool Co.
HUDSON MASS., U. S. A.



THE PRINCIPLE IS RIGHT

THE HAMMER WITH THE HUMAN STROKE





HIGH SPEED RIVETING HAMMERS

(PATENTED)

Another of the Many Ways they Serve the Automotive Industry

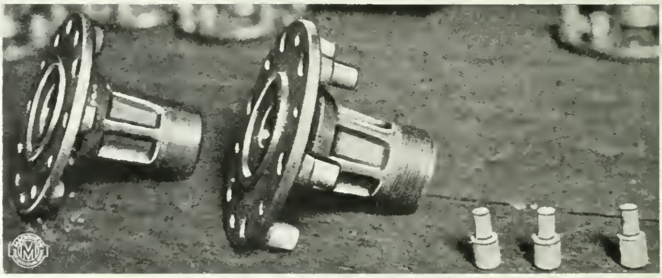
One of the busiest machines in the plant of the Dayton Wire Wheel Company is this four-year-old High Speed Riveting Hammer, used for riveting pins in wire wheel hubs.

Six steel pins, 3/8" diameter at the end that is riveted, are pressed into holes of corresponding size on the hub flange, a fixture plate holding them in position for riveting.

Above is seen the work in progress; below the hubs before and after riveting. Seventy-five of the Hubs are handled each 60 minutes, or a total of 450 rivets are headed per hour.

Send sample parts of your work to be riveted and returned for your inspection.

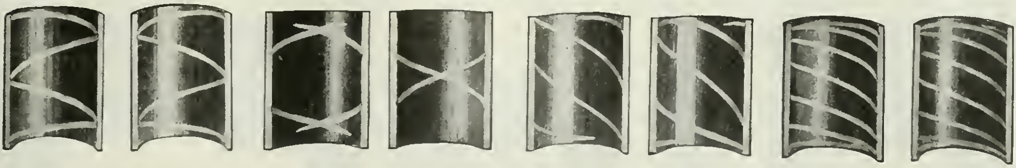
Production 450 Pins Per Hour in Wire Wheel Hubs



THE HIGH SPEED HAMMER COMPANY, Inc.

Rochester New York, U. S. A.

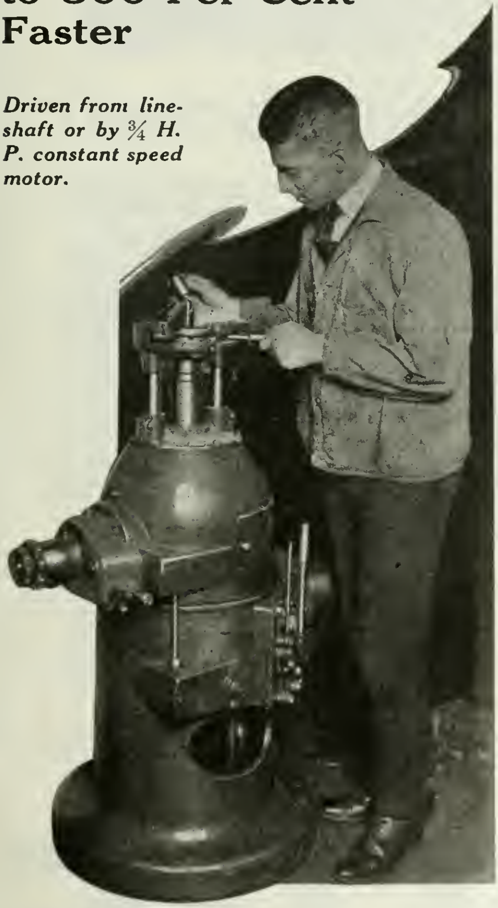
CHICAGO BRANCH: C. W. Schuchardt, Mgr., 568 W. Washington Boulevard. AGENCIES: Burton, Griffiths & Co., Ltd., London, E. C., for the British Isles. Aktiebolaget Rylander & Asplund, Stockholm, Sweden, for Sweden and Finland. China, Japan and South American Trading Company, Ltd. Yokohama, Kobe and Osaka, Japan, for Japan and Dependencies.



Consider the Matter of Oil Grooving!

The Sacrey Universal Oil Groover is 100 to 300 Per Cent Faster

Driven from line-shaft or by ¾ H. P. constant speed motor.



You can increase output and reduce the cost of oil grooving all kinds of cylindrical and odd-shaped parts with the Sacrey Oil Groover. Any kind of work and any combination of grooving—inside or outside. No skill and little floor space required.

Work is entered from the top and centered automatically by a three-jaw chuck or special fixture. Machine is fully self-contained, controls are all within easy reach and the design is such that *the work does not revolve.*

Hand feed is used for small jobs, power feed for production, in which case all the operator need do is to chuck and unload the work as the machine is practically automatic.

Details of this machine and its application on request, also sample bushing

NOTE—We are always glad to oil groove samples and return them with time and cost estimates, without obligation.

Philadelphia Eng. & Mch. Co., Phila., Pa. Please send me, without obligation, a sample bushing oil grooved on the Sacrey Machine—with record of grooving time.

Name..

Position..

Company..

City..

State..

M-8-21

The Philadelphia Engineering & Machine Company

1130 Race Street PHILADELPHIA, PA.

PUMPS

TRIPLEX · CENTRIFUGAL · ROTARY · DEEP WELL · HAND

Goulds Triplex Pump Fig. 696, size 7 x 10, at United States Chain & Forging Co. Works, York, Pa.

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Satisfactory! -as guaranteed

Goulds Pumps have won an enviable reputation in York, Pa., for real service.

Twelve years ago the American Chain Co. installed a Goulds Triplex Pump, Fig. 1696, size 7 x 10 and have had twelve years of satisfactory service from it.

In September, 1919, the United States Chain & Forging Co. installed Goulds Pump, Fig. 1696, size 7 x 10, operating against a 40 foot head for delivering water to tank at the York factory. The service has been highly satisfactory and maintenance low.

About the same time a Goulds Pump, Fig. 1696, size 7 x 10 fitted with Form C driven connection to a 15 hp. motor was installed in the plant of the York Ice & Milk Co. Here, too, the service has been very satisfactory.

The York Water Company uses a Goulds Centrifugal Pump, Fig. 3030, in the filtration plant for pumping wash water against a 19 foot head from a clear well up through the filters for washing. Another example of satisfactory service and low maintenance cost.

Goulds Pumps wherever operated give satisfaction to owners because every Goulds Pump is guaranteed to perform satisfactorily the specific work for which it is sold.

If you are interested in pumping, a set of our Bulletins will be worth writing for—our Engineering Dept. will be glad to assist you on any pumping problem.

GOULDS

Machine Shop Efficiency and Lubrication

Supervision of the work in the shop to keep men and machines working at full capacity is the golden rule.

But the machine must be in a position to respond fully. There is where correct lubrication—the Texaco kind—enters. We say Texaco kind advisedly, for we have the proof—the only proof that counts—RESULTS—to back this up.

Texaco Shop Lubricants have a record of performance in shops of all kinds, and numbers of builders of machine tools and equipment, such as lathes, planers, boring mills, drills, presses, cranes, etc., recommend Texaco lubricants, because they are satisfied that Texaco will aid the showing of the machines they make and sell.

Supporting and enhancing the excellence of Texaco Shop Lubricants is the service of Texaco Lubrication Engineers.

Our staff includes experts on shop lubrication, who will make a survey of your shop and tell you which Texaco Lubricants to use for the various machines and parts.

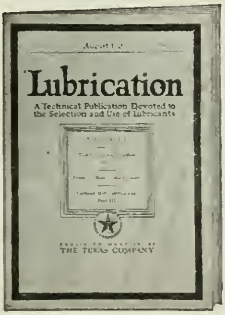
Through efficient recommendation it is more than likely that they will be able to show you how to do the work with fewer lubricants.

This is helpful in more ways than one. It decreases the chances of confusion; it decreases the storage space necessary; it simplifies orders on the Supply Department for oils; it assists in the better operation of machines through standardization of methods of selection and application of lubricants.

Let us assist you in securing topnotch shop efficiency through correct lubrication. Some of our shop lubricants are:

For General Machine Lubrication	Texaco Machine Oil
For Lubricating Cutting Tools	Texaco Cutting Oils Texaco Soluble Oil
For Gear and Machine Tools	Texaco Crater Compound Nos. 1, 2 and 5

There is a Texaco Lubricant for Every Purpose



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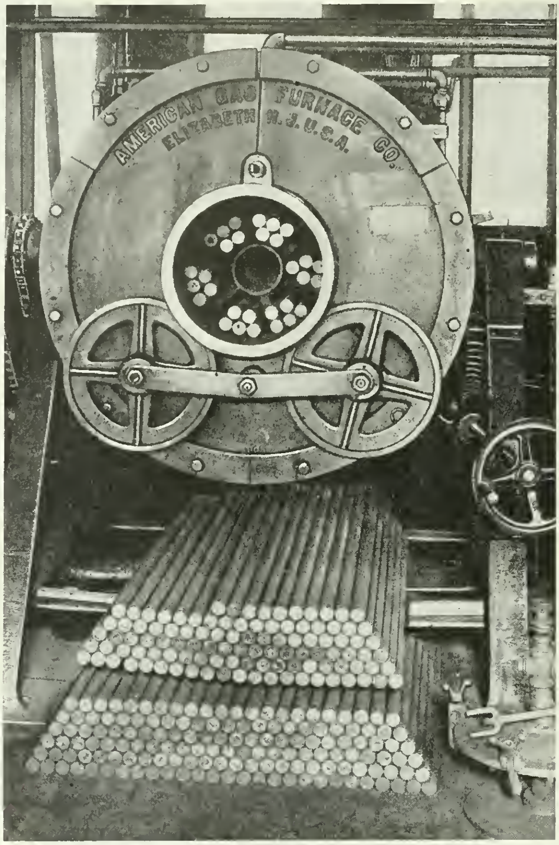

Carbonizing Mine Axles—810 Pounds Per Charge

American Gas Furnaces

Products of more than 40 years' experience and specialization, American Gas Furnaces are made in a wide and practical range of styles and sizes to perform all kinds of heat-treating operations on all classes of work.

The No. 2 B Carbonizing Machine is shown arranged for carbonizing long, cylindrical parts. Several pieces of work are accommodated in each compartment of the fixture in the retort which rotates constantly—permitting quick heating and uniform mixing of work and gas by which all articles become uniformly carbonized to any specified depth in minimum time.

The mine axles shown are 1½″ diameter, 50″ long and weigh 27 pounds each —30 axles (810 lbs.) being considered a full charge.

American Gas Furnace Products include:

AUTOMATIC QUENCHING TANKS
BLOWERS
BLOWPIPES OR BLOW-TORCHES, HAND AND STAND
BOOSTERS, GAS
BRASS MELTERS
BRAZING FURNACES AND TABLES
BURNERS
BURNERS FOR ELECTRIC LAMP BULB MANUFACTURE
CARBONIZING MACHINES
CYANIDE FURNACES
CYLINDRICAL FURNACES
FORGES
FORGES, GLASS BENDING
HARDENING HAMMERS
HEATING MACHINES
MELTING FURNACES
MUFFLE FURNACES
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PLATING FURNACES
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TUBE HEATING FURNACES
EVERY TYPE OF GAS BLAST BURNER, FURNACE AND HEATING MACHINE FOR INDUSTRIAL USES

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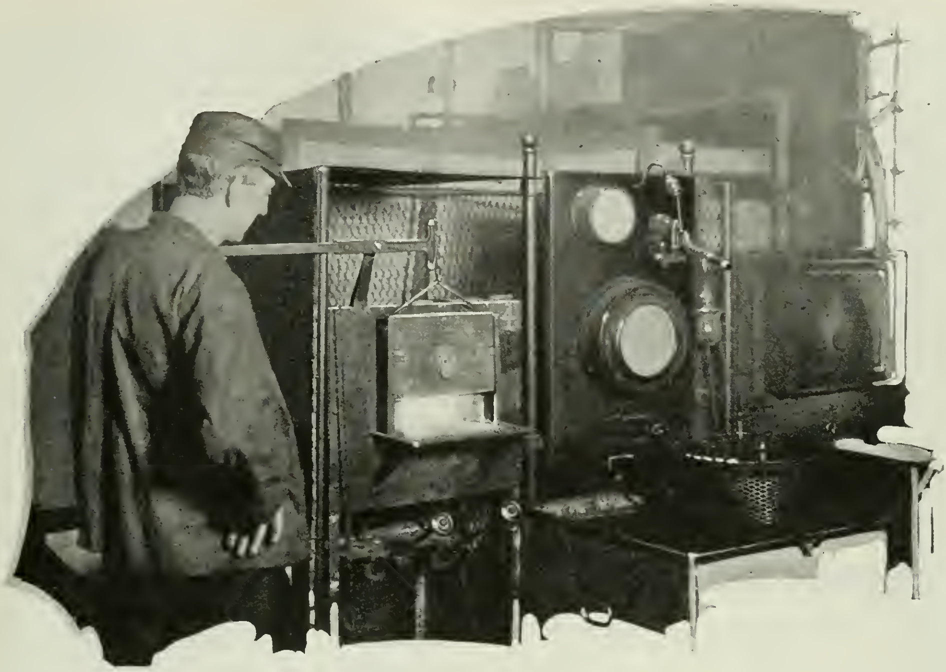

A Constant, Uniform High-Speed Heat

IT means a great deal to know what production you can be sure of getting from a high-speed tool. When high-speed tools are heat-treated in a fuel fired furnace, it is almost impossible to produce them of uniform goodness. And this is not the fault of the steel. It is caused by non-uniformity of temperature, and by a variable temperature, and atmosphere.

In Hoskins High-Speed Electric Furnaces the temperature is constant and it is uniform. And it is under easy, hair-line control. Under these conditions, uniformity of results is certain to be had. When automatic screw machine tools, for example, are set up, you know accurately how much work they will produce. You can count on them. Their edges, furthermore, will be clean and sharp without any scale.

If you use many high-speed tools, the Hoskins High-Speed Electric Furnace would be a big asset in your tool-room. If you don't use much high-speed steel, this furnace would not be a good investment for you. But if your high-speed requirements are large and important, the Hoskins High-Speed Electric Furnace will lower costs for you. Send today for Catalog 101-M.

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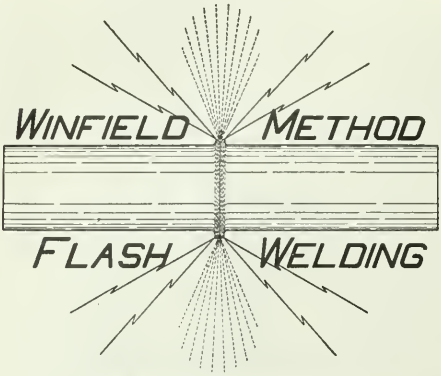
HOSKINS PRODUCTS



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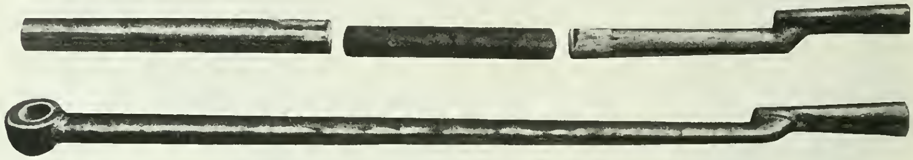
Flash welding method as perfected by the Winfield Electric Welding Machine Company will not only reduce the amount of current required to make an electric butt weld but also will reduce the time required to make the weld.

In a recent test on tool steel welded to nickel our machine welded same by flash method in twenty-nine seconds where the same weld by push weld method required five minutes.

If you are contemplating the purchase of a butt welder be sure and secure our prices on special flash weld machines.

Reduced cost of welding and reduced time in welding increased production.

No bulge of material to be hammered down in this method. A slight burr is all that has to be sheared or ground off.



THE WINFIELD ELECTRIC WELDING MACHINE CO.

Factory and General Office:

WARREN **OHIO, U. S. A.**

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Special machines designed for the rapid production of SPOT, BUTT and SEAM welded work.

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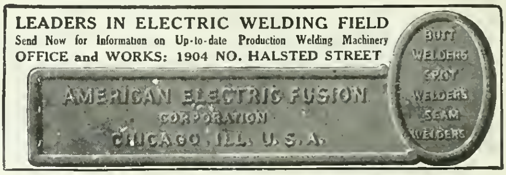
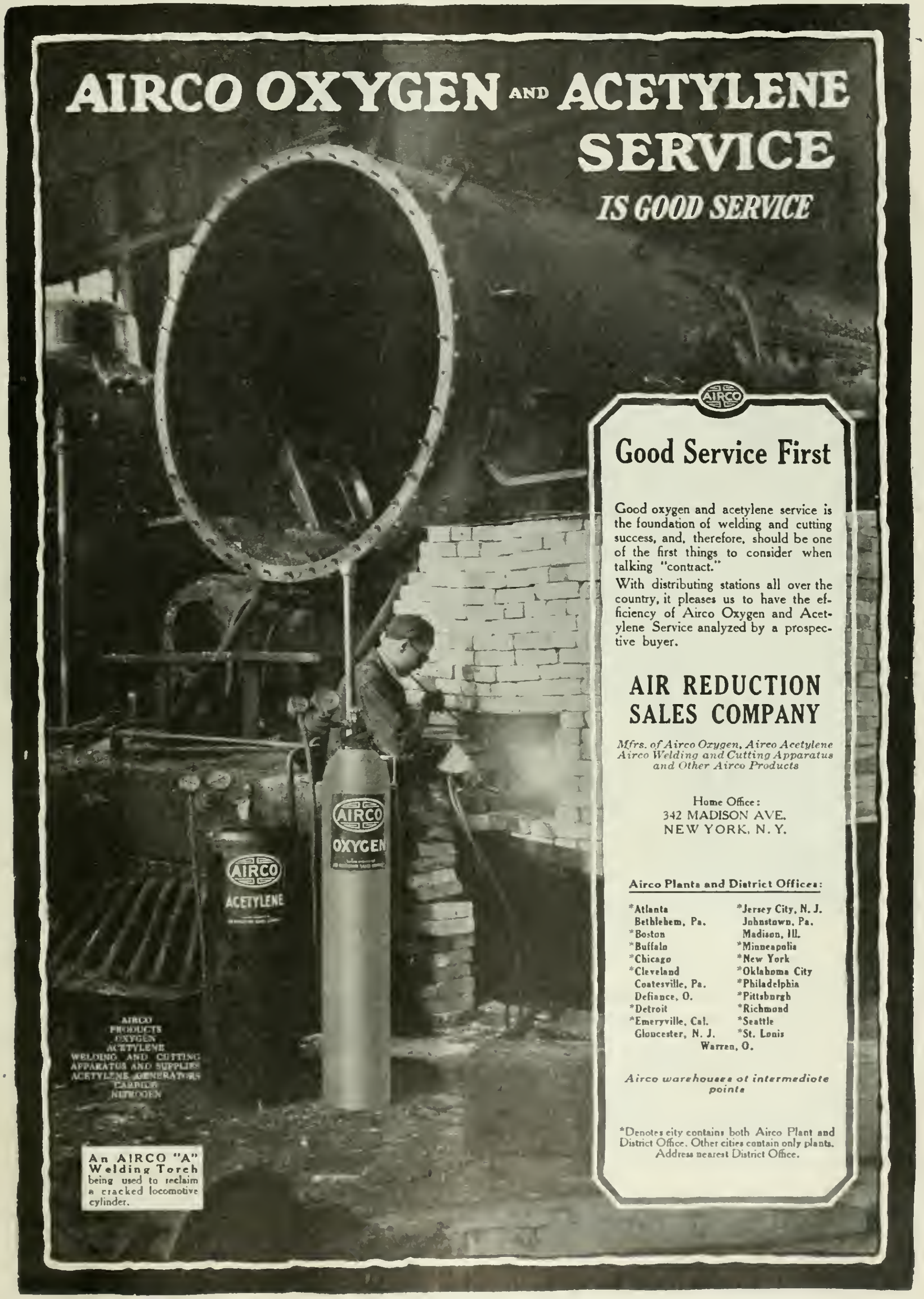


LEADERS IN ELECTRIC WELDING FIELD
Send Now for Information on Up-to-date Production Welding Machinery
OFFICE and WORKS: 1904 NO. HALSTED STREET



An AIRCO "A" Welding Torch being used to reclaim a cracked locomotive cylinder.

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Good oxygen and acetylene service is the foundation of welding and cutting success, and, therefore, should be one of the first things to consider when talking "contract."

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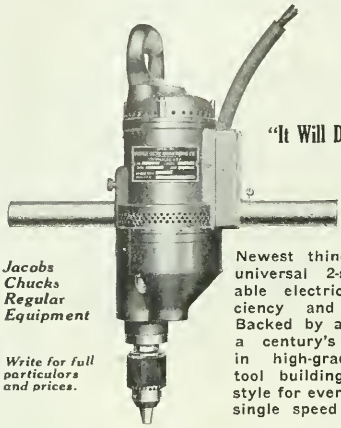

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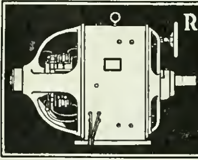

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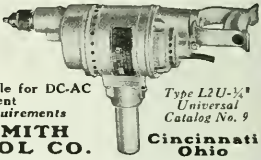

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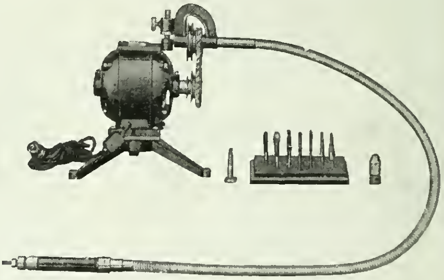

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Gas Cylinders
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Gauge Bodies
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Grinders, Hand
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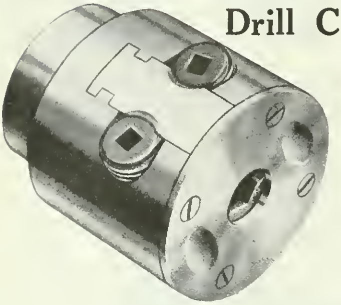

The Twin Screw Drill Chuck

Strong gripping power, safety and unusual durability are outstanding advantages of this accurate, rugged Drill Chuck. Body is close grain cast iron, jaws and screws of high carbon steel, tempered, the cap plate—designed to prevent spreading under strain.

All parts are interchangeable and machined to exceedingly close limits.

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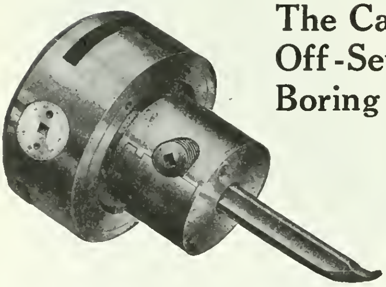

The Casler Off-Set Boring Head

Designed to minimize the number of tools and tool changes required to bore holes to size and also to permit performing this operation on the milling machine as well as the lathe and drill press, the Casler Boring Head provides for enlarging any diameter four times the rated offset of the boring head *with one tool.*

For example, by using a boring head with ½″ offset and a boring tool with a cutting lip of 1½″ from the center of the tool shank a 2″ diameter can be increased to 4″ *without changing tools.* More Details? Certainly, where to?

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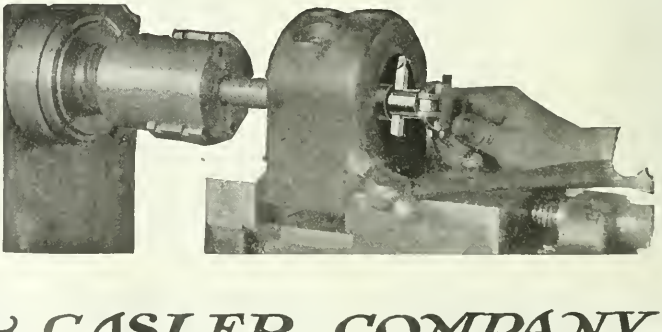

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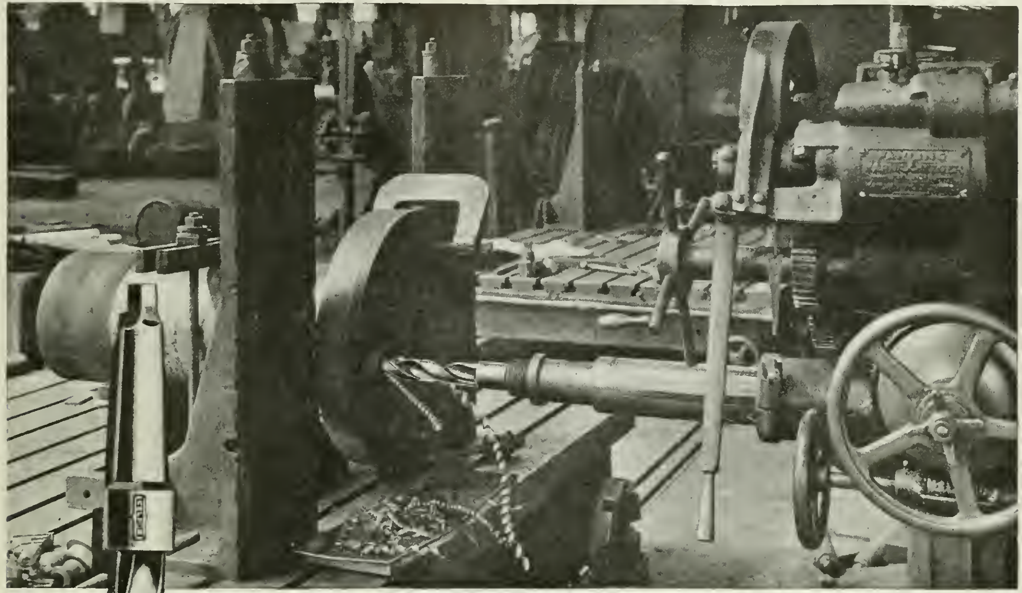

The photograph shows a Celfor Drill drilling flange couplings for Diesel Oil Engine Shafts.

Diameter, 3⅝ inches; Depth, 3 inches; Feed, .0013; R. P. M., 140.

If you ever see a drill producing clean, healthy, honest-looking chips, you will find that in most cases it is a *Celfor* Drill.

Celfor Drills are known by their ability to make lots of accurate, clean-cut holes.

They are made by the Clark Equipment Co., at Buchanan, Mich.

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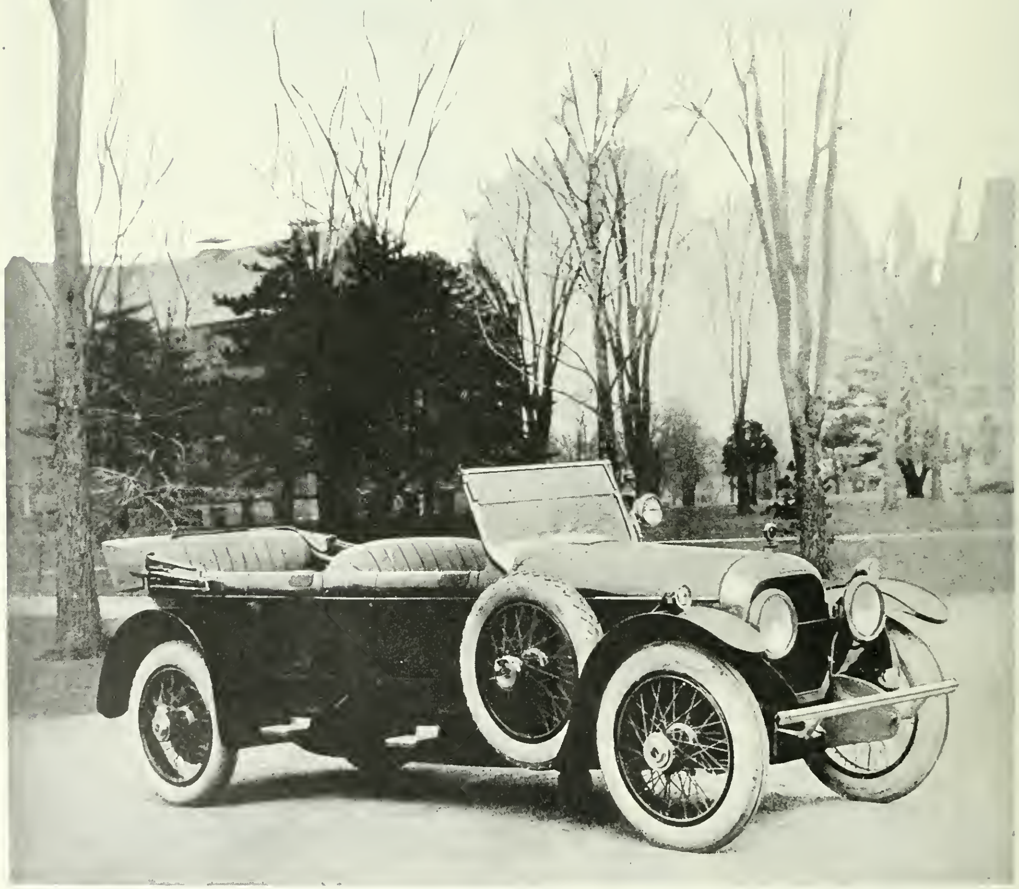

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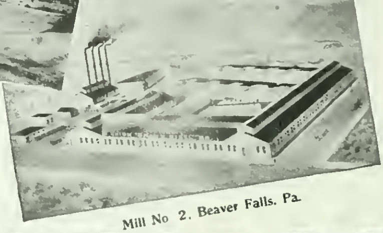

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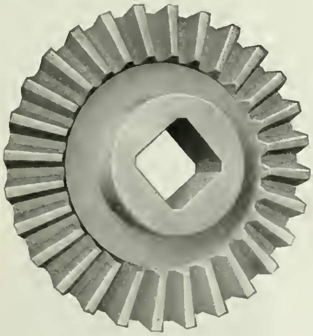

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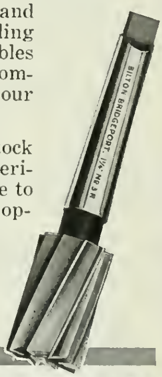

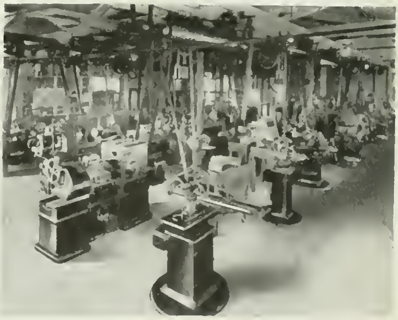

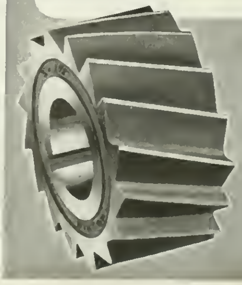

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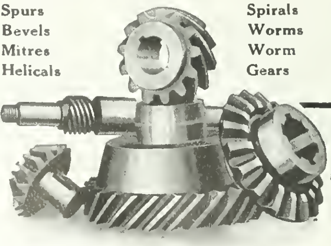

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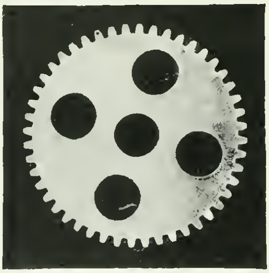


GENERATED

in our

Gear Cutting Department

(Cut is full size)

Let Us Quote You

MEISSELBACH-CATUCCI MFG. COMPANY
54 STANTON STREET NEWARK, N. J.

"TRY SIMONDS"

Cut Gears, Racks, Worms, Worm Gears, Special Machinery

Write

THE SIMONDS MFG. CO., Pittsburgh, Pa.

PHILADELPHIA
GEAR TIME

"Every Second Counts"

Philadelphia Worm Gear Units

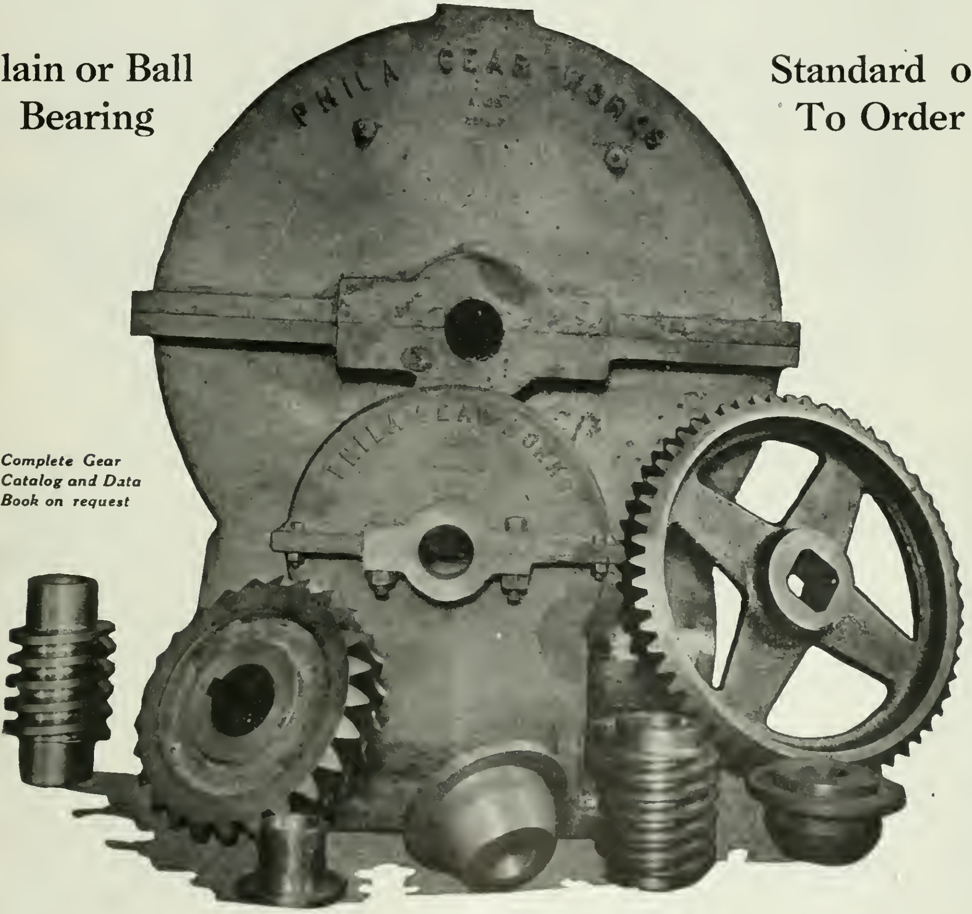
For the convenience of our customers and in accordance with our policy of giving complete gear service our worm and wheel division carries a large stock of standard gear reductions—completely housed, assembled and tested, ready to set up.

Worms are located above or below the gears according to the class of service for which they are designed; centers are accurately fixed beyond possibility of gears getting out of alignment and ample lubrication is provided.

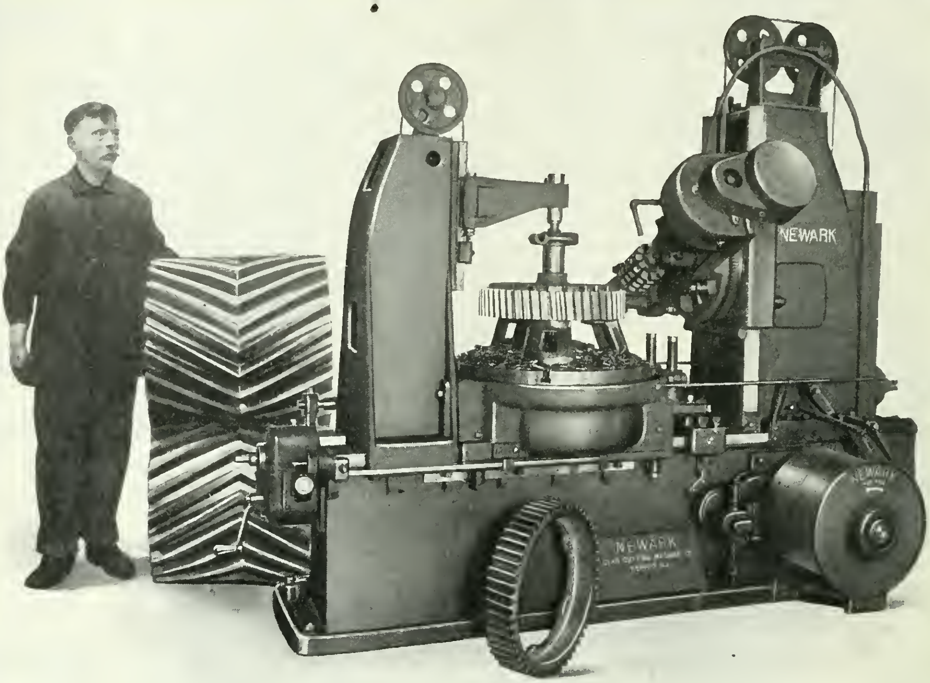
Plain or Ball Bearing

Standard or To Order

Complete Gear Catalog and Data Book on request



Philadelphia GEAR Works 1120-1128 Vine St.
Philadelphia



Newark Gear Hobbing Machines

For helical gears, spur gears, and worm wheels. "Newark" machines combine accuracy with productive capacity. They are the result of many years of experience. The pioneer hobbing machine in this country still holds its place as the leader.

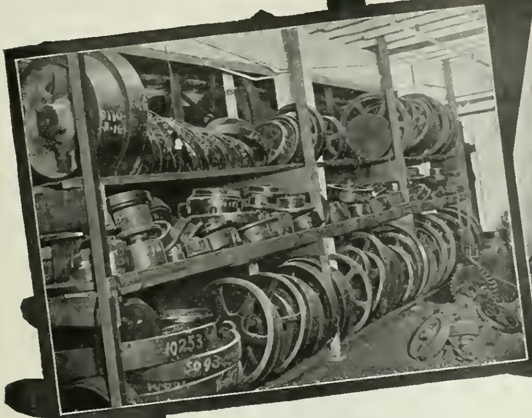
"Newark" Hobbing Machines embody a differential mechanism which permits spiral leads to be accurately obtained, without the usual complex mathematics. Our machines are simple. Feeds can be changed without resetting.

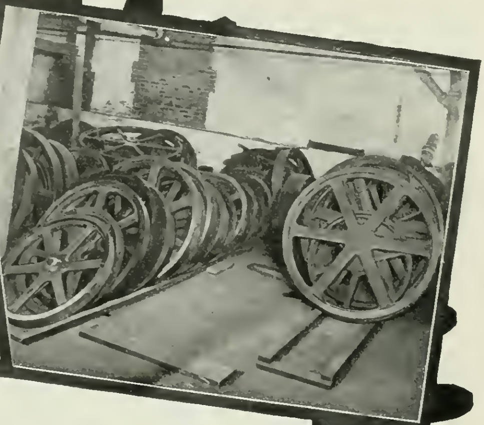
All adjustments are conveniently made And these machines are HEAVY DUTY—rapid producers.

NEWARK GEAR CUTTING MACHINE COMPANY

Henry E. Eberhardt, President

NEWARK NEW JERSEY, U. S. A.





Thousands of Gear Patterns

We have a pattern on hand for every gear that our 30-year experience has taught us is liable to be needed in a hurry. You can see, therefore, that you're pretty safe in depending on Meachem Gear Service whenever you're up against it for a quick gear replacement.

But the best way to make sure is to try us now. Just select a few of the gears you're liable to need, and send us the list, telling us you need them in a hurry. We'll surprise you not only on deliveries, but on prices as well, and you'll find that Meachem Gear quality will help to make future replacements less frequent.

THE MEACHEM GEAR CORPORATION

Sole manufacturers of new process Rawhide Gears and Pinions—Still made under the direction of the inventors and the men responsible for every stage in their development.

Canal St. and West Shore R. R.
SYRACUSE, N. Y.

MEACHEM GEARS

Be Sure Your Big Gears Are

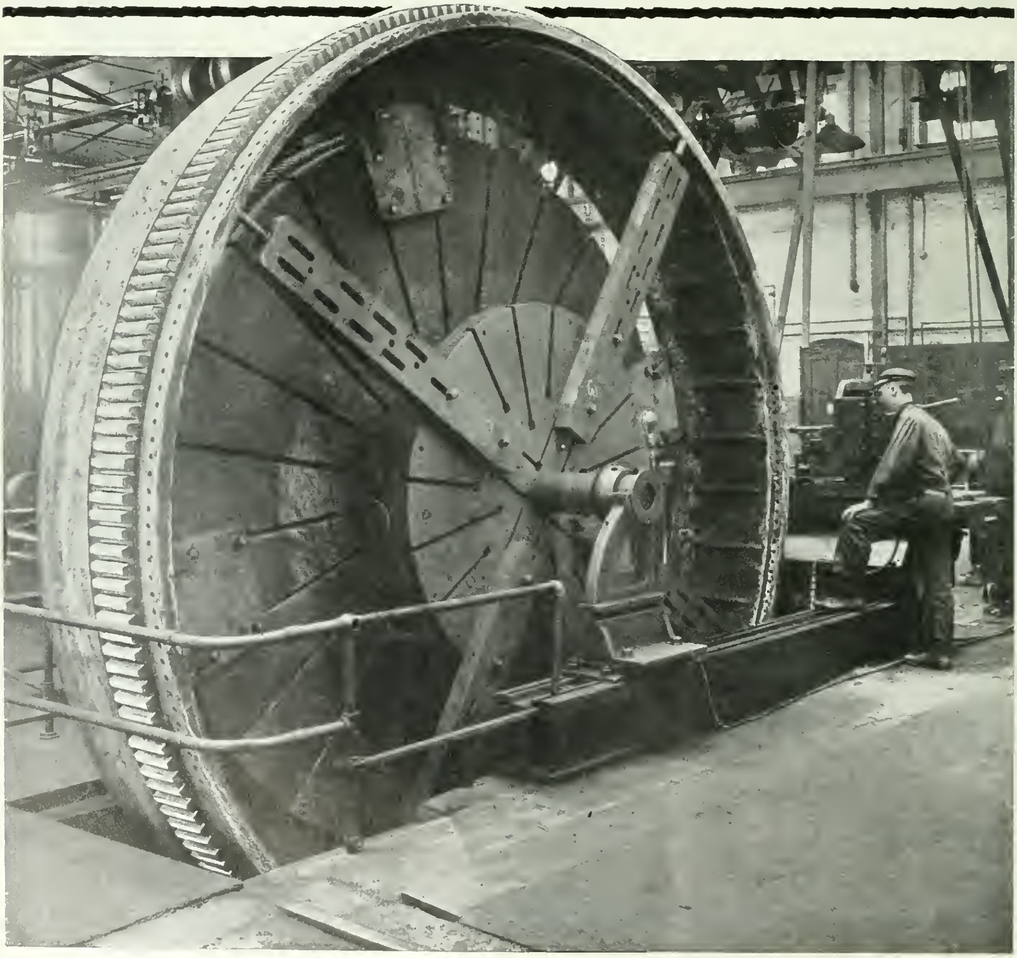
GLEASON GEARS

Designed by Gleason Gear Experts, cut on Gleason Machines, worthy products of the Gleason Plant, made to meet most exacting demands.

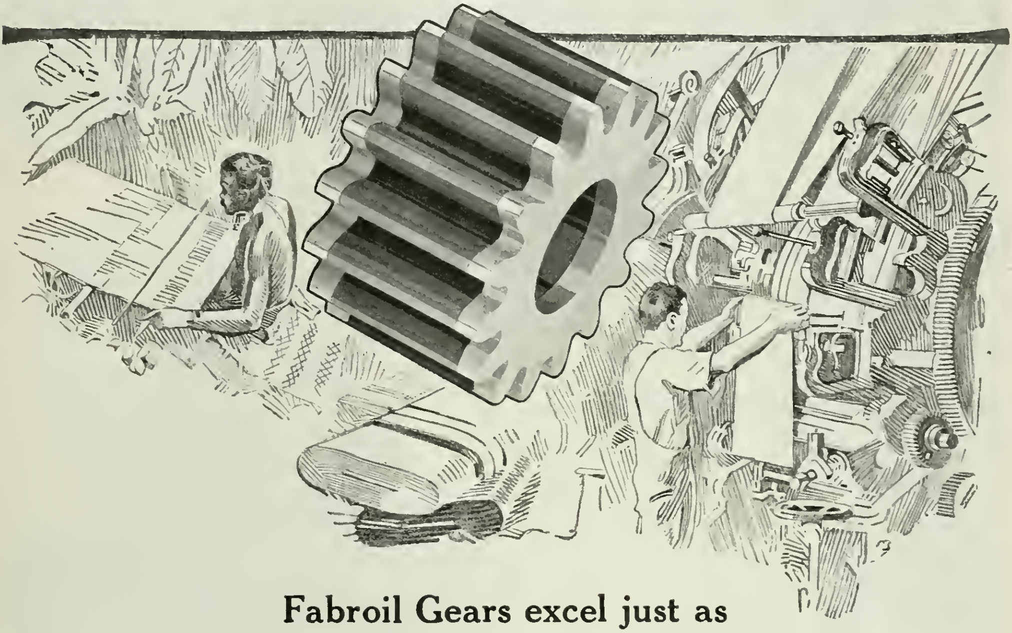
Good quality, quick deliveries and fair prices—you get them all when you buy Gleason Gears.

Send us your drawings and specifications; we'll furnish the blanks or do the cutting only.

GLEASON WORKS, Rochester, New York, U. S. A.



Machinery, to stand the pace of present day production, must be fitted with up to date appliances



Fabroil Gears excel just as machines beat jungle tools

Motor-driven spinning frames, twisters, sewing and other textile machines are fitted with Fabroil Gears to cushion gear trains against undue vibration, to make their operation quieter and to lengthen the life of the machinery.

In the solution of machine drive problems in the textile industry, Fabroil Gears have played a large part. Their ability to run quietly and to operate successfully in humid atmosphere has led to their adoption by machine manufacturers and mill superintendents. Fabroil Gears do not shrink nor are they attacked by vermin when kept in storage.

For a wide range of uses Fabroil Gears are made in any sizes from one inch diameter upward. Textile mills commonly use them in sizes from 3 to 8 inches diameter.

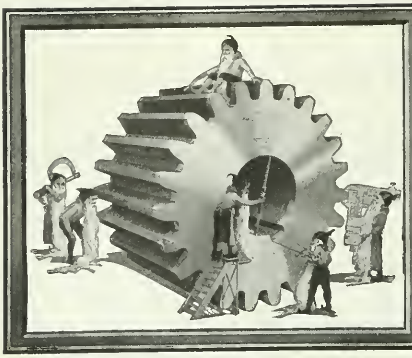
Ask the nearest G-E office for complete information

General Electric Company

General Office
Schenectady, N.Y.

Sales Offices in
all large cities

40-1



GANSCHOW
"QUALITY"
RAWHIDE AND BAKELITE
PINIONS
WILLIAM GANSCHOW COMPANY
CHICAGO G ILLINOIS

BOSTON STANDARDIZED GEARS

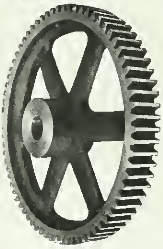
600,000
In Stock

Ready to Deliver

1,500 sizes and a wide variety of styles in Brass, Iron and Steel await your order at our factory and branch offices in 17 cities.

Get the 1921 catalog listing new material. Note the addresses of our new branches.

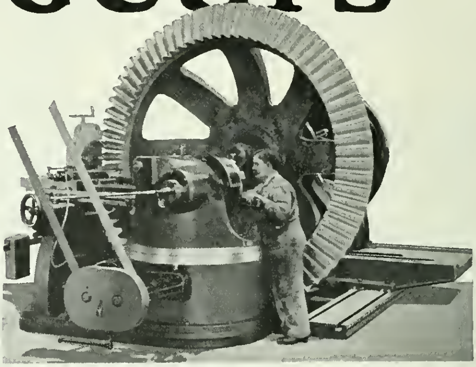
Special Work. Cutting a specialty.



BOSTON GEAR WORKS
MAIN OFFICE AND WORKS
Norfolk Downs, 71 QUINCY, MASS.

Branches and Salesrooms:
NEW YORK, N. Y., - 151 Lafayette Street, 215 Centre Street
CHICAGO, ILL., - - - - 623 W. Washington Boulevard
CLEVELAND, OHIO, - - - - 803 W. Superior Avenue

Earle
Gears



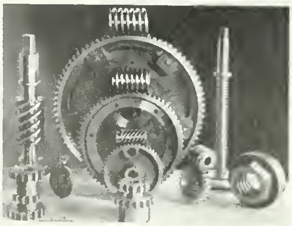
Big Gears Especially

We make gears of all sizes and styles—but we specialize in the production of those large gears that are most difficult to obtain, that require most highly specialized equipment and experience to produce.

We'd like to help you—try us.

The Earle Gear & Machine Company
Stenton and Wyoming Aves. Philadelphia

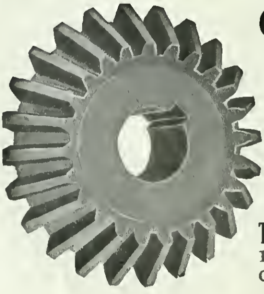
How About Your Gears?



We run our gear business on the principle that it is better to do one thing well than half a dozen things indifferently. That is one of the reasons why Alling-Lander Gears are incorporated in so many well-known mechanisms. Send for quotations.

ALLING-LANDER COMPANY, Inc.
Basket Street *Makers of "The Wonder Gear"* SODUS, N. Y.

Prompt Deliveries on Special Gears



CINCINNATI
SERVICE

gives you special gears of the highest grade at short notice. Send us your blue prints; write for Catalog C.

The Cincinnati Gear Co.
1825-1841 Reading Road
CINCINNATI OHIO

Gears

SPURS, BEVELS, MITERS, MORTISE WHEELS, WORM AND WORM WHEELS

We have the most complete line of equipment in the U. S. A. for making machine molded cast tooth gears. With the machine molding system a single tooth block is used and all the teeth are accurately machine spaced, insuring gears that are free from the inaccuracies of pattern molded gears, at the same time eliminating a large part of the pattern expense.

Capacity 1 inch to 6 inch pitch, up to 20 feet diameter and 20 tons in weight.

CUT TOOTH GEARS

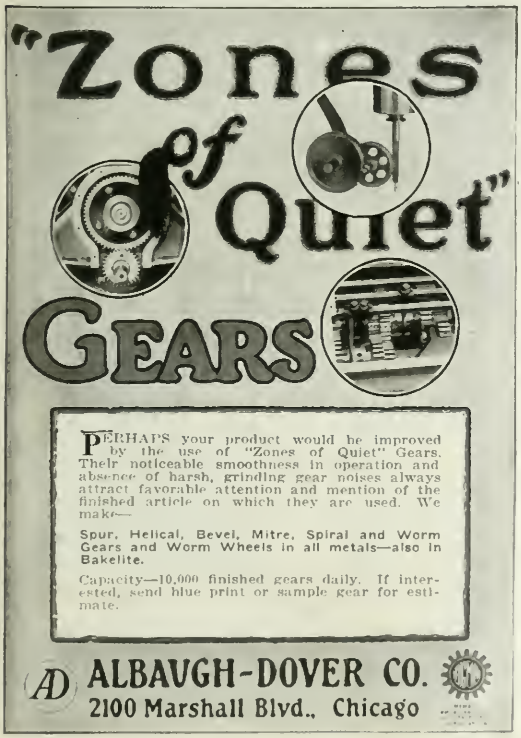
We make a complete line of ELEVATING, CONVEYING AND POWER TRANSMITTING MACHINERY.

H. W. CALDWELL & SON COMPANY

CHICAGO, 17th STREET and WESTERN AVE.

NEW YORK
50 Church St.

DALLAS, TEX.
709 Main St.


"Zones of Quiet" GEARS

PERHAPS your product would be improved by the use of "Zones of Quiet" Gears. Their noticeable smoothness in operation and absence of harsh, grinding gear noises always attract favorable attention and mention of the finished article on which they are used. We make—

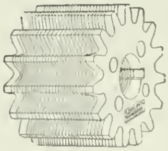
Spur, Helical, Bevel, Mitre, Spiral and Worm Gears and Worm Wheels in all metals—also in Bakelite.

Capacity—10,000 finished gears daily. If interested, send blue print or sample gear for estimate.

ALBAUGH-DOVER CO.
2100 Marshall Blvd., Chicago

"CHICAGO"

Rawhide Gears



Booklet mailed on request.

Some Reasons for Their Popularity.

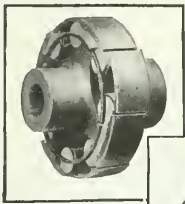
"Chicago" Rawhide Gears differ from others in that they retain the original thickness and density of the green hide, thus preserving every element of strength. Built with unusual care, they are exceptionally durable; Chicago Rawhide Gears are guaranteed to give service.

We manufacture Belting, Lace Leather and Cut Lacing, Hydraulic Packing, Rawhide Mallets and Hammers, Rawhide Gears, Leather Specialties, etc.

The Chicago Rawhide Mfg. Company

1301 Elston Avenue CHICAGO, ILL.

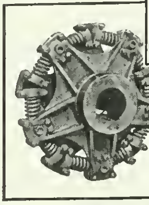
New England Branch: Lewis E. Tracy Co., 127 Broad St., Boston



Type A—Coupling

Type C—Coupling

Type B—Coupling



Lengthen the Life of Machinery

In a rigidly connected driving and driven unit, the life of the equipment is directly proportional to the vibration and peak load.

Flexible couplings absorb vibration and peak load shocks, thus greatly increasing the life of the equipment.

Nuttall flexible couplings are built in three distinct types—A, B, and C, in order that every particular service condition may be exactly met.

Write for Catalogue No. 15.

R.D.NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

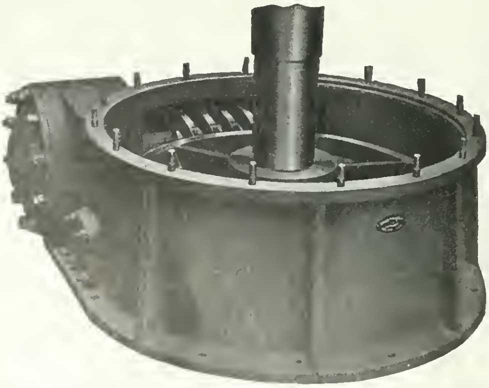
Nuttall

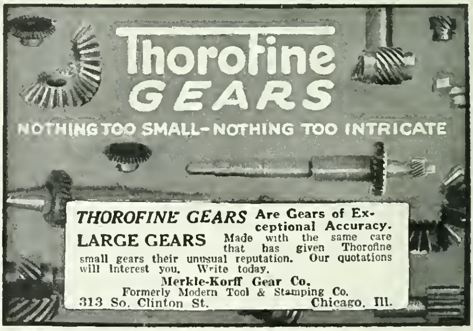
HINDLEY GEARS

For Use Where Only the Strongest are Successful

High speeds and hard pulls generally mean Hindley Gears. Accurate, powerful, correctly cut; they meet the stress of strenuous service in many varying mechanisms. Write for figures in connection with applying Hindley Gears to your product.

HINDLEY GEAR COMPANY
1105 Frankford Ave. Philadelphia, Pa.





Thorofine GEARS

NOTHING TOO SMALL—NOTHING TOO INTRICATE

THOROFINE GEARS Are Gears of Exceptional Accuracy.

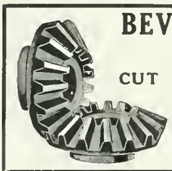
LARGE GEARS Made with the same care that has given Thorofine small gears their unusual reputation. Our quotations will interest you. Write today.

Merkle-Korff Gear Co.
Formerly Modern Tool & Stamping Co.
313 So. Clinton St. Chicago, Ill.

Hindley Worm Gearing

Complete drives with housing ready for power

ALBRO-CLEM ELEVATOR COMPANY
Erie Avenue and D Street PHILADELPHIA, PA.

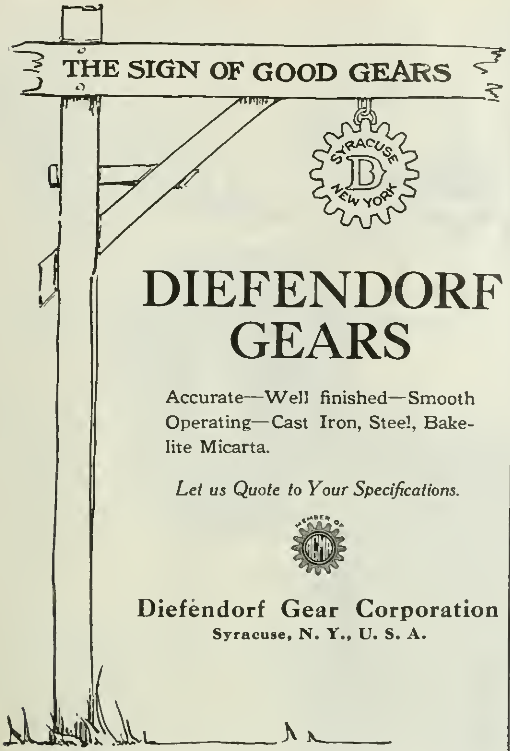


BEVEL GEAR GENERATORS. BEVEL GEARS

CUT THEORETICALLY CORRECT.

Special facilities for cutting Worm, Helical, Miter, Internal and Elliptical Gear Wheels.

The Bilgram Machine Works
1231 Spring Garden Street, Philadelphia, Pa.


THE SIGN OF GOOD GEARS
SYRACUSE
D
NEW YORK

DIEFENDORF GEARS

Accurate—Well finished—Smooth Operating—Cast Iron, Steel, Bakelite Micarta.

Let us Quote to Your Specifications.

Diefendorf Gear Corporation
Syracuse, N. Y., U. S. A.

The Differential Mechanism is the Dominant Feature of

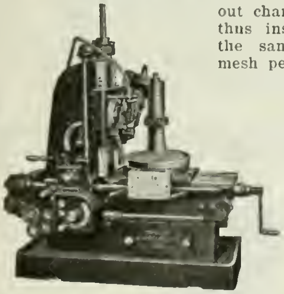
HERCULES Gear Hobbers

The Differential Mechanism so simplifies the operation of the Hercules Gear Hobbing Machine that it is regarded by many users as its dominant feature.

It reduces calculations necessary for spiral gear generation to a simple arithmetical computation. It makes possible the cutting of right or left hand gears of the same lead with the same hob without changing the gear train, thus insuring two gears of the same lead which will mesh perfectly.

With the differential feed per work revolution may be altered at any time without affecting the helix angle—a very important feature.

Write for complete description.



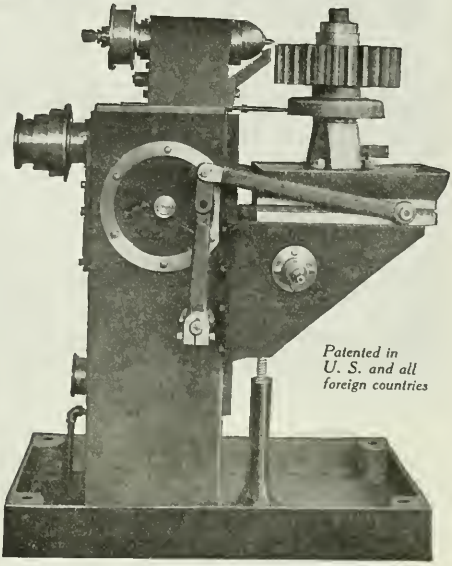
Made in two sizes—8" and 24".

Hercules Machine and Tool Company, Inc.

General Offices: Broome & Lafayette Sts., New York City
Works: Astoria, Long Island

CROSS

GEAR TOOTH ROUNDING MACHINE



Patented in U. S. and all foreign countries

No One Knows When You Change Gears

If your gears have been rounded on the Cross Gear Tooth Rounding Machine no one knows when you change gears unless they are right beside you. Gears which mesh without clashing indicate a superior product, and you'll always find a ready market for it.

The Cross rounds a 6/8" or 5/7" pitch gear at the rate of 25 teeth in 60 seconds, or a 4/5" pitch gear at the rate of 15 teeth in a like period. It handles gears up to 36" diameter—2-pitch or finer.

Details on request.

Cross Gear & Engine Co.
809 Bellevue Avenue
DETROIT MICHIGAN

"Round Corners on a CROSS"

Two day delivery plus Parcel Post makes you our next door neighbor.

Specify number of teeth, pitch or outside diameter, face overall, bore and keyseat.

Thirty years' experience enables us to return the highest grade rawhide pinions to you in a minimum time and at a minimum cost.

A trial order will convince you. Our service and prices are pleasing the most discriminating buyers. May we hear from you?

We also manufacture metal gears $\frac{3}{4}$ inch to 12 feet.

MEMBER OF AGMA

THE HORSBURGH & SCOTT COMPANY

Cleveland, Ohio, U. S. A.

EIGHT out of EVERY TEN

orders that we get for gears come from concerns that have patronized Jones before.

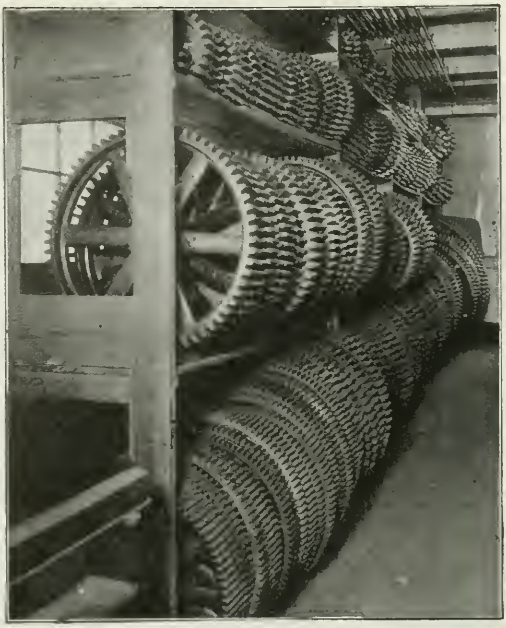
From this it is obvious that Jones has something more to offer than merely *gears*—for many of these orders come from points which are many miles away.

That something is *Service.*

Here, for instance, is a corner of the pattern department. There are row upon row of patterns of standard gears which are indexed to facilitate quick handling.

So, when an order for standard cast-tooth gears comes in, there is rarely any delay on account of patterns.

In many instances the order is completed and the gears are shipped within twenty-four hours.



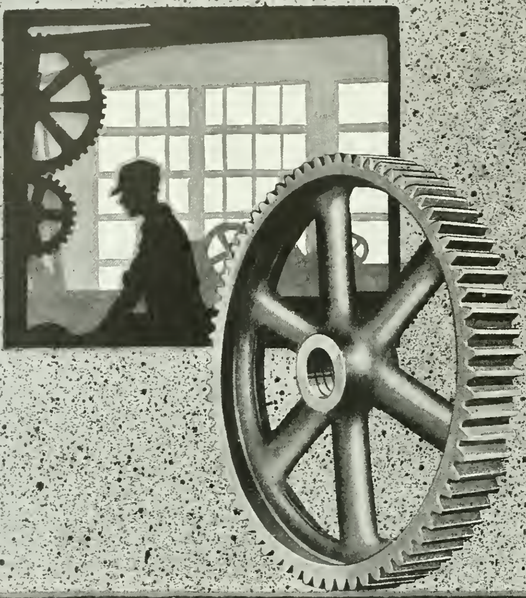
W. A. Jones Foundry & Machine Co.

4409 West Roosevelt Road, Chicago
20 Murray Street, New York

Jones
Cut and Cast GEARS

MEMBER OF AGMA

J-131



FOOTE

DEPENDABLE GEARS
Give
Positive Satisfaction

Made of highest quality close-grained metal, and with sufficient metal at every part to give a wide margin of safety, yet without excess weight—made accurate and true and rigidly inspected. FOOTE GEARS give positive satisfaction.

Submit your gear problems to Foote. Foote Engineers are at your service to assist you with your gearing problems.

Foote Bros. Gear and Machine Company

Manufacturers of Rawhide and Bakelite Pinions and Cut Gears of All Kinds

Send for Catalog.

242-252 N. Curtis St., Chicago, U. S. A.

FOOTE DEPENDABLE GEARS

Meisel Gears

Quality Assumes All Obligations

Quality delivers the only reliable service. Quality, providing it is uniform, settles the question of continued dependability. Quality in the final reckoning brings cost to the most economical figures.

Meisel quality is quality without compromise, the product of steadfast purpose to maintain a standard that cannot be surpassed.

MP

Registered

Making gears to this formula has made our business one of the most important factors in industry. Let us show how profitably we can serve you in the gear field.

We also take Screw Machine Work up to 5½" and do Heat-treating, Broaching, Contract Work, Case Hardening, Tooth Rounding, Splining and Internal and External Grinding.

MEMBER OF AGMA

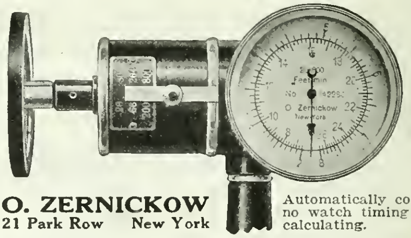
Meisel Press Mfg. Company

948 Dorchester Ave., Boston 25, Mass.

Get a Descriptive Circular of the

O-Z CUTMETER

See how and why this device will enable you to operate your machines at the point of highest efficiency.



O. ZERNICKOW
21 Park Row New York

Automatically correct, no watch timing or calculating.

SPUR—BEVEL—SPIRAL—WORM
GEARS

Automobile Gears in Large Quantities

TAYLOR MACHINE COMPANY
7804 CARNEGIE AVENUE CLEVELAND, OHIO

HERRINGBONE CUT GEARS

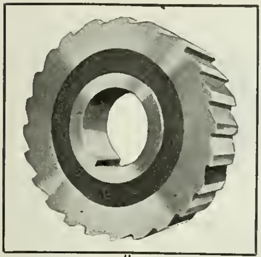
MILL DRIVES
SPEED REDUCERS

SPUR
WORM
BEVEL GEARS

FAWCUS MACHINE CO. PITTSBURGH, PA.

DON'T BUY NEW MILLING CUTTERS

Until We Have Reclaimed Your Old Ones



Useless Wornout Cutter

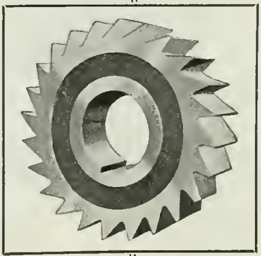
Your worthless wornout Milling Cutters, Reamers, Slitting Saws and End Mills can be made as good as new at a fraction of their original cost by the "Eastern Cutter Salvage Process."

Most important of all WE DO NOT ANNEAL the tool or disturb the original temper.

The largest national manufacturers are having their tools "Eastern" salvaged—Westinghouse and General Electric for instance. Can you afford not to investigate this most genuine money-saving proposition?

Here is an example—*A HSS Plain Milling Cutter 3" x 3" costs approximately $20.00 today. We reclaim this tool when worn out for $4.48, and make it as good as when new.*

Write for latest revised price list or send orders direct to



Same cutter "Eastern" Salvaged

Eastern Cutter Salvage Corp., 115 Kirk Place, Newark, N. J.

New England Representative:—E. C. Van Sickel, 28 School St., Boston, Mass.

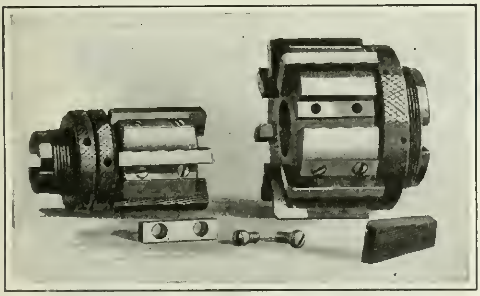
Save High Speed Steel

Corresponding corrugations on the blades and gripping parts make it possible to get accurate adjustment and make slipping impossible no matter how short the blades.

Made also with spiral set blades and in special styles to suit requirements.

Adjustable Reamers
(design patented)
in which the blades *cannot* slip

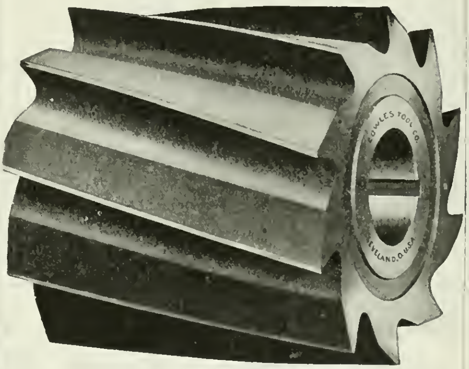
Send for Circular



The Cleveland Cutter & Reamer Co.
1619 Merwin Avenue CLEVELAND, OHIO
Detroit Office: 2180 East Grand Boulevard

COWLES CUTTERS

FOR DEPENDABILITY



Quality First

Plain Milling Cutters	Concave Cutters
Side Milling Cutters	Shell End Mills
Interlocking Side Milling Cutters	Metal Slitting Saws
End Mills	Gear Cutters
Angular Cutters	Inserted Blade Cutters, etc.
Convex Cutters	Special Cutters

They are producers, tempered to *Red Hardness*, making them *Tough* and *Durable*.

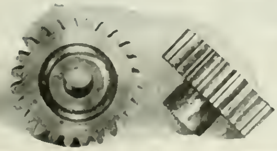
We carry a large stock. Wire or mail inquiries.

We sell DIRECT to the USER

COWLES TOOL COMPANY
CLEVELAND OHIO, U. S. A.
Cutter Designers and Manufacturers

Overland Model Four Timing Gears In Stock

CLOYES GEAR WORKS
1620 Collamer Avenue Cleveland, Ohio



Gears and Gear Cutting

We guarantee satisfaction

RODNEY DAVIS
PHILADELPHIA, PA.

You've Heard of the Red-E Dog and Driver for Milling Machines

It's a time and money saver. No spoiled work due to incorrect spacing and dog working loose. Just what you want for milling spirals and tapers or cutting gears.

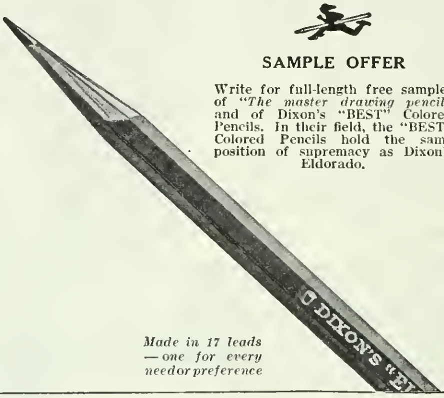
Write for Catalog 19-M for details of all our tools.

Mayhew Steel Products, Inc.
Ready Tool Co. Division
291 Broadway
NEW YORK N. Y.

DIXON'S ELDORADO

"the master drawing pencil"

Perhaps we shouldn't suggest that you use a pencil that others will keep trying to borrow. It's selfish on our part. We know that once you have bought or borrowed a Dixon's Eldorado you will never again be satisfied with any other:—The quality of the master drawing pencil is clearly reflected in its work.



SAMPLE OFFER

Write for full-length free samples of *"The master drawing pencil"* and of Dixon's "BEST" Colored Pencils. In their field, the "BEST" Colored Pencils hold the same position of supremacy as Dixon's Eldorado.

Made in 17 leads — one for every need or preference

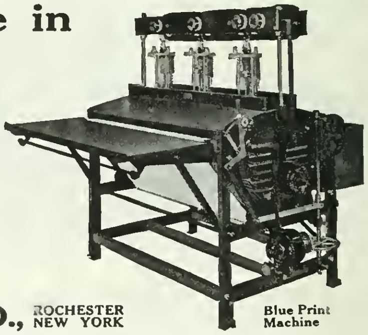
JOSEPH DIXON CRUCIBLE CO.
Pencil Dept. 74-J, Jersey City, N. J.
Canadian Distributors:
A. R. MacDougall & Co., Ltd., Toronto

Blue Prints—Ready for Use in Four Minutes

Print Drying Machine

Paragon Blue Prints that take only four minutes to make, are permanent, clear and sharp, washed, dried and ironed.

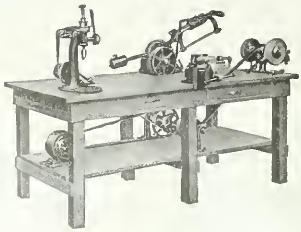
Paragon Equipment costs more to install, but makes prints fifty times as fast. We can prove its economy. Write for full story—then follow your own judgment.



Blue Print Machine

PARAGON MACHINE CO., ROCHESTER NEW YORK

MYERS TOOLS



MYERS COMBINATION WORK BENCH
Write for Particulars
MYERS MACHINE TOOL CORP., Columbia, Pa., U. S. A.

Lupton TOOL CABINETS

Steel Shelving, Tool Stands and Pressed Steel Bench Legs. Order from warehouse stock. Ask for Catalogue C.

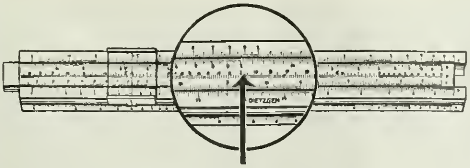
David Lupton's Sons Company
Allegheny Ave. and Tulip St. Philadelphia

★ COLUMBIA ★ TRADE MARK ★ GALLIA ★ TRADE MARK

BLUE PRINT PAPERS.

Send for SAMPLES

NEW YORK **KEUFFEL & ESSER CO.** HOBOKEN, N.J.
CHICAGO · ST. LOUIS · SAN FRANCISCO · MONTREAL



The Scale

that gives the accuracy and exceptional range to the

PHILLIPS SLIDE RULE

It enables many formulas in Civil, Mechanical and Electrical Engineering to be solved with greater rapidity and accuracy than is possible with any other rule.

An Example

Divide 65^2 by (51 x 85)

One slide movement does it. Try it on your rule.

Send for Catalog

EUGENE DIETZGEN CO.

Branches:
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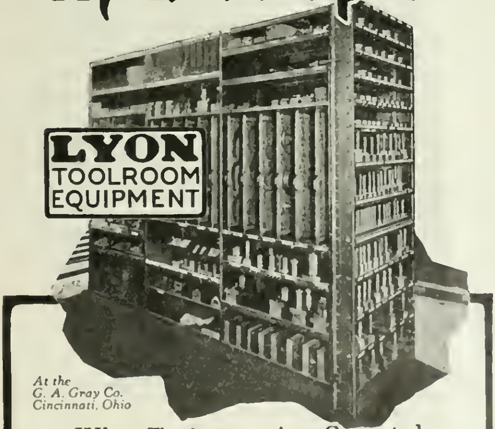
MORE TOOLS In Less Space



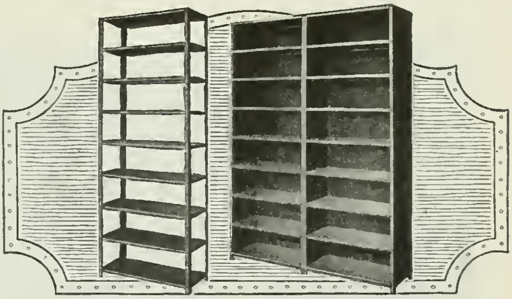
At the G. A. Gray Co. Cincinnati, Ohio

When Toolrooms Are Crowded

Many firms are increasing their tool supply to produce added lines and new designs. They must store more tools in the same space. Mr Marx, V P of the G. A. Gray Co., in an interesting article, "Storing Gauges and Tools," published in "Machinery," tells how this was done in their plant

A copy of Mr. Marx's article will be gladly sent you on request

Lyon Metallic Manufacturing Company, Aurora, Ill.



Plain Skeleton Shelving *Plain Shelving with Backs and Partitions.*

Built on a Unit Skeleton

You provide for your future growth when you buy Allsteel Shelving. Remember it is always adaptable. Built on the unit principle, it can be quickly changed or extended to meet any conditions.

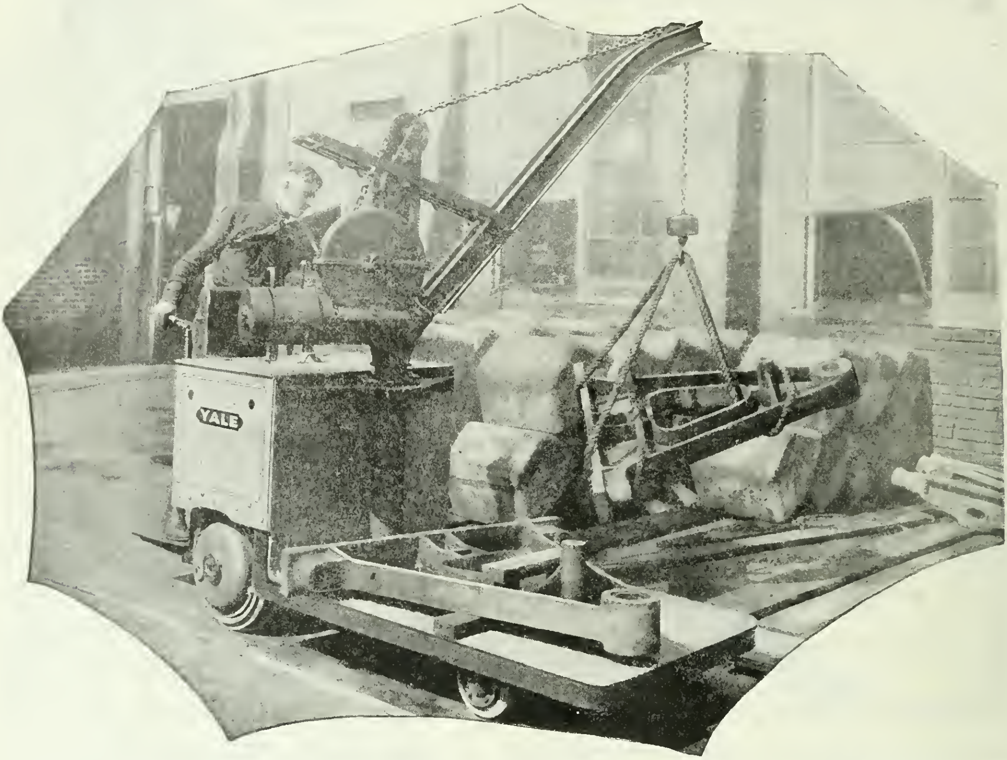
It is strong, portable, fire-resistant. It meets modern factory demands for steel shelving that can be added to or taken from at will. Look into Allsteel before you buy. Send for our 32 page Shelving data book.

GF Allsteel
Shelving

The General Fireproofing Company
Youngstown, Ohio

Branches:
New York Chicago Boston Washington
Atlanta Seattle Philadelphia San Francisco
Dealers in all principal cities

Allsteel



The Yale Way is a 1-Man Way

THE Yale DF-60 Crane Truck illustrated, enables one man to carry these heavy shaft hanger brackets from the rough storage yard into the machine shop, and to place them directly on the planer bed.

Consider the saving effected by this in both time and labor!

Careful studies recently made in a large manufacturing plant showed that each ton of finished products turned out required the equivalent of 268 tons of handling.

The Yale Way more than pays for itself the first year in the saving it effects in material handling costs.

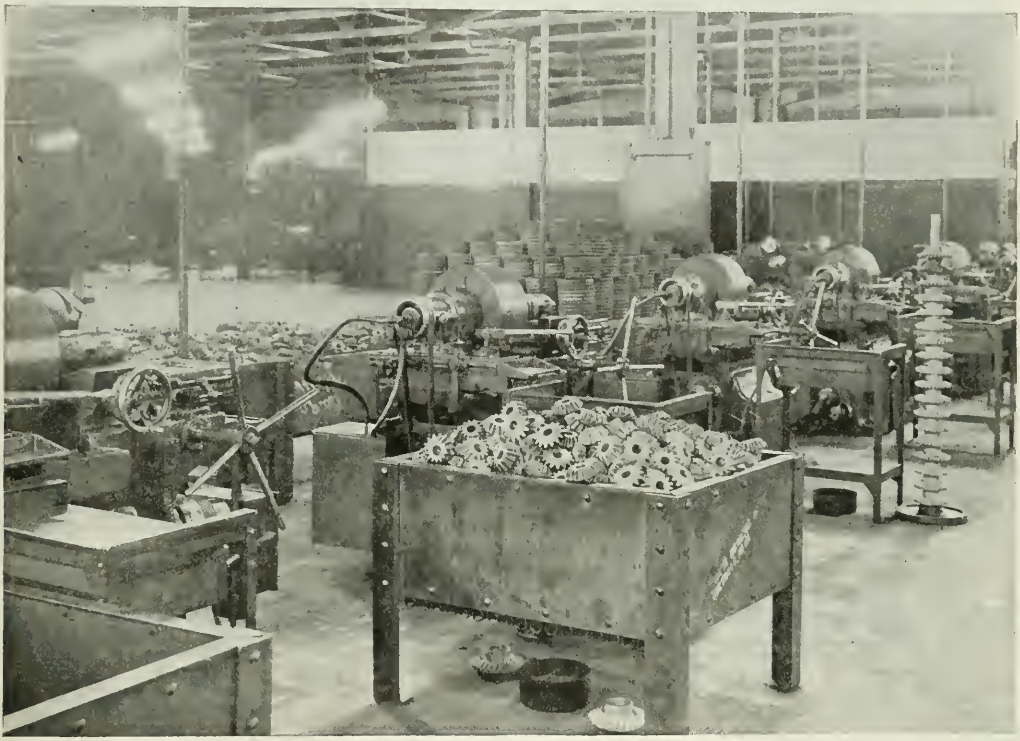
We can tell you, for instance, how one Yale truck saved $60 per day hauling foundry sand; how in another plant a return of 344% on the investment was effected the first year; and numerous other instances of unusual savings.

Write today for facts about Yale Electric Industrial Trucks, Tractors and Trailers, Chain Blocks, Electric Hoists, and Trolley Systems.

Yale Made is Yale Marked

The Yale & Towne Mfg. Co.
Makers of Yale Products: Locks, Hoists and Electric Industrial Trucks
Stamford, Conn.

Y
YA
YAL
TRADE YALE MARK **Hoisting and Conveying Systems**



An example of the thorough, yet shadowless illumination afforded by Cooper Hewitt lighting

Why They Decided on Cooper Hewitt Lighting

"It may interest you to know why I called up and gave you my decision. I was over the other night and looked at the lighting in the plant you recommended. When I went in I noticed all lighting was at least 35 feet above the work and no drop lamps on the machines anywhere I thought the men must be having a hard time to get by with that condition, but when I inspected the working point, I was surprised to note that there was practically a daylight condition there.

"I asked the mechanic if he could see his work all right with his light so far away, and he told me that it was all right; that he would 'just as well work under that light as daylight.' I asked three or four others and received the same opinion. I even did a short trick on one or two machines to thoroughly convince myself and then I asked the foreman.

"He told me that their night production was kept up to the day standard, and had been for a long time; that he considered the men had as good light conditions as the day shift.

"Right then I recalled that another firm in this city who had been doing similar work on similar hours, and whose plant was incandescent lighted, had been but 75% efficient at night as compared with the day.

"That is why I decided to install Cooper Hewitt Lamps, and that is why you had a telephone call to come down and get the order."

Isn't this a good enough reason for lighting *your* factory with Cooper Hewitts?

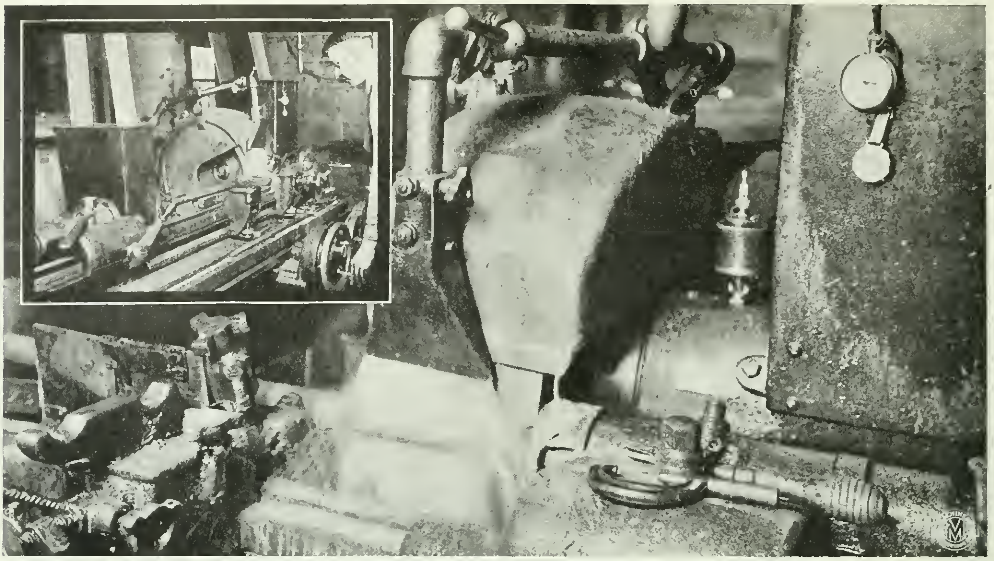
Cooper Hewitt Electric Company

Boston—161 Summer Street
Chicago—618-9 Fisher Building
Cincinnati—First National Bank Bldg.
Cleveland—Engineers' Building
Detroit—Ford Building
Hoboken—95 River Street

Hoboken BETTER THAN COOPER HEWITT LIGHT INCREASES PRODUCTION DAYLIGHT **New Jersey**

Los Angeles—Keese Engineering Corp.
Milwaukee—Security Building
New York—120 Broadway
Philadelphia—Drexel Building
Pittsburgh—Westinghouse Building
St. Louis—Title Guaranty Bldg.
Syracuse—University Building

CH-66



EC OMY **ECONOMY** EC OMY
TRADE MARK REG. U.S. PAT. OFF.
GRINDING LUBRICANT

Saves Power
Speeds Production
Satisfies the Operators

Economy Grinding Lubricant Speeds the Production of Automobile Axle Shafts in the Plant of the Edwards Electric Company, Easton, Pa.

Once again the three dominant characteristics of Economy Grinding Lubricant come to the fore: saving power, speeding production and satisfying the operators.

So far-reaching are the benefits of Economy Grinding Lubricant in wet grinding that once tried it is always used by plants employing this process.

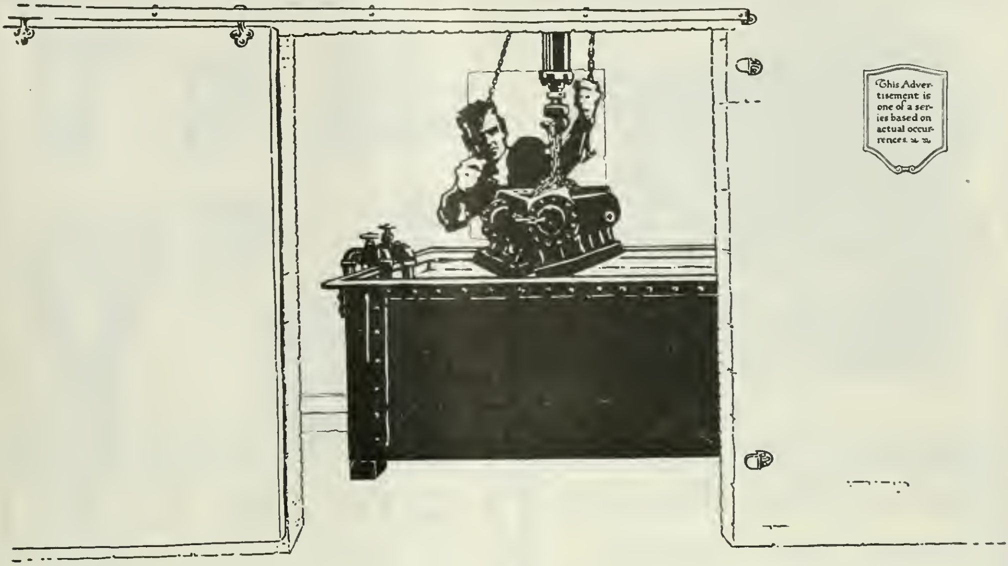
There's the freedom from clogging, the free cutting, the absence of rust, the finer finish. You realize the cutting qualities of your wheels are being utilized to the utmost.

Then, think of the men—no more burnt hands and faces from alkaline solutions—no objectionable odor.

All along the line Economy Grinding Lubricant will be a distinct benefit to your plant.

Send for sample and quotations

THE WHITE & BAGLEY COMPANY
Worcester, Mass., U. S. A.



This Advertisement is one of a series based on actual occurrences.

Saves $180 Weekly Since Cleaning Auto Parts With OAKITE

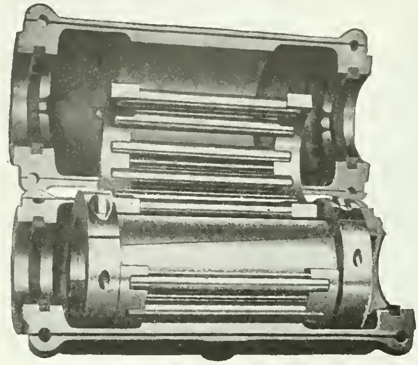
An Auto Factory now uses Oakite materials instead of caustic soda for cleaning fenders, dash plates and other sheet steel parts, because Oakite saves at least $180 every week in labor, and does faster and better work.

Formerly had trouble with rejects after japanning—which ran 6% to 8%, sometimes as high as 15%. Parts are now so thoroughly cleaned that japan takes perfectly and rejects are unknown.

With caustic it was necessary to wipe parts with gasoline before tack ragging. The elimination of this step, together with the fact that parts cleaned with Oakite are easier to wipe than parts cleaned with caustic, has made it possible for two men to do as much work as eight men did under previous conditions.

Write for booklet—Oakite Service for Automobile and Aeroplane Manufacturers. Sent free on request to responsible concerns.

OAKITE MANUFACTURED BY
OAKLEY CHEMICAL CO.
26 THAMES STREET · NEW YORK



Here's how Sells Roller Bearings lower your power costs at least a fifth

First: There is the *cost* of the fuel—you use less.

Second: Your freight and hauling costs are lowered.

Third: The cost of handling—it is considerably less.

—And then there is the saving on belts through the elimination of slippage.

You can substitute Sells Roller Bearings overnight without removing a pulley or taking down a line of shafting. They fit your present hangers, post hangers and pillow blocks.

In Sells Roller Bearings exclusively is found that split steel sleeve that fits over the soft shaft, protecting it from wear.

We'll send our book Anti Friction Power Transmission.

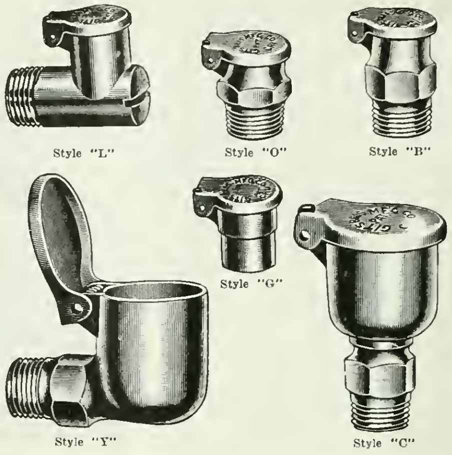
John D. Sells
Manager

Royersford Foundry & Machine Co.
54 N. 5th Street Philadelphia, Pa.

Here are a few Installations:

Millers Milling Company
Aunt Jemima Mills Company
French, Shriner & Urner
United Shoe Machinery Company
Gillette Safety Razor Company
American Agricultural Chemical Company
Newberry Cotton Mills
Babcock & Wilcox Manufacturing Company
Borden Condensed Milk Company
Dodge Brothers
American Car & Foundry Company

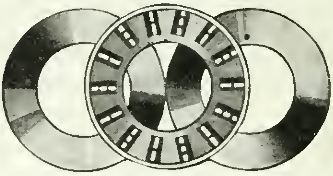
SELLS *Roller Bearings*



GITS OIL CUPS

Give perfect satisfaction where others fail. State style and size in which you are interested, and we will send free samples and catalog.

Gits Bros. Manufacturing Company
1901 S. Kilbourne Avenue CHICAGO, ILLINOIS



ROLLER THRUST BEARINGS

from 1" SHAFT DIA., UP
ONE—OR ONE THOUSAND

STOCK SIZES or made to your specifications.
Send FULL Dimensions, SKETCH or old BEARING as sample.

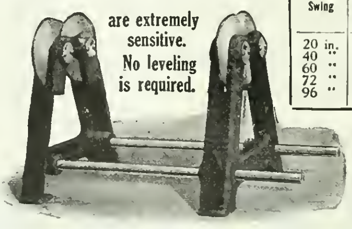
THE GWILLIAM COMPANY
23 FLATBUSH AVENUE BROOKLYN, N. Y.
253 WEST 58th STREET NEW YORK, N. Y.
1314 ARCH STREET PHILADELPHIA, PENNA.

Anderson Improved Balancing Ways

are extremely sensitive.
No leveling is required.

They are made in the following sizes

Swing	Greatest Distance Between Standards	Capacity in Lbs
20 in.	20 in.	1,000
40 "	30 "	2,000
60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000



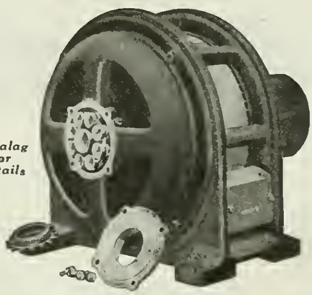
Manufactured by
ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET
ROCKFORD ILLINOIS

"Rollway" Roller Bearings Now Fill Every Bearing Need

It is ten years since we started manufacturing "Rollway" Anti-friction Bearings—the first ones being mostly of the heavy duty type; and many "Rollway" journals and Electric Motor Bearings are still in use on electric railroads throughout the country.

As the fame of "Rollway Service" spread we received inquiries from other fields and developed a wide variety of styles and sizes so as to supply practically every need from stock. Depending on size, the saving of power varies from 4 to 20% besides a 50 to 75% reduction in lubrication and maintenance costs.

Catalog for Details



"Rollway" Bearings for all Railway and Industrial Purposes

THE RAILWAY ROLLER BEARING COMPANY
SYRACUSE, NEW YORK, U. S. A.

FORD TRIBLOC

"What'll I do if it slips?"
"It won't slip!"

There are no "life nets" in a factory. Hoists are built with a liberal margin of safety. In FORD TRIBLOCS this is 3½ to 1.

FORD TRIBLOCS have won the confidence of thousands of men who use them daily. They know "It won't slip!"

The LOOP HAND CHAIN GUIDE is a patented malleable iron loop. It parallels the lower half of the hand chain wheel, providing a strong rigid flange, which guides the chain at any angle, and prevents gagging or overriding.

Men work the FORD TRIBLOC from all sides with speed, precision, and *confidence!*

All sizes and capacities. Write us for particulars.

FORD CHAIN BLOCK CO.
2nd and Diamond Sts., Philadelphia, Pa.
Over-seas Representative
ALLIED MACHINERY CO., OF AMERICA
51 Chambers St., N. Y., U. S. A.
Paris Brussels Turin Barcelona Rio de Janeiro

2182-D

NORMA

The higher the speed of rotating surfaces, the greater the liability to wear. Machines running at high speeds need every wear-protection. With "NORMA" Precision Ball Bearings, all the wear is confined to hardened steel balls rolling on hardened steel races, finished with mathematical precision. Friction is almost eliminated—which means that wear is made almost negligible. And the utmost mechanical efficiency is assured. Our engineers are at your service.

THE NORMA COMPANY OF AMERICA
Anable Avenue, Long Island City, New York
Ball, Roller, Thrust and Combination Bearings

FRANCKE FLEXIBLE COUPLINGS For Direct-Connected Machinery Shafts

SMITH & SERRELL, 46 Central Ave., Newark, N. J.

PINTITE RIGID COUPLINGS For Line Shafting

SEND FOR BULLETINS

"PIONEER" STEEL HANGER STANDARD PRESSED STEEL CO.—PHILADELPHIA

"PIONEER" Steel Hangers
"HALLOWELL" Steel Bench Legs
Safe—Durable—Economical
Bulletins on request.
Standard Pressed Steel Co.
JENKINTOWN, PA.

NORTHERN HOISTS

"TYPE D"
ELECTRIC

NORTHERN ENGINEERING WORKS
DETROIT MICHIGAN — U.S.A.

"NIGRUM"
IMPREGNATED HARDWOOD
OIL-LESS BUSHINGS
TRADE MARK REG. U.S. PAT. OFF.

Save the Cost of Neglect

Neglected lubrication exacts a heavy toll in premature wear and breakdown.

"Nigrum" (impregnated hardwood) Oil-less Bushings, by their ability to function smoothly in spite of neglect, afford a welcome protection against these costly dangers.

We also manufacture "Bound Brook" graphite-and-bronze Oil-less Bushings.

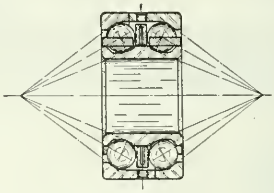
All Genuine Graphited Oil-less Bushings have always been made at Bound Brook, U. S. A.

Bound Brook Oil-less Bearing Company
Specialists in the manufacture of Oil-less Bushings for more than a third of a century.
BOUND BROOK NEW JERSEY
Detroit Office, 1723 Ford Building

Langhaar Self-Adjusting
L-S-A
Ball Bearings

They are correctly designed. They are not self-destructive. Ball Spinning and wedging by centrifugal force are eliminated.

Another exclusive feature is SELF-ADJUSTMENT. (No Play).



The Langhaar Ball Bearing Co.
Second Street Aurora, Indiana, U. S. A.
Michigan Representatives:—Engineering Specialties Company
3024 West Fort Street Detroit, Mich.

"MORTON'S"
CABLE CHAINS

Reserve Strength

Your machines running at high speed place equipment under severe strain.

That's why we take unusual precaution to manufacture a chain with plenty of reserve strength.

Faulty chain equipment retards production—PLAY SAFE—order MORTON'S CABLE CHAIN.

Quotations on request.

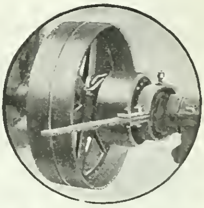
Thomas Morton
245 Centre St. New York

Don't Waste Oil

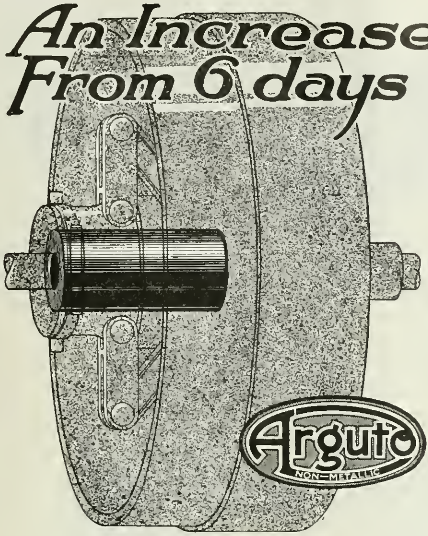
Mule-Pull Clutches have Ring Oiling lubrication—they save oil. The end of the loose sleeve carries a reservoir containing a revolving steel ring. At every turn a generous supply of oil is delivered to the bearing without waste. Friction is eliminated, shut-downs and repairs are reduced to a minimum. Specify Mule-Pull Clutches on your machinery and get the benefit of a thoroughly reliable clutch.

Brown Engineering Co.
133 N. Third St., Reading, Pa

Send for circular.



An Increase From 6 days to 10 years



Outwears the best bronze metal.
Smoother than grease.

Arguto Oilless Bearing Co.
Pioneer Manufacturers of Oilless Bearings
145 W. Berkley St., Wayne Junction
Philadelphia

Figure up these savings for your plant

"Prior to the use of the ARGUTO Oilless Bearings we burned out a babbitt box and two bronze boxes within two weeks time." (From a letter).

Say 6 days apiece for the metal bearings, though it wasn't that long. That was *ten* years ago and the ARGUTO Bearings are still in use after running continuously without lubrication
—without attention
—without repairs
—without replacement
—without shut-down

Let us see what the savings on the cost of bearings only total. The two bronze boxes cost, at that time,

$2.06 each in place	$4.12
The babbitt box cost	1.30
Every two weeks	$5.42

Every two weeks is $140.92 a year.

Ten years is $1409.20, on ONE bearing, mind you, and that does not take into account the cost of oil, repairs, new shafting, or attention.

Find out about

ARGUTO Oilless Bearings

THE CHICAGO LINE CP&S CO POWER TRANSMISSION

ECONOMICAL, POWER SAVING SERVICE
Ball Bearing Specialties of

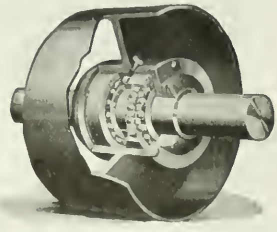
The Chicago Line

Foolproof, dustproof, oil tight. Will not leak, drip or spatter oil. Correct design, durable, accurately machined, trouble free, noiseless. Cannot stick, freeze or wear the shaft.

Ball Bearing Clutch Pulley

Daggett Ball Bearing Loose Pulley
Ball Bearing Clutch Pulley
"All Loose" Countershaft Drive
Marvel Grinder (Ball Bearing)

All equipped with
S K F Ball Bearings



Daggett Ball Bearing Loose Pulley

Booklet sent on request.

CHICAGO PULLEY & SHAFTING CO.

Main Office, 40 South Clinton Street
Chicago, Illinois

Factory, Menomonee Falls
Wisconsin

The Sign of Efficiency *The Sign of Durability*

MORSE SILENT CHAIN DRIVES

Positive as Gears THE MORSE "ROCKER JOINT" *Flexible as a Belt*

Longer Life

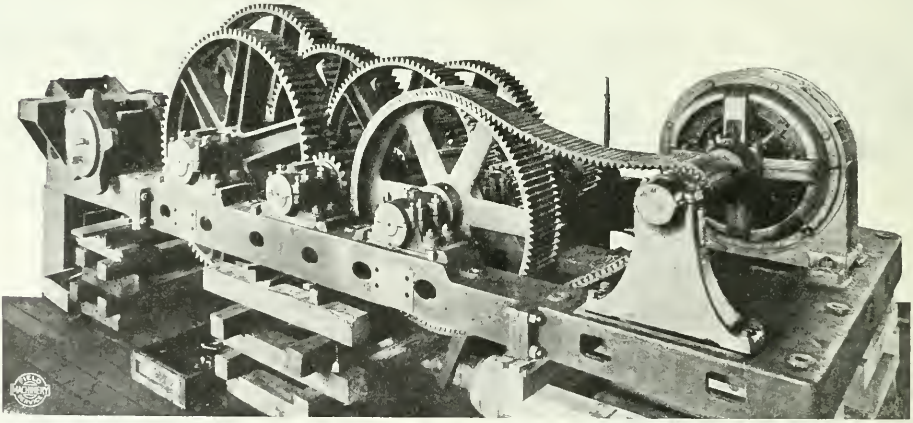
Extensively Used for Special Mill Machinery

The Vaughn Machinery Company of Cuyahoga Falls, Ohio, has been using Morse Chain Drives for the past ten years, in equipping its well-known line of steel and rubber mill machinery—principally on draw benches, wire drawing frames, pointers and calenders.

The Morse Chain shown is used to transmit power from a 17 tooth gear on a 100 H.P. motor, to a 113 tooth drive sprocket on the reduction gearing of a Vaughn Straightway 4″ Draw Bench—a distance of 60″ between centers.

Morse Drives run cool, oil baths not required, save power and space, increase production, allow better arrangement and reduce maintenance costs. Our engineers are ready to show you.

See our exhibit at the Seventh National Exposition of Chemical Industries, 8th Coast Artillery Armory, New York, week of September 12.



MORSE CHAIN CO., LARGEST MANUFACTURERS OF SILENT CHAINS IN THE WORLD **ITHACA, N. Y.**

Morse Engineering Service *Assistance Without Obligation*

Write for Booklet

Address Nearest Office

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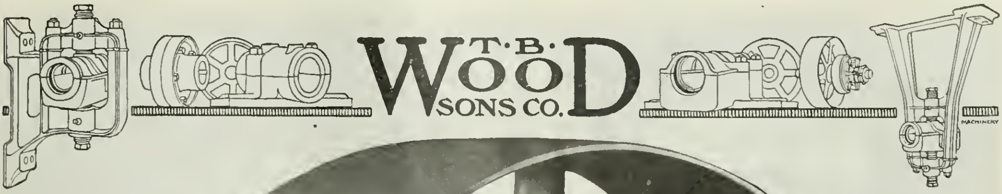
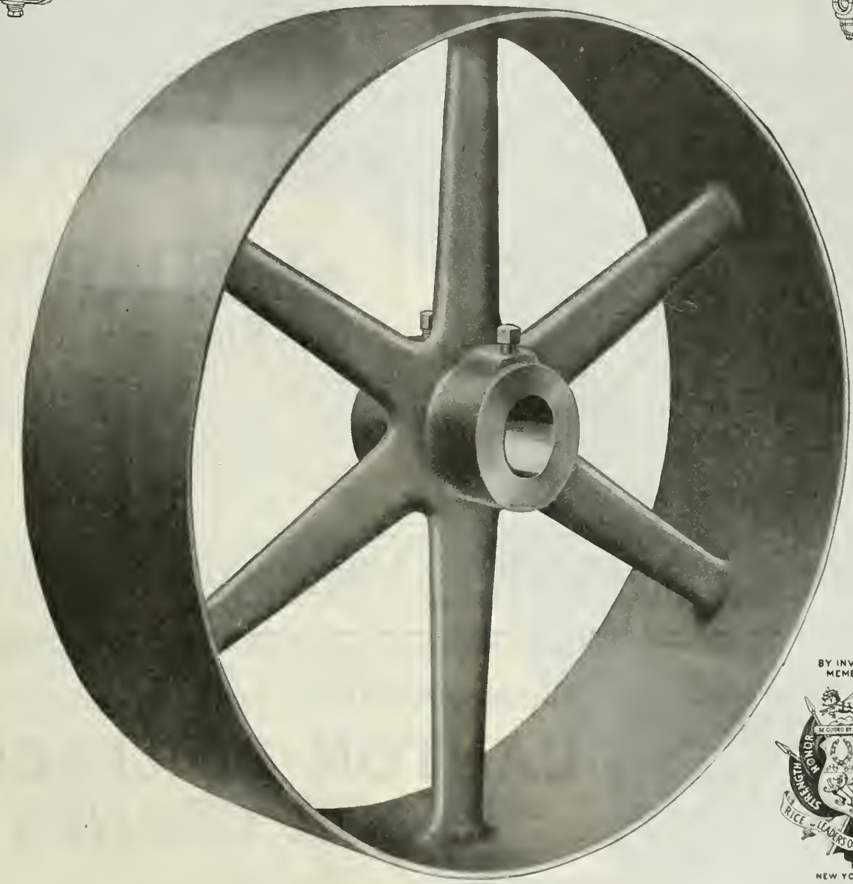
BALTIMORE, MD. . . . . 1402 Lexington Bldg.
BOSTON, MASS. . . . . 141 Milk Street
CHARLOTTE, N. C. . . . . . 404 Commercial Bank Bldg.
CHICAGO, ILL. . . . . Merchants L. & T. Bldg.
CLEVELAND, OHIO . . . . Engineers Bldg.
DETROIT, MICH. . . . . Cor. 8th and Abbott Sts.
KANSAS CITY, MO., Finance Bldg. . . . Morse Engr. Co.
MINNEAPOLIS, MINN., 413 3rd St. S. Strong-Scott Mfg. Co.
CANADA . . . . Jones & Glasco, Regis'd
MONTREAL, St. Nicholas Bldg. Toronto, Traders' Bank Bldg.
NEW YORK CITY . . . . 50 Church St.
PHILADELPHIA, PA. . . . . 808 Harrison Bldg.
PITTSBURGH, PA. . . . . Westinghouse Bldg.
SAN FRANCISCO, CAL. . . . . Monadnock Bldg.
ST. LOUIS, MO., Chemical Bldg . . . . Morse Engineering Co.

"Morse" is the Guarantee Always Behind the Efficiency, Durability and Service





BY INVITATION MEMBER OF
BE GUIDED BY THIS FOUNDATION
STRENGTH HONOR QUALITY SERVICE
RICE — LEADERS OF THE WORLD — ASSOCIATION
NEW YORK U.S.A.

In the Final Analysis——Cast-Iron Pulleys

Have you ever thought of the pulley troubles you have had and how invariably the drive was made satisfactory by installing Cast-Iron pulleys—either supplanting pulleys of some other type or by changing to cast-iron pulleys of suitable construction?

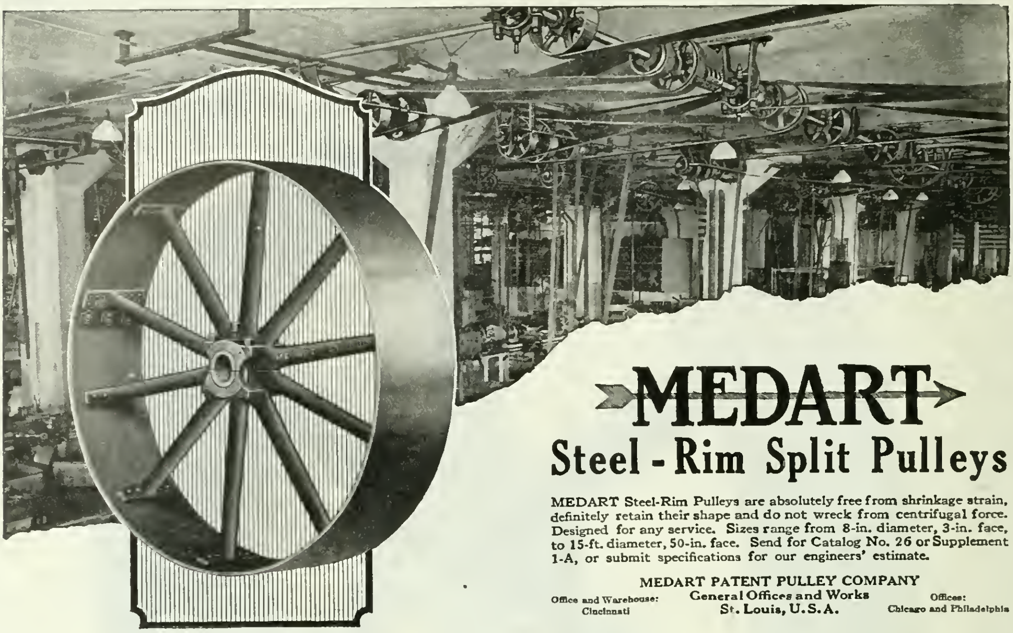
BUT IT WAS A CAST-IRON PULLEY THAT FINALLY STOOD UP UNDER THE SERVICE

Almost every user of power has had this experience and always the solution of continuously satisfactory transmission service has been the installation of cast-iron pulleys.

The use of cast-iron pulleys in the initial installation will prevent trouble.

T. B. WOOD'S SONS CO., Chambersburg, Penna.

W POWER TRANSMITTING MACHINERY W



MEDART

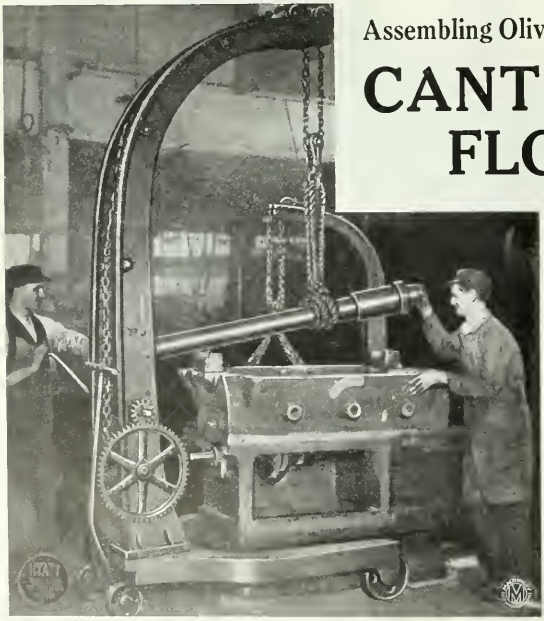
Steel-Rim Split Pulleys

MEDART Steel-Rim Pulleys are absolutely free from shrinkage strain, definitely retain their shape and do not wreck from centrifugal force. Designed for any service. Sizes range from 8-in. diameter, 3-in. face, to 15-ft. diameter, 50-in. face. Send for Catalog No. 26 or Supplement 1-A, or submit specifications for our engineers' estimate.

MEDART PATENT PULLEY COMPANY

Office and Warehouse: Cincinnati
General Offices and Works St. Louis, U.S.A.
Offices: Chicago and Philadelphia

MEDART *means* **EVERYTHING** *in* **LINE SHAFTING EQUIPMENT**



Assembling Oliver Lathes is Vastly Simplified by the Use of

CANTON PORTABLE FLOOR CRANES

They're "The Handiest Tools in the Shop," say the men at the Grand Rapids, Michigan, plant of the Oliver Machinery Company, where this photograph was taken.

They do the work of the overhead cranes when these are busy or have a "break down"; run with ease into the corners where trolleys do not carry, under galleries and close up to machines that overhead cranes cannot reach.

Especially valuable in the Lathe Department where their use facilitates assembling—cuts labor costs—and reduces the danger to heavy parts.

Sizes to carry loads up to 6000 pounds, one man operation. Catalog?

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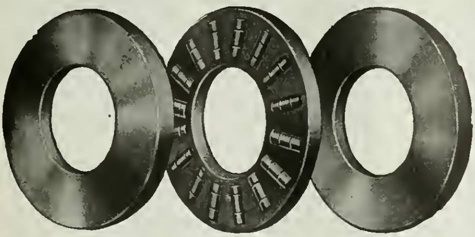
Permanent Exhibit Salesroom, 45 West 18th St., New York



SUCCESS

Success in manufacturing is dependent upon many factors, but since selling prices are largely determined by market conditions, it hinges primarily on obtaining the lowest possible factory cost.

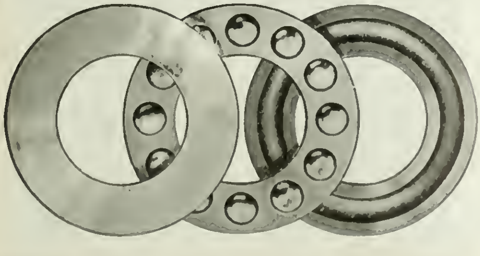
Investigation shows that power wastage and repairs to bearings are among the largest losses a plant can sustain. By choosing Ball and Roller Bearings both these leakages can be brought to the irreducible minimum.

Ball and Roller Bearings

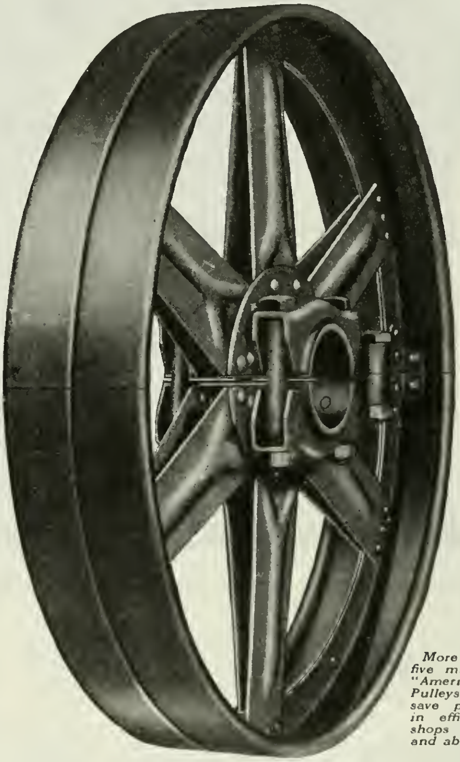
We make Radial Roller Bearings, Journal Roller Bearings, Roller Thrust Bearings and Ball End Thrust Bearings (in both inch and millimeter sizes). We carry a full line and have unusual facilities for manufacturing Cylindrical Rollers.

Catalog 9 yours for the asking

THE BALL & ROLLER
BEARING COMPANY
DANBURY CONNECTICUT, U. S. A.



AMERICAN STEEL SPLIT PULLEYS



More than five million "American" Pulleys now save power in efficient shops here and abroad.

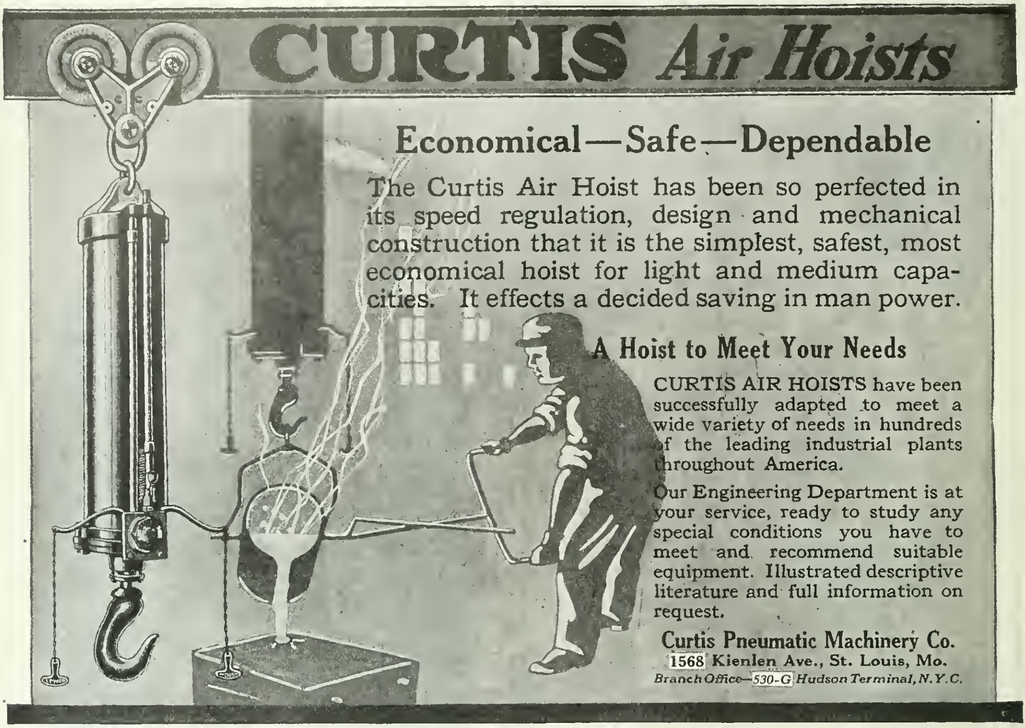
Basic Principles that Stand New Tests

SUCH features as strength, durability, weight, power conservation and ease of application of various types of pulleys were tested and studied in designing the "American" Pulley. Though there have been refinements, it is significant that the basic design has met every new test.

Send for booklet, "Getting Maximum Pulley Efficiency," which shows commonly unknown pulley facts.

The American Pulley Company
Philadelphia, Pa.

The AMERICAN PULLEY



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Economical—Safe—Dependable

The Curtis Air Hoist has been so perfected in its speed regulation, design and mechanical construction that it is the simplest, safest, most economical hoist for light and medium capacities. It effects a decided saving in man power.

A Hoist to Meet Your Needs

CURTIS AIR HOISTS have been successfully adapted to meet a wide variety of needs in hundreds of the leading industrial plants throughout America.

Our Engineering Department is at your service, ready to study any special conditions you have to meet and recommend suitable equipment. Illustrated descriptive literature and full information on request.

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"Commercial"
ANNULAR BALL BEARING

A large fraction of all Commercial Annular Ball Bearings have special features and are designed to cheapen or simplify the customer's assembly. Problems in annular ball bearings should be referred to us for the most economical solution.

Inexpensive. For moderate radial and radial-thrust loads at 3000 r.p.m. or less.

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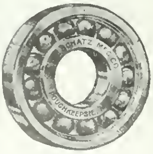

The Schatz Manufacturing Co.
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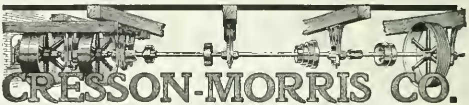
Pacific Coast—F. M. Cobbledick Co., 1031 Polk Street
San Francisco, Cal.



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Power Transmitting Machinery

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Almost sixty years' experience and competent engineering advice are at your disposal.

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Engineers—Founders—Machinists
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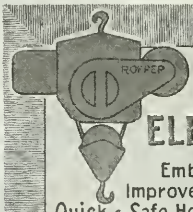

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ELECTRIC HOISTS
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Quick & Safe Hoisting Appliances!
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This is a Hilliard Friction Clutch

Used Wherever
Power Drives
Heavy Machines

From lathes to "merry-go-rounds," from paper corrugating machines to tanneries—on all kinds of machines, in all classes of work, you will find many users who say Hilliard Friction Clutches are the ideal means of getting individual control with the smooth, even drive and stop-without-jerk so necessary to big machines. "They give no trouble, require no repairs," to quote one enthusiastic user.

Try a Hilliard Friction Clutch for 60 days at our expense. Then tell us what *you* think.

The Hilliard Clutch & Machinery Co.
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FAFNIR
Ball Bearings
all standard types & sizes
FAFNIR Double Ball Bearing Hanger Boxes.

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DIAMOND CHAIN DRIVE

The "Diamond" line of high grade Steel Roller and Block Chains offers a chain for every power transmitting purpose. It includes over 70 models, ranging from ½ to 2 inch pitch and from ⅛ inch to 1¼ inch width. They are highly efficient, long in life and low in cost.

Write for catalogs and estimates.

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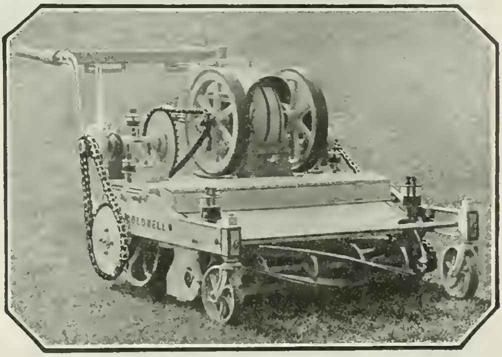

BALDWIN Roller Chain Drives provide a positive trouble-free means of power transmission between the prime mover and driver. This Coldwell power driven lawn-mower, for instance, illustrates their use both as a final and intermediate drive.

Baldwin Bulletin No. 12 entitled "Miscellaneous Applications of Baldwin Chain Drives" contains many applications of chain drives that will interest engineers and manufacturers. It will be sent you without charge.

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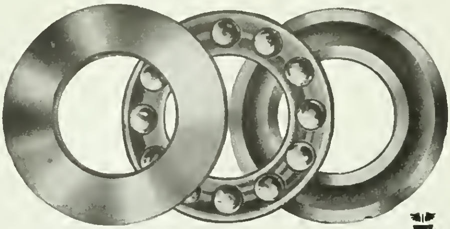
BALDWIN
CHAINS



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Manufacturers of

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of all types

Let our engineers help to solve
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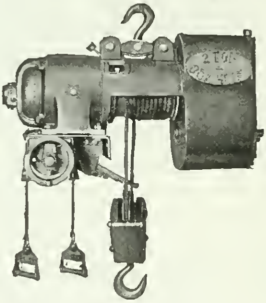

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Machines for every purpose where loads must be quickly lifted. Manufactured in standard sizes. Immediate shipment on those for regular voltages.

Write for Bulletin No. 2600 and benefit by our 41 year's experience.

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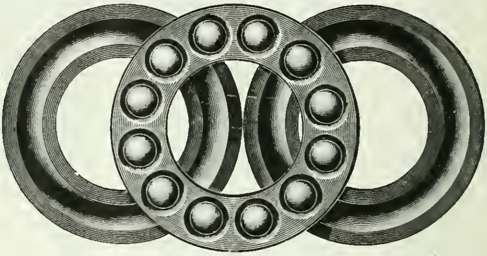

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Reflect the perfection of a life-long study of bearing construction.

Workmanship of the highest standard.

Designing of scientific engineers.

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Bearings Made to your Requirements

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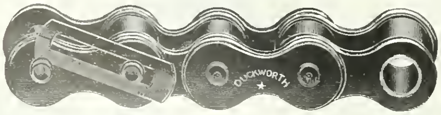
CHAINS and SPROCKETS



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½", ⅝", ¾", 1" Pitch. All Standard Widths

BLOCK AND TWIN ROLLER TYPE

1" Pitch ⅛", 3/16", ¼", 5/16", ⅜", ½" Wide.

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The Largest Manufacturers of Motorcycle Chains in the World

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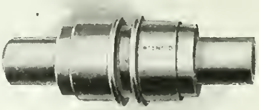


Send for New Catalog C-3

Hanson Friction Clutch

THE

HANSON

CLUTCH & MACHINERY CO.

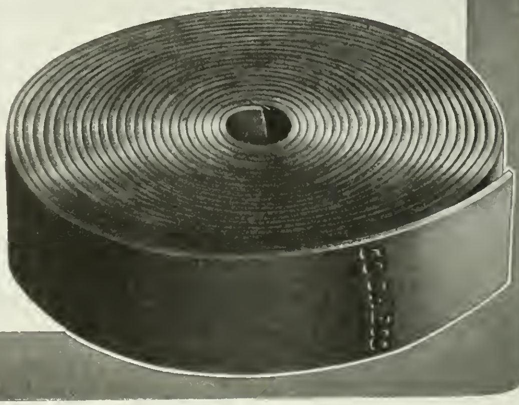
TIFFIN, OHIO, U. S. A.

Have you ever considered the part the belt plays in the work you get from the power you buy? Walk through the shop, examine your belts and note their condition—then see which are those delivering all you pay for.

Cocheco Belting saves power by reducing waste. Cut from backbone center stock of carefully curried oak tanned packer steer hides it is "live" leather—belting that retains its resiliency indefinitely.

We've made belting for 79 years—Cocheco represents the best experience of those years. Let us tell you some of the things we have learned about belting and, incidentally, a little more about Cocheco.

COCHECO BELTING



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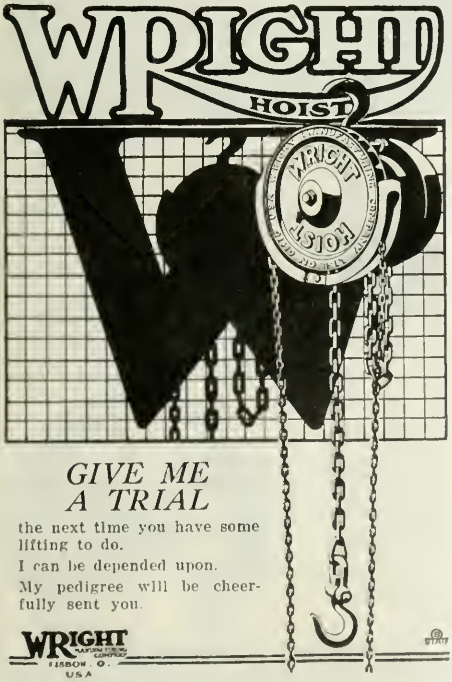

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the next time you have some lifting to do.

I can be depended upon.

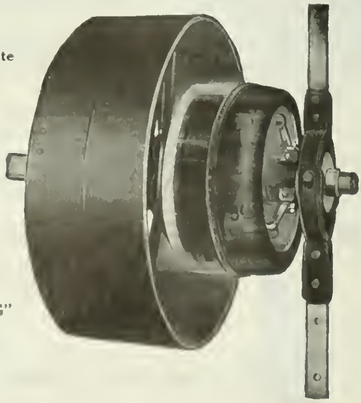
My pedigree will be cheerfully sent you.

WRIGHT MANUFACTURING COMPANY
LISBON, O.
USA

"EDGEMONT"

The Clutch for Hard Service

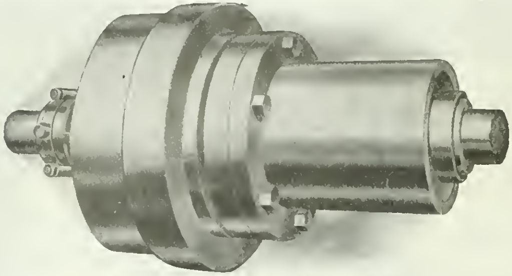
Wherever power transmission is intermittent, the Edgemont Clutch is the ideal method of control. No load too heavy, no speed too high; it is simple, easily adjusted and guaranteed to transmit full rated power; regularly used in many well-known machines and countershafts. Friction plates have burn-proof linings which are readily replaced and require no lubrication.



Extended Sleeve Plate Type "C"

Catalog "G" for Details

THE EDGEMONT MACHINE CO.
2700 National Ave. DAYTON, OHIO



M. & W. CLUTCH

For sustained high speeds and heavy pulls, the Moore & White Friction Clutch has no superior. It is mounted on a ball-bearing sleeve, insuring long life and minimum friction. It has the ability to run for long periods without lubrication or attention. It is thoroughly trustworthy and renders real service to the user. Let us help you in your selection of clutch equipment.

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THE MOORE & WHITE CO.
Established 1886
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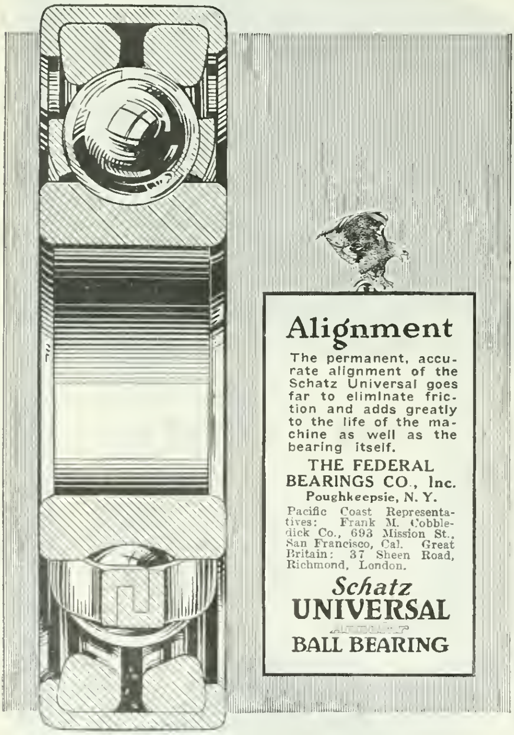

Alignment

The permanent, accurate alignment of the Schatz Universal goes far to eliminate friction and adds greatly to the life of the machine as well as the bearing itself.

THE FEDERAL BEARINGS CO., Inc.
Poughkeepsie, N. Y.

Pacific Coast Representatives: Frank M. Cobbledick Co., 693 Mission St., San Francisco, Cal. Great Britain: 37 Sheen Road, Richmond, London.

Schatz
UNIVERSAL
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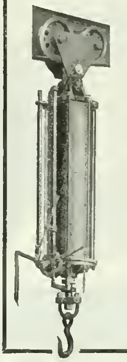
BALL BEARING



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Built to meet any condition of material handling. Accepted as standard equipment everywhere.

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Manufacturer and Distributor for
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F. BROWN'S PATENT FRICTION CLUTCH COUPLINGS AND PULLEYS

FOR HIGH SPEED

FOR HEAVY DUTY

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ESTABLISHED 1854
THE
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MACHINISTS MILLWRIGHTS

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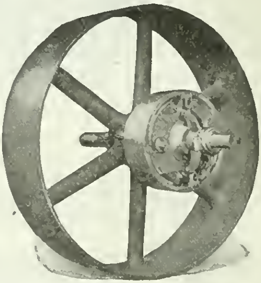
POWER TRANSMISSION
MACHINERY
GEARS
FOR MOTOR, MACHINE, MILL OR POWER PLANT
ROPE DRIVES A SPECIALTY



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We lay out make drawings, furnish the material and erect it Special machinery built to drawings and specifications

WORKS: ELIZABETH, N. J.

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Stock and to Order Diamond, Whitney, Baldwin, Duckworth, and Coventry Chains. Block, Roller and High Speed Silent Types on Hand.

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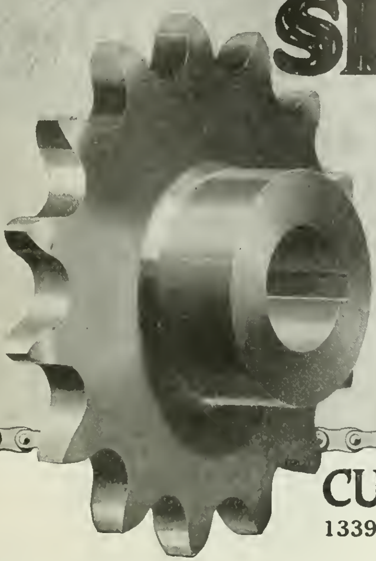

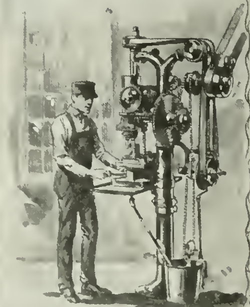

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The Load at All Times Is Under Complete Control

A light pull, and up goes the load. Stop pulling, and, without jerking, it becomes instantly motionless. Lowering is under complete control at all speeds.

Blocks are finely finished, and run up to 20 tons rated capacity, each tested to a 50 per cent overload.

Write for full particulars.

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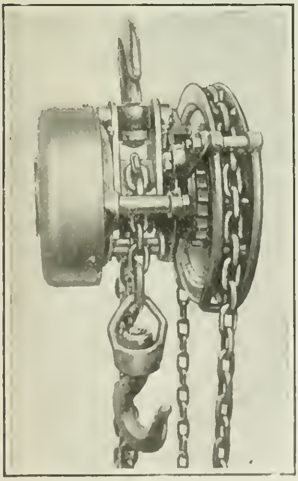

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From Hook → To Hook →

100% Efficiency IN Hoists

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Are your production costs still too high?

Drastic price declines have probably forced on you, as on most manufacturers, an equally drastic lowering of your costs of production.

You already have cut expenses to the bone. You have reduced your operating force to a point where further reduction would seriously cripple your plant.

Yet, despite all you have done, production costs are still too high. You cannot successfully meet the prices offered by your competitors.

The question now uppermost in your mind is, "What am I going to do?"

You may believe that further lowering of your production costs is impossible—that you have eliminated every item of unnecessary expense.

It is probable, however, that you have overlooked one factor having a tremendous bearing on manufacturing costs—PLANT LUBRICATION.

We do not mean just "oil." We mean the proper application of the right oils to meet, and meet exactly, the lubricating requirements of your plant at minimum cost—that will show savings in power costs and that will considerably lessen depreciation losses and maintenance charges.

This is where we can help you. We know oils and we know machinery. Our plant lubrication engineers—time after time—have discovered and corrected power losses from faulty plant lubrication. Thus, Cutting Oil engineers in many instances have made very material reductions in costs of production.

Get in touch with our nearest branch office. *You incur no expense or obligation whatever.*

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Producer and Refiner of Lubricating Oils, Fuel Oil, Gas Oil, Gasoline and Other Petroleum Products

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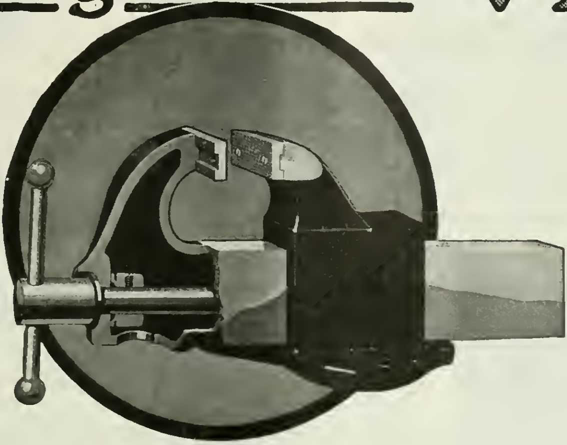
COLUMBIAN

Sledge-Tested VISES



Twice as Strong as Cast Iron

COLUMBIAN Sledge-Tested Vises are the only vises made of malleable iron and because of this fact, and the patented hollow jaw construction, they are twice as strong as cast iron vises of the same size.

Columbian Vises are better vises also because of their greater depth of jaw, their easier working quality, their removable steel jaw faces and self-aligning screw. The ball ends of the handle are forged on and can never come off.

Columbian Machinists' Vises are standard equipment in the foremost industrial and railroad shops of the United States and Canada and are carried in stock in every industrial center.

Yet these fine vises cost no more than you are asked to pay for cast iron vises.

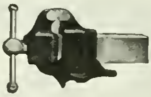
When you buy vises specify Columbian.

Columbian Hardware Division

of The Consolidated Iron-Steel Manufacturing Co.

World's largest makers of vises and anvils.

Cleveland



Yost Anvils and Vises

First Choice of the Skilled Mechanic

Good men appreciate good tools; that's why so many skilled mechanics choose Yost Anvils and Vises. Yost Anvils are one-piece steel castings made to stand the severest service. Yost Vises come in styles to suit all needs.

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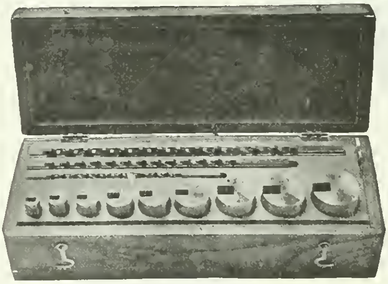
Yost Manufacturing Company
Meadville, Pa.

Yost Clip Horn Farrier's Anvil

Cutting Keyways with the Broach-Well Keyway Set on the Arbor Press is an Entirely Practical and Economical Operation—



(Patent Pending)

Just slip the work on to the accurately sized bushing, insert the tool steel cutter with the patented Velco tooth, place under your arbor press and press through just as you would press out an arbor. The entire operation takes less than a minute and any number of keyways exactly alike may be produced.

Should you require more than one keyway in a single piece, simply turn the work around the arbor to the required angle and repeat the operation.

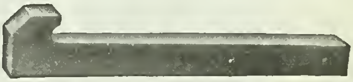
The Keyway Set will be found indispensable in the repair shop and tool-room, and the price is so low that the Set is available to the smallest shop.

Descriptive circular and prices on request.

The Velco Manufacturing Co., Inc., Greenfield, Mass.

WE SPECIALIZE ON

MACHINE KEYS
AND WOODRUFF KEYS



Any Size—Any Style—Any Quantity

With a new factory especially equipped for the purpose we are prepared to save you money. Write for prices.

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58-62 CLYDE STREET BUFFALO, N. Y.

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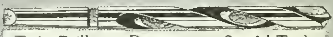
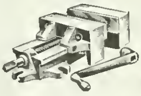


Twist Drills Reamers Special Tools

FASTFEED DRILL AND TOOL CORPORATION
TOLEDO, OHIO

DRILL VISE



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With and Without Jig Attachments
Often used on miller, shaper or planer.

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Knurl Holders

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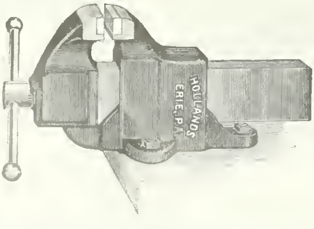
Providence, R. I.

Great Britain — Burton, Griffiths & Co.

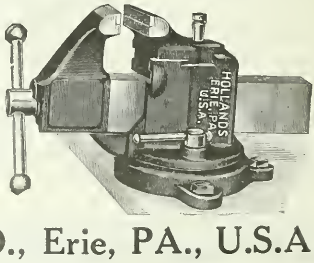
France, Italy, Switzerland, Spain and Holland, Fenwick Freres & Co.

HOLLANDS VISES



Have a record of over thirty years' satisfactory service.

Let us send the catalog.



HOLLANDS
ERIE, PA.
U.S.A.

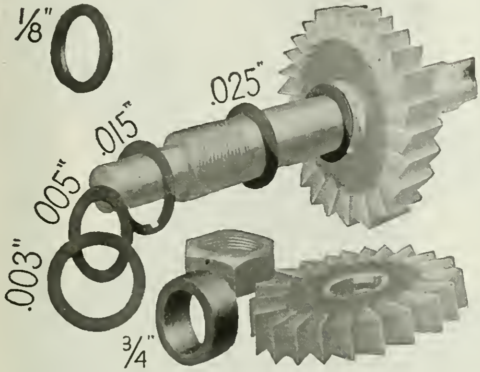
HOLLANDS MANUFACTURING CO., Erie, PA., U.S.A.

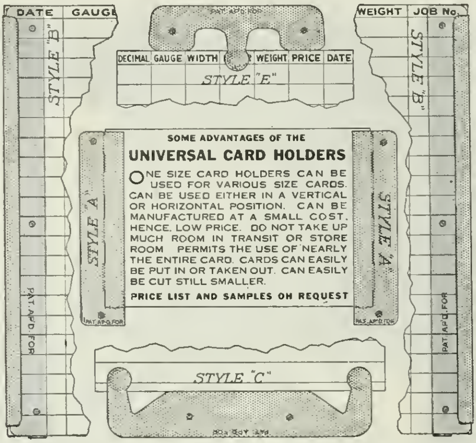
When you buy special tools and accessories from a specialist you get better tools at less cost than when you make them yourself—even such small items as

SPACING WASHERS

To Prove This, Try Ours on Your Next Order

Stock sizes—with or without standard keyways —for arbors of the following diameters: 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 1 7/8, 2, 2 1/4, 2 1/2, 3, 3 1/2 and 4 inches. Stock thicknesses: .003, .005, .015, and .025 inches. To order, .0015 to 3.000 inches.





SOME ADVANTAGES OF THE

UNIVERSAL CARD HOLDERS

ONE SIZE CARD HOLDERS CAN BE USED FOR VARIOUS SIZE CARDS. CAN BE USED EITHER IN A VERTICAL OR HORIZONTAL POSITION. CAN BE MANUFACTURED AT A SMALL COST. HENCE LOW PRICE. DO NOT TAKE UP MUCH ROOM IN TRANSIT OR STORE ROOM. PERMITS THE USE OF NEARLY THE ENTIRE CARD. CARDS CAN EASILY BE PUT IN OR TAKEN OUT. CAN EASILY BE CUT STILL SMALLER.

PRICE LIST AND SAMPLES ON REQUEST

Card holders for stock bins, shelves, trucks, stock boxes, etc., are another small but important commodity more economically manufactured by people in that line of business.

Universal Card Holders

are adaptable for cards of various proportions, can be used in either vertical or horizontal position and permit the use of almost the entire card which can be readily inserted and removed.

Four sizes in stock—2, 3, 4 and 5 inches. Other sizes to order. We now make these in two styles.

Samples and Price Lists on Request

DETROIT STAMPING COMPANY, 3445-3459 West Fort Street
DETROIT, MICH., U. S. A.

Never Again

—a tragedy in one act, that needs no explanation to the man who knows the

Athol - Starrett Vise

If this picture had been clipped from a "movie" reel and you were to see what went before—and after—the first thing you'd ask when you stopped laughing would be, "But what's the trick about the other fellow's vise"—that is unless you are already familiar with the safety and convenience of the *Athol Starrett Vise:* its ratchet type handle that stays put at any convenient point and can't slip through and pinch your finger; its positive base lock (the only one on the market); its buttress type jaw screw which insures the famous bull-dog grip of Athol-Starrett Jaws.

Let us tell you about them

ATHOL MACHINE
and FOUNDRY CO.
ATHOL MASS., U. S. A.

FIRTH-STERLINGISM

is the doctrine of the human element in steel making and tool making, a just tribute to the man at the fire and the man at the machine. Efficiency and capacity in tools are in proportion to the character put into the work.

Steel and tools have character just as men have character. All character, human and metallic, is developed by natural processes. There must be enough friction, but not too much. There must be enough work, but not too much. Claims for tool steel or advertisements which eliminate the man and the human element of coöperation have a depressing effect on personal ambition and this effect means failure. The mechanic has pride in his job just as the president has pride in his job. Both have responsibility and both need encouragement.

Nothing is more helpless than a bar of steel. Alone it can do nothing. It leans against the wall of a blacksmith shop awaiting man's skill and the heat of the forge to call it to work and action. The human element of determination makes steel tools cut metals; the human element of determination makes steel ships cut the seas.

No first-rate tool was ever made in a hurry except by accident. Time is required for honest work. A thoughtful tool dresser will measure aright the value of time in heating steel. The design of a tool is more important than the temper, but every good tool must have both. Proper designing and proper forging are important, tempering to suit the work is important, the grinding is important, but all these may be right and the tool fail by improper use. Firth-Sterlingism recognizes that credit to all is the spirit of the age; including the man that designs, the man that forges, the man that tempers, the man that grinds and the man that uses the tool; all coöperating for success and profit to the man that pays the bills. There is a capacity in a well-made tool that defies analysis because it is part of the man himself. The mission of a bar of steel has only begun when it is delivered to the buyer. At that point the seller's responsibility ceases and the buyer's responsibility begins. The outcome is beyond the control and responsibility of the maker of the steel. Superiority in steel is a fact. All steel is not alike. There is more in steel than chemists can find. Good steel came before laboratories. Good bread came before cook-books. Good blacksmiths and good mechanics came before printing-presses.

"Power dwells with cheerfulness;
Hope puts us in a working mood,
Whilst despair is no muse, and
Untunes the active powers."

FIRTH-STERLING STEEL COMPANY

McKeesport, Pa.

Copyright, January, 1911

FRANKLIN DIE-CASTINGS

Spreading a Great Educational Influence

Not so long ago good music was a treasure of the chosen few. Years of study were necessary to play an instrument. Today, irrespective of technical skill, the great educational influence of good music is at the command of everyone.

Among other modern manufacturing methods the Die-Casting Process has been instrumental in enabling the general public to enjoy good music. Franklin Die-Castings, used in phonographs, player pianos and organs, have helped to reduce production costs in the manufacture of these instruments.

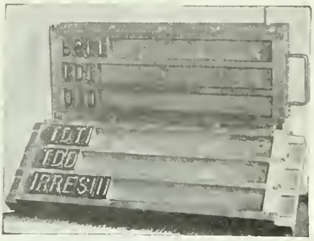
Franklin engineers, in 1892, originated the die-casting process. Franklin Die-Castings have helped manufacturers ever since to speed and simplify production in many fields of industry.

The addition of the standard No. 12 Aluminum to the Tin, Lead and Zinc base alloys already in use enables us to meet a still wider range of individual needs.

We quote from samples or blueprints.

Write for booklet
"Franklin Die-Casting in Many Fields."

FRANKLIN
DIE-CASTING CORPORATION
Gifford and Magnolia Sts.
SYRACUSE, N. Y.



Modern Marking—How it is done

No. 2. In a Sheet Metal Products Plant

A certain concern makes products from sheet metals, specializing milk and ice cream cans.

This concern wished to mark its products both before and after the forming operations were completed—a difficult problem. The marking problem was put up to us.

WE SOLVED IT!

Have you a marking problem? Are you sure you are getting real marking service?

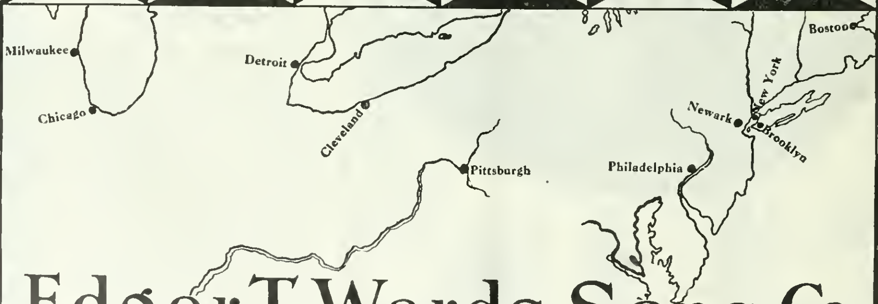
"PITTSBURGH" MARKING DEVICES
SERVICE YOU CAN DEPEND UPON

MARKING ENGINEER

PITTSBURGH STAMP COMPANY, INC.

Modern Marking Devices. Established 1913

PITTSBURGH, PA.



Edgar T. Wards Sons Co.

Offices and warehouses to serve all manufacturing territory in United States. Write to the city nearest your factory.

Ward's Steel Specialties and Ward's Country-Wide Service from Every Office

Ward's Tool Steels = Shafting = Screw Stock = Steel Tubing = Spring Wires = Tempered Strips = Non-Shrinkable Tool Steel = Drill Rods

FARRELL-CHEEK
STEEL FOUNDRY CO.
STEEL FC CASTINGS
"Makers of steel castings that are a little better than the next best."
SANDUSKY, OHIO, U.S.A.

It's the method—more than the metal—which determines the quality.
A new exclusive method is making Supercast Die Castings

Dependable SUPER CAST Die Castings

THE SUPERIOR DIE CASTING CO.
Detroit CLEVELAND Philadelphia

Do the Machines You Build Require
HOLLOW BORED FORGINGS and STEEL SHAFTS?
If so, it may pay you to submit your blue prints and let us quote on such items as Lathe Spindles, Piston Rods, Rams, Clutch Shafts, etc.
AMERICAN HOLLOW BORING CO., Erie, Pa.

DIE CASTINGS
Prompt delivery guaranteed. Send samples, blueprints or sketches for estimates.
MT. VERNON DIE CASTING CORPORATION
MOUNT VERNON, N. Y.

MOLTRUP
Finished Machine Keys

Know Them By Their Quality

Users of Moltrup Finished Machine Keys know them to be a superior product. They appreciate their accuracy and fine finish.

Moltrup Machine Keys are made from cold drawn steel specially prepared for the purpose. They are stocked in all sizes generally used, and can be shipped immediately. Quick deliveries on specials if you need them.

May we send you the latest Moltrup Catalog?

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AGENCIES New York Office, Woolworth Bldg. Central Steel and Wire Co., Chicago and Detroit. Union Iron & Steel Co., Cincinnati. H D Cushman Co., · Cleveland, Ohio. Milton Pray, Monadnock Bldg., San Francisco, Cal. Alaska Bldg., Seattle, Wash. John W. H. Evans & Co., London, England.

FERRO-URANIUM
FERRO-VANADIUM
of the Highest Quality

STANDARD ALLOYS COMPANY, Pittsburgh, Pennsylvania

*"Carefully Forged—
Correctly Heat-Treated"*

You can always say it of

Dyson Spindle Forgings

Made to match the quality of the finest machines. Try them.

JOSEPH DYSON & SONS
CLEVELAND OHIO, U. S. A.

How would you produce a part like this?

*Our
Experts Proved*

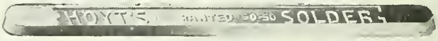
ACKLIN STAMPING
The Best and Cheapest Way

This electric fan base, Acklin Stamped and ready for finishing, is an excellent example of the satisfactory results obtained by our methods; the economy of the method can only be realized by comparison of costs.

Let our experts estimate on some part you are now machining—and then make your own comparisons.

The Acklin Stamping Company
1657 Dorr Street TOLEDO, OHIO

HOYT SOLDERS



Solder users everywhere recognize the high quality of HOYT Solders—the result of perfect mixing and refining of carefully selected metals by the most modern methods. No better solder than HOYT Warranted can be secured, while HOYT Strictly Solder proves more than satisfactory to those wanting a medium grade product.

If your regular jobber cannot supply you, write us for the name of one who will.

HOYT METAL CO. **63 Boatmen's Bank Bldg.
St. Louis, U. S. A.**

ESF

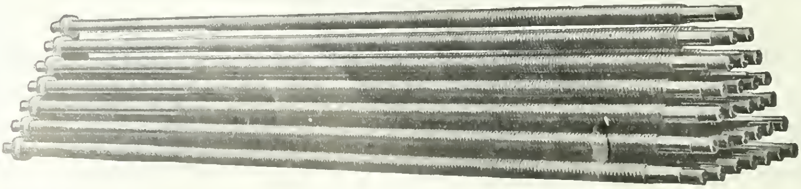
High Speed Carbon and Alloy Tool Steels, Special Alloy and Carbon Steels, Bars, Billets, Shapes.

An investigation of the adaptability of "ESF" steels for your rigid requirements will help you (as it has others) to solve your steel problem and to obtain a greater quantity of finished products at a lower cost. Write us about Special Alloy Steels, Constructional Steels, Tool Steels, High Speed Steel, etc.

ELECTRIC STEEL & FORGE CO.
CLEVELAND, OHIO

Remember Hindley When You Need Screws

They're cut with scientific accuracy on special machines; are guaranteed correct. They're strong, well finished, long-lived and economical to use. Any pitch—thread—quantity. Write for quote.



HINDLEY
GEAR
COMPANY

1105 Frankford Ave.
PHILADELPHIA, PA.

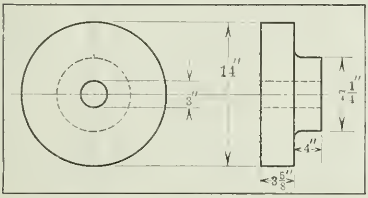
Typical J & J Better Forgings

Before they tried J & J Better Forgings, the people for whom we make these steel hubbed gear blanks used steel castings, 10 to 20 per cent of which had to be rejected after machining because of blow-holes.

The saving effected by the change is threefold—first, the elimination of rejections; second, the greater strength and durability of forged steel; third, the reduction of machining time because of the uniform closeness to finish dimensions—a characteristic of all J & J forgings.

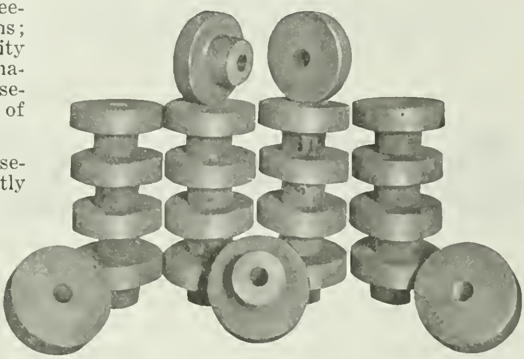
These blanks average 183 lbs. and one selected at random tipped the scale at exactly 182.

Let us estimate on your requirements.

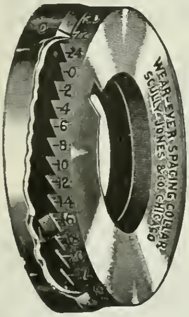


Uniform Size—
Minimum
Machining

BETTER FORGINGS



The Johnston & Jennings Co.
Incorporated 1894
Addison Road and Lake Shore R. R. Tracks
Cleveland Ohio, U. S. A.



Save Their Cost in a Single Using

Wear-Ever Adjustable Spacing Collars

Accurately adjustable in 12 steps of .002" each, rigid as a solid collar when set—a cheap and easy way to speed milling cutter set-up.

TRY ONE

SCULLY-JONES & CO.
647 Railway Exchange Bldg.
CHICAGO ILL., U. S. A.

EXPANDED METAL SAFETY GUARD CO.
14th St. and Vernon Ave. Long Island City, N. Y.

The highest type of engineering and construction service in the design, manufacture and installation of

MACHINE GUARDS

FLEXMET

Flexible Metal Hose and Accessories

For Any Purpose Whatsoever. *Pressures up to 10,000 lbs. Sizes up to 72" Inside Diameter. Complete with Any Kind of Fittings.*
BREEZE METAL HOSE & MFG. CO., Inc. 1904
256 South Street, Newark, N. J.

Bingham Stampings

Designing the correct dies is more than half the battle in the economical production of intricate stampings. Even in the simplest it is an important factor. We have made die designing a specialty: that's the secret of the success of Bingham Stampings. Send samples or prints for quote.

The Bingham Stamping & Tool Co.
1435-7 Dorr Street TOLEDO, OHIO

DOEHLER
DIE-CASTING CO.

WORLD'S LARGEST PRODUCERS
OF
DIE-CASTINGS
TIN,-LEAD,-ZINC,-ALUMINUM-ALLOYS, DO-DI BRASS.

EASTERN PLANT
BROOKLYN N.Y.
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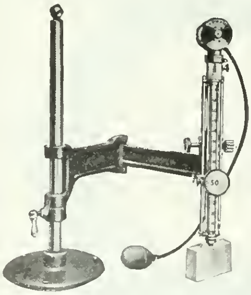
CENTRAL PLANT
TOLEDO O.
SMEAD & PROSPECT AVES.

WESTERN PLANT
CHICAGO ILL.
COTTAGE GROVE AVE & 97TH ST.

THE SCLEROSCOPE



Used All Over the World

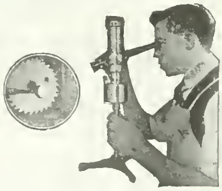
Metal workers everywhere depend on this simple, foolproof device for determining the hardness of metal; governments have adopted it as the international standard. It can be used to advantage on large work or small and requires no skill to operate.

Insures the Quality of Metal Parts

Ask us about the Shore Method of Selective Carbonizing and Hardening

The Pyroscope

The Pyrometer tells you the heat inside the furnace, but the Pyroscope shows you the temperature of the work itself. Durably constructed and easy to use. Let us tell you about it.



The Shore Instrument & Mfg. Co.
Van Wyck Ave. and Carll St. Jamaica, N.Y.

FOREIGN AGENTS: Agent for Great Britain and Colonies, Coats Machine Tool Co., Ltd., 14 Palmer St., Westminster, London, S. W.; Glasgow, Newcastle-on-Tyne. Yamatake & Co., Tokyo, Japan. Aux Forges de Vulcain, Paris, France. R. S. Stokvis & Zonen, Ltd., Belgium and Holland.

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THE ABBOTT BALL CO.
ELMWOOD HARTFORD, CONN.

Take Us Up on This—

Send us a piece of scrap H. S. Steel; we'll "EL-WELD" it free of cost to a tool steel shank, and you'll have a cutting tool for nothing. A piece ½" x 1" to ¾" x 1½" will do. This will show you how our electric welding process will save you money.

THE ELECTRIC WELDING CO., 2114-16 Superior Viaduct
CLEVELAND, OHIO

WOLFRAM
TRADE HIGH SPEED STEEL MARK

VULCAN CRUCIBLE STEEL CO., Aliquippa, Pa.

GOODELL-PRATT
1500 GOOD TOOLS

Instruments of Precision

for particular workmen

You have to buy precision tools largely on faith. The reputation of the maker is your best guarantee of accuracy.

The confidence and faith that toolmakers and machinists have in Goodell-Pratt Tools are never misplaced. Here are tools that are as good as money in the bank. They're made to give you long and faithful service.

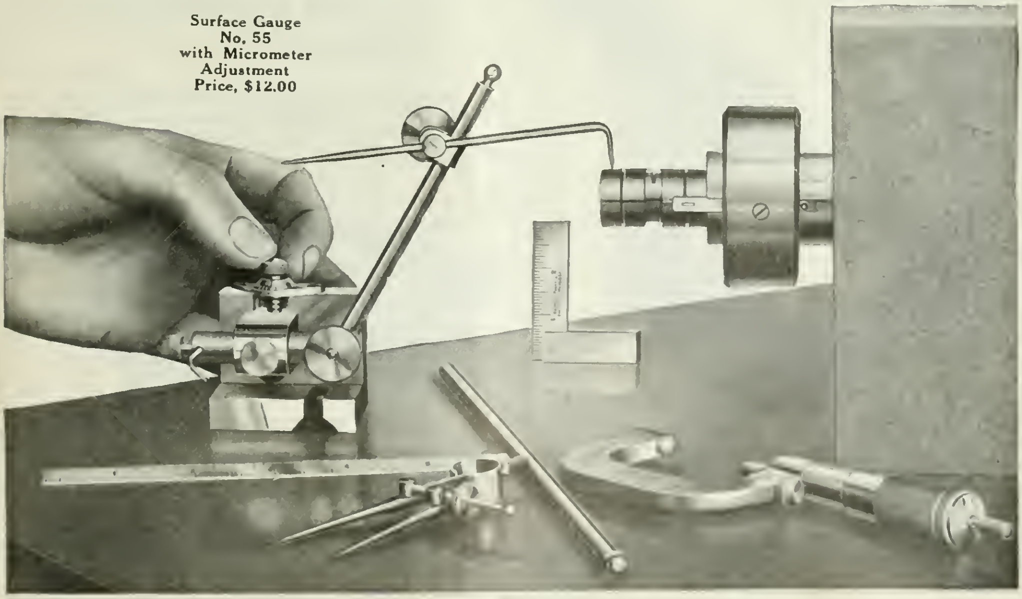
Micrometers, Calipers, Steel Rules and Surface Gauges in all the standard styles and sizes

As a test—before you buy another steel rule, measure it up with a micrometer.

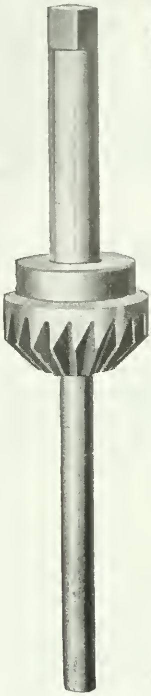
This simple, easy test is proof positive of the accuracy of all Goodell-Pratt Steel Rules. The more cranky you are about the tools you use, the better you'll like those made by Goodell-Pratt.

Your hardware dealer has Goodell-Pratt Tools or can get them for you. Talk to him. Ask him, or write us for a copy of our new machinist's tool catalog, "Tools for the Toolmaker," picturing and describing the very tools you have always wanted to own. It's free.

GOODELL-PRATT COMPANY
Toolsmiths
Greenfield, Mass., U. S. A.



Surface Gauge
No. 55
with Micrometer
Adjustment
Price, $12.00



Make Quick Work of Valve Grinding

A poppet valve in your gas engine can be quickly ground to accurate fit if the valve seat is first scraped clean of carbon and heat pits.

The Sioux Valve-Seat Reamer

Slips easily down into the valve-seat, and with just a few turns cuts a smooth, clean face on the seat. Then little work remains in grinding the valve to its seat.

Sioux Tools For Valve-Repairing

—are just the right tools for emergency valve-jobs. They are accurate to the last degree, built to last, and any shop-hand can use them. Sioux tools will save many costly tie-ups in the factory.

Your Jobber Sells Them.

Albertson & Co., Sioux City, Iowa

A Micrometer with a Lock Nut

SLOCOMB

"The Longest Lived Micrometer that can be Bought"

In shops handling comparatively small lots of precision parts, the cost of snap gages is disproportionately high. For this class of inspection the uses of micrometers with lock nuts is recommended. A micrometer with a one-inch range can be used to handle the work of about 4000 snap gages, and is also instantly available for measuring when desired.

To provide this form of service, we now equip the Slocomb Micrometer with a simple, positive lock nut *when specified;* its unusually long tool steel screw with long bearing on the nut and the solid tool steel anvil provide the durability necessary to withstand this exacting form of service.

Catalog 16 describes the line

SLOCOMB MICROMETERS ARE USED ALL OVER THE WORLD

Reg. U. S. Pat. Office

J. T. SLOCOMB COMPANY, Providence, R.I.

CHICAGO REPRESENTATIVE: R. R. Street & Co., 26 North Clinton St. PACIFIC COAST REPRESENTATIVES: The Charles A. Dowd Sales Co., 320 Market Street, San Francisco, Calif. FOREIGN AGENTS: England: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, and Glasgow. Japan: Alfred Herbert, Ltd., Yokohama. Italy: Charles Civita, Milan. Australia: Edwin Wood, Pty., Ltd., Melbourne and Sydney.

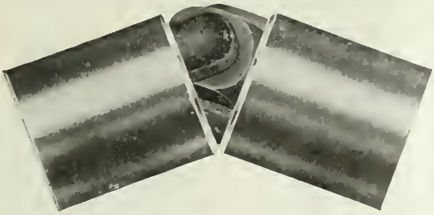
G & P Universal Joints

For "Safety First" in Delicate Mechanisms

It is interesting to note that many designers of delicate mechanisms are making use of Gray & Prior Universal Joints for places where even a slight deflection would be fatal to the efficient operation of the machine. They counteract play, reduce vibration, and insure a smooth, uniform connection.

The wearing surfaces of G. & P. Universal Joints are scientifically case hardened, making them extremely long lived. They have no sharp corners, no screws or small parts to renew, and no corners to collect dirt.

Stock sizes range from ⅞″ to 2⅞″ for shafting up to 1¾″ in diameter. They will meet most needs; but where necessary "specials" can be quickly produced. Write for details.



Manufactured by

GRAY & PRIOR MACHINE CO.

38 Suffield Street Hartford, Conn.

Introduce Colton-Detroit High Speed Drills to Your Plant

You'll be astonished at their efficiency. They wear well and cut quickly; wide grooves prevent clogging.

Colton-Detroit High Speed Drills are made from tough, highly refined steel.

They're forged and finished by a special process; have lots of backbone. They'll stand high speeds and heavy feeds for long periods.

Compare the running time between Colton-Detroit Drills with that of the drill you are now using. Prove their worth to your own satisfaction.

Our catalog will give you an idea of what to expect from us. You are in no way obligated by asking for it.

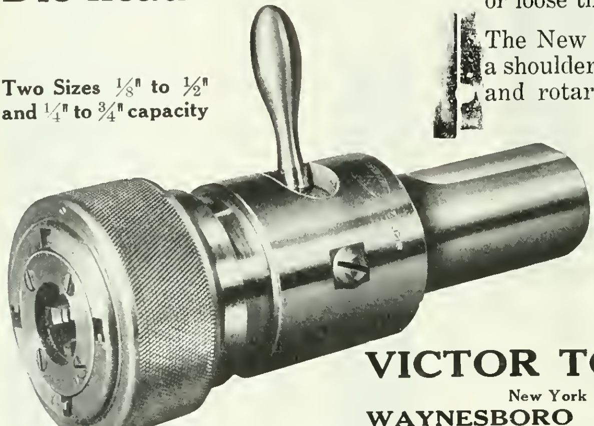
ARTHUR COLTON CO.

2618 Jefferson Avenue, East, Detroit, Mich.

REPRESENTATIVES **Buffalo:** P. F. Fosnight, Ellicott Square Bldg. **Chicago:** Illinois Metal & Tool Co., 9 South Clinton St. **Milwaukee:** General Sales Agency, 3205 Vine Street. **New York City:** F. A. Brady, Inc., 30 Church Street. **Pittsburgh:** W. E. Nagle & Son, Jenkins Arcade Bldg. **Philadelphia:** Wenson Tool Co., 824 Bulletin Bldg. **San Francisco:** L. G. Henes, 75 Fremont St. **Syracuse:** Barnes & Irving, Inc.

Try the New VICTOR Self-opening Die-head

Two Sizes $\frac{1}{8}$" to $\frac{1}{2}$" and $\frac{1}{4}$" to $\frac{3}{4}$" capacity



The most important improvement in our Victor Style "E" is use of a ring instead of separate plungers for holding and actuating the chasers. These are of the time-tried Victor style, with tapered edges, are fully supported for their entire length when in cutting position, and are adjustable 1/16" either way for cutting tight or loose threads.

The New Victor will cut threads close to a shoulder. It is made in both stationary and rotary types—the latter being supplied with taper or special shank, according to the type of machine in which it is to be used.

Try the New Victor on a troublesome thread. It will save you money.

VICTOR TOOL COMPANY

New York Office, 131 W. 39th Street.

WAYNESBORO PA., U. S. A.

REPRESENTATIVES: New England, O. H. Lorange, Boston Michigan, Firmhill Machine Supply Co., Detroit. Illinois and Wisconsin, Eugene Goller & Co., Chicago. Indiana, Thomson Tool and Supply Co., Indianapolis. Philadelphia, Swind Machinery Co. Cincinnati, Gang Machinery Company.

Try a Murchey at Our Expense

MURCHEY
COLLAPSING TAPS

None More Economical
None More Efficient

We welcome you to try a Murchey Tap in your shop on your work at our expense. The Murchey ensures accurate threads, greater production and real satisfaction.

In the picture a Murchey Tap is cutting a thread $1\frac{1}{4}$" long in a 5" drain tee—time, 45 seconds. You can use the Murchey to equal advantage in your plant. In fact, we know if you'll try it, you'll standardize it. Write us.

Murchey Machine & Tool Company

34 Porter St., Detroit, Michigan

CLEVELAND OFFICE
1625 Williamson Bldg.

NEW YORK OFFICE
99 Warren St.

Pittsburgh Representatives: Laughlin & Barney, 819 Wabash Bldg.; Chicago Representatives: R. E. Ellis Engineering Co., 621 Washington Blvd.; Los Angeles, Representatives: Harron, Rickard & McCone, 225 South San Pedro Street; Coats Machine Tool Company, 14 Palmer St., Westminster, London S. W., England; Fenwick Freres & Company, 8 Rue de Rocroy, Paris.

CARPENTER

THREAD CUTTING TOOLS

Standard in Some Shops for 51 Years

Uniformly high quality insures long service, permanent satisfaction — permanent customers.

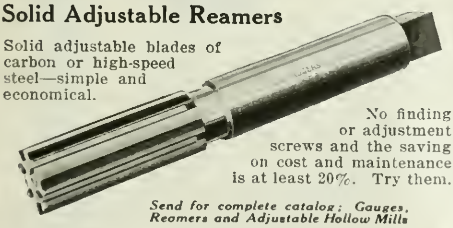
Try Carpenter Tools on your thread cutting work and watch the result.

The J. M. Carpenter Tap & Die Co.
PAWTUCKET RHODE ISLAND

ROGERS TOOLS

Solid Adjustable Reamers

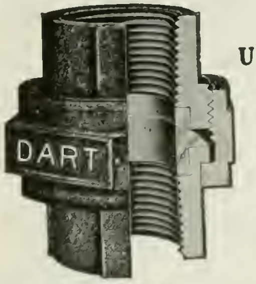
Solid adjustable blades of carbon or high-speed steel—simple and economical.



No finding or adjustment screws and the saving on cost and maintenance is at least 20%. Try them.

Send for complete catalog; Gauges, Reamers and Adjustable Hollow Mills

The John M. Rogers Works, Inc.
Gloucester City, N. J., U. S. A. 1865-1921



DART

Unions, Ells, Tees and Flanges

Made with bronze to bronze seats that cannot corrode, well cut threads that insure a good fit. Rust proof, non-leaking pipe joints that save trouble.

Send for a sample union and the price list.

E. M. DART MFG. CO., Providence, R. I.
The Fairbanks Co., Sales Agents.
Canadian Factory: Dart Union Co., Ltd., Toronto

CARD TAPS

Immediate Delivery from Stock on all regular catalog goods.

Orders for special taps and dies executed promptly.

Try this service—the high quality of all Card Products is already established.

Catalog 30 for details

The CARD Quality

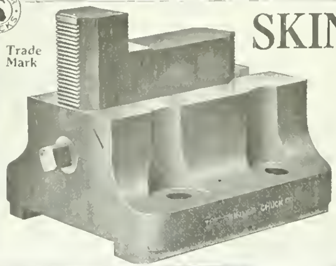
S. W. CARD MFG. CO.

Division of Union Twist Drill Co.

MANSFIELD MASS.
New York Office: 62 Reade Street

EUROPEAN AGENTS: Chas. Churchill & Co., London, Birmingham, Manchester, Glasgow and Newcastle-on-Tyne. Aux Forges de Vulcain, general offices and salesrooms, 3 Rue St., Denis, Paris; Important Branches and Salesrooms, Lyon Bordeaux, Lille. V. Lowener, Vesterbrogade, 9 B. Copenhagen, Denmark V. Lowener, Drottinggattan, 90, Stockholm, Sweden. V. Lowener's Maskinforretning, Sverre Mohn, Christiania, Norway R. S. Stokvis & Zonen, Ltd., Rotterdam. J Lambercier & Co, Geneva, Zurich. C Clvita, Milan, Italy. Hijo de Miguel Mateu, of Barcelona and Bilbao, Spain. Ateliers Demoor, Brussels, Belgium. A M. Papasideris & Co., Athens, Greece Andersen, Meyer & Co., Ltd, Shanghai, Changsha, Hankow, Harbin Hongkong, Kalgan, Pekin, Tientsin and Vladivostok Mestre & Blatge, Rio de Janeiro, Brazil, Buenos Aires, Argentine Republic.

Trade Mark



SKINNER BORING MILL JAWS

Note the powerful, compact construction of these sturdy jaws. For heavy duty work on boring mills and large lathes, these jaws, fitted to the parallel slots in the faceplate or table by means of the double rib, insure a most positive grip.

Furnished in iron or steel body single or double rib, as desired

THE SKINNER CHUCK COMPANY
NEW BRITAIN, CONN., U. S. A.
Established 1887

New York Office: 94 Reade Street
San Francisco Office. Rialto Building
Chicago Office. 552 W. Washington Blvd.
London Office: 139 Queen Victoria St., E.C. 4

ETTCO

A Hand-Operated, Self-Tightening Drill Chuck—as Safe as the Drill Press

Body, cap, screw, jaws and thrust bearing—the fine parts of this simple well-made chuck—are assembled without extra screws, nuts or other small parts to work loose or project. The "Ettco" is dust-proof, can't come apart and requires no key. All parts are of steel. The cone-shaped screw bears on its entire length and jaws cannot bind, turn or get out of true.

A trial will show its worth. Circular on request.

EASTERN TUBE & TOOL CO.
INCORPORATED
594 Johnson Ave., Brooklyn New York

"HUNTER" PNEUMATIC HAMMER RIVET SETS AND CHISEL BLANKS

Shanks faced to a slight radius insure piston contact in line with the axis of the set.

This is a particular advantage when the hammer cylinders are worn, increasing the effect of the piston stroke and making a marked reduction in shank breakage.

Standard Chisel blanks are made from ¾ x 9" or ⅞ x 8" Octagon steel. Standard sizes and types carried in stock.

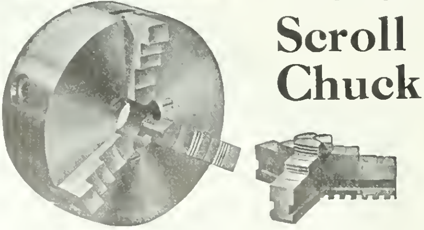
We also manufacture and carry in stock a full line of metal cutting circular saw blades

HUNTER SAW & MACHINE CO.
PITTSBURGH, PA.

Horton

Send for catalog of our complete line—Lathe and Drill Chucks, Face-Plate and Boring Mill Jaws.

Scroll Chucks



The E. Horton & Son Co., Windsor Locks Conn., U. S. A.

TAPS AND REAMERS

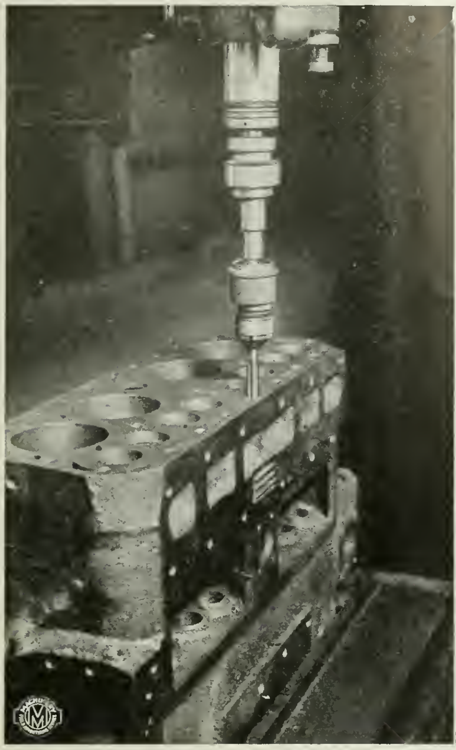
First-class Tools and Prompt Deliveries

REIFF & NESTOR CO., Lykens, Pa.

AMERICAN THREAD CUTTING TOOL MAKERS

Send us your tapping problems. Careful attention given to each tool insures long life and interchangeable product.

American Tap & Die Co., Greenfield, Mass.



PROCUNIER TAP CHUCKS

Motor Manufacturers Find them Valuable Aids to Production

This one of a busy trio of Procunier Tap Chucks in use at the Supreme Motors Co. (Warren, Ohio) when this photograph was taken, is shown tapping holes in cylinder heads for automobile motors. These holes, 3/4" deep and 7/16" in diameter are tapped at the rate of 24 every three minutes; a production record that is consistently maintained without tap breakage. Here, as in all cases where Procunier Tap Chucks are used, correct chucking gets production, saves taps and cuts production costs.

The circular shows other installations and gives details. Send for it.

WILLIAM L. PROCUNIER
18 South Clinton Street Chicago, Ill., U. S. A.

What Stops Men Swearing?

First of all, what makes them swear most of all? Bad tools? Abso-lutely! Handles coming off files, for instance. And when they swear they don't work, so it's up to you to lay in a stock of

Osgood File Handles

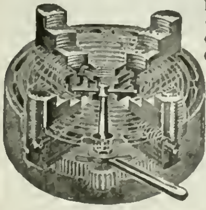
They're so strong that one will outlast 20 to 30 ordinary wooden handles. A thin steel tube forced into the handle prevents splitting, takes all the strain and holds the tool so it won't pull out.

Write direct or see your dealer.

J. L. OSGOOD TOOL CO.
43-45 Pearl St. Buffalo, N. Y.

If you want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting - off Chucks.



Spur Geared Scroll Combination Lathe Chuck

Strongest Grip, Greatest Capacity
Great Durability and Accuracy
WESTCOTT CHUCK CO.
ONEIDA, N. Y., U. S. A.
Ask for Catalogue

ALMOND

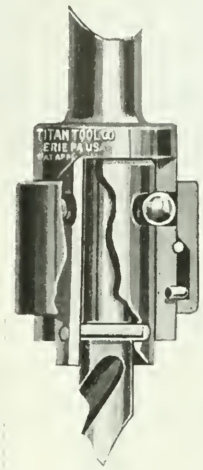
Teeth cut on nut giving *Direct Drive* and hardened steel Pinion Bushings which prevent wear are exclusively Almond features and insure long life.

Other ALMOND *Products*

Lathe Chucks, Right Angle Transmissions, Micrometer Calipers, Flexible Steel Tubing

T. R. ALMOND MFG. CO.
ASHBURNHAM MASSACHUSETTS

Titan Positive Drive Quick Change Drill Chucks



Compact design and the quick change feature make them especially valuable for multiple drilling work. The spring - actuated ring insures efficient operation in any position.

Tool changes are made without the use of a taper drift; a self-contained drift or key is carried in the top of the collet projecting beyond it when the tool is in place. A single blow drives it down and the tool out without danger to the tool or chuck.

Efficient chucks that give good service and wear well. Made for straight or taper shank tools. Get the circular.

TITAN TOOL CO., Erie, Pa.

New York, N. Y.: Grob Hardware Corp., 36 Murray St. Boston, Mass.: W. H. J. Fitzgerald & Co., 165 High St.. Philadelphia, Pa.: Normoyle & Lapp, 514 Liberty Bldg. Detroit, Mich.: National Sales Engineering Corp., Kresge Building. Chicago, Ill.: The J. L. Stone Co., 549 W. Washington Boulevard. Cincinnati, Ohio: C. M. Bigger & Co., 414 Elm St. Hamilton, Ontario: Price & Campbell, 212 Rosslyn Ave., South.

TRUMP DRILL CHUCK

For Drills ⅜-in. and under

Small, handy and inexpensive, Trump Drill Chucks are finely finished, accurately centered, extremely durable. They are made of hardened steel, have only three parts, and are self-contained. Three sizes: No. 1 takes drills up to ⅛″, No. 2 up to ¼″, and No. 3 up to ⅜″. Write for descriptive circular.

TRUMP BROS. MACHINE CO.
WILMINGTON, DEL., U. S. A.

Our Line is Collets

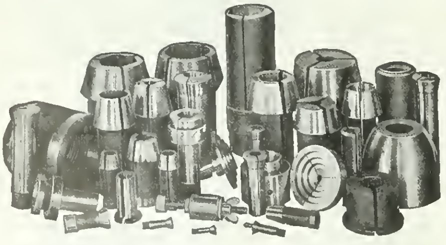
Styles and Sizes Unlimited

Collets for all standard hand and automatic screw machines for bench, tool-room and engine lathes; step collets, special collets, draw bars and adapters, we make them all and are regularly serving many first class shops.

Our collets satisfy. Our prices satisfy.

Do you know the "Inanout" Double Acting collet?

More details?



Morrison Machine Products, Inc.

"America's Collet Specialists"

Rochester New York

Lavoie Air Chucks

A New and Better Idea

Simple in construction; easy to operate.

Attached directly to main spindle, and is without gears of any kind.

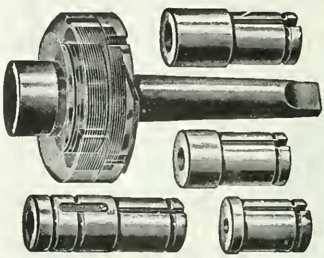
Chucks put on and removed in an instant.

Only a thin film of air is required to operate the single acting piston, and heaviest cuts can be taken with moderate air pressure.

Write for particulars.

The Frontier Chuck & Tool Co., Inc.
30 Letchworth Street Buffalo, New York

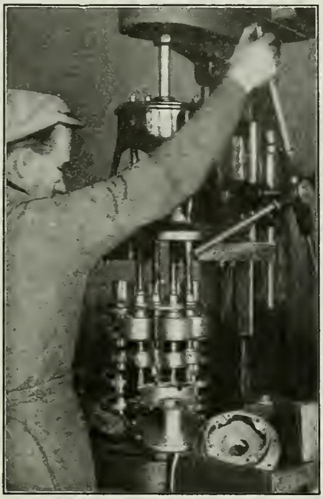
The Safety Drill and Tap Holder



is the only attachment for the purpose that gives universal satisfaction and is unequaled in efficiency, convenience, rapidity, accuracy and simplicity. Nothing to break or get out of order. Made in 4 sizes, covering from 0 to 2½ inches diameter.

The Beaman & Smith Co., PROVIDENCE Rhode Island

MULTIPLE TAPPERS



cut cost; exact duplication of work; 2560 3/8"-holes drilled and tapped in 8 hours.

40 malleable iron differential gear cases per hour.

Compact
Simple
Durable

Taps up to 5/8" with only 2 1/4" between centers—larger sizes proportionately compact.

Put in Errington Tappers and save expense. Send blue-prints and full particulars for outfit on trial to do your work.

ERRINGTON MECHANICAL LABORATORY

Broadway and John St., New York; Western Branch: Machinery Hall, 549 W. Washington Blvd., Chicago. New England Branch: 831 Old South Bldg., Boston, Mass. Catalog Francais: Edgar Bloxham, Paris, 12 Rue du Delta.

WEAR-EVER

The One Piece Tap Chuck that Fits All Spindles

A simple, low-priced chuck that gives an accurate, positive drive under all conditions. Made also for use on milling cutters and drills. Write for a circular.

SCULLY-JONES & COMPANY
647 Railway Exchange Building CHICAGO, ILLINOIS

The Chuck That Never Slips.

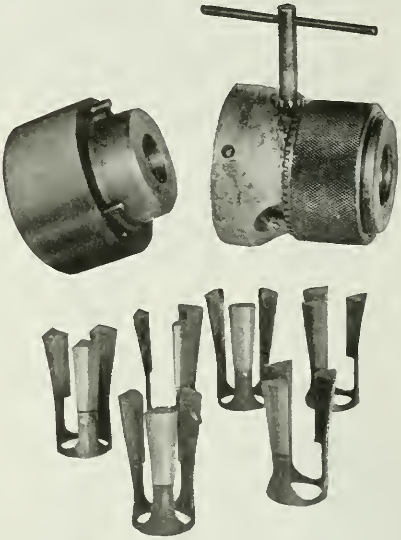
The More You Crowd It,

The Tighter It Grips.

NARRAGANSETT MACHINE CO.
PROVIDENCE, R. I., U. S. A.

THE NEY
"Positive Grip"
Collet Chuck

A Self-Contained Unit Adapted to An Unusually Wide Range of Work



Ney Chuck with Six Collets Complete

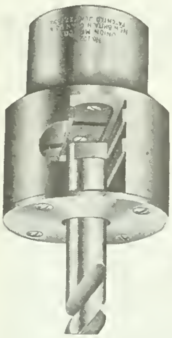
Sizes of Collets: $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$ *and 1 inch*

One Ney Chuck will often take the place of several others—it's only a question of using whichever one of the six collets will accommodate the work. It is tightened rapidly by means of a key and closes on the work with an unbreakable grip.

It is compact, rigid and powerful, with no projecting parts to injure the operator's hands, so that it is possible to bring the tool close to chuck without danger from revolving parts.

Write for interesting folder showing Ney Chuck in action.

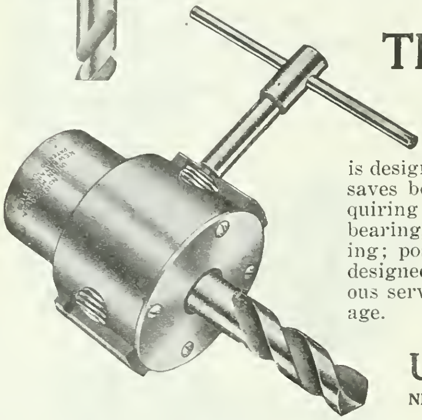
The J. M. Ney Co.
Hartford, Connecticut
U. S. A.



Union Drill Chucks

Yes, Mr. Manufacturer, even such comparatively insignificant things as drill chucks can make a difference in the quantity and cost of output.

The Union Drill Chuck, shown at the left, is a positive, rapid, accurate producer—a friction chuck equipped with a patent transverse slot to permit the use of drills with tenons. The advantages are well worth investigating.



The New Britain Drill Chuck

is designed for drills up to 1″ diameter and saves both time and trouble on work requiring frequent tool changes. It is ball bearing, hand operated and self-tightening; positive, but will not lock; a chuck designed to stand up under hard, continuous service and to keep down drill breakage.

Details of full line in catolog.

UNION MANUFACTURING CO.
NEW BRITAIN CONN., U. S. A.
New York Office: 26 Cortlandt Street
Makers of a Complete Line of Chucks

Tapping Set Screw Holes in Double Grooved Motor Pulleys with a

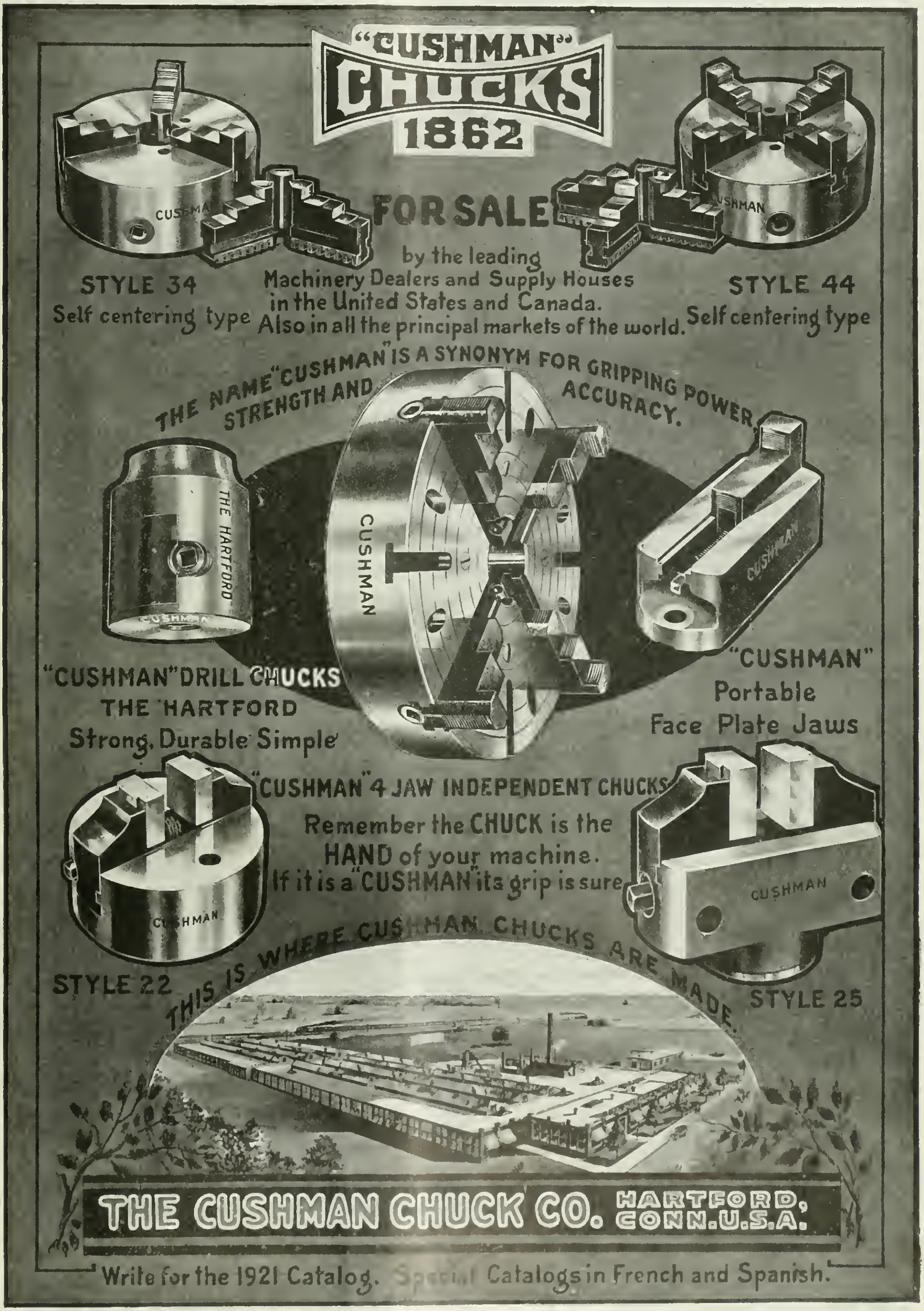
WOODSTOCK

SAFETY TAPPING CHUCK

Not a particularly exacting job this, except for the fact that the material is cold rolled steel—the pulleys being designed for use in electric motors. The holes tapped are ¼″ diameter, 5/16″ long, 20 threads per inch. A type C Woodstock Tapping Chuck is used, equipped with the No. 1 Reversing Attachment which automatically reverses the direction of the tap by raising the spindle of the drill press.

Try a Woodstock Safety Tapping Chuck for 30 days at our expense. Put it on your most expensive tapping job and watch the costs dwindle. Catalog tells all about it.

Peter Bros. Mfg. Co.
135 Railroad Avenue
ALGONQUIN ILL., U. S. A.



"CUSHMAN" CHUCKS 1862

FOR SALE by the leading Machinery Dealers and Supply Houses in the United States and Canada. Also in all the principal markets of the world.

STYLE 34
Self centering type

STYLE 44
Self centering type

THE NAME "CUSHMAN" IS A SYNONYM FOR GRIPPING POWER, STRENGTH AND ACCURACY.

"CUSHMAN" DRILL CHUCKS
THE HARTFORD
Strong, Durable Simple

"CUSHMAN"
Portable
Face Plate Jaws

"CUSHMAN" 4 JAW INDEPENDENT CHUCKS

Remember the CHUCK is the HAND of your machine. If it is a "CUSHMAN" its grip is sure.

STYLE 22

STYLE 25

THIS IS WHERE CUSHMAN CHUCKS ARE MADE.

THE CUSHMAN CHUCK CO. HARTFORD, CONN. U.S.A.

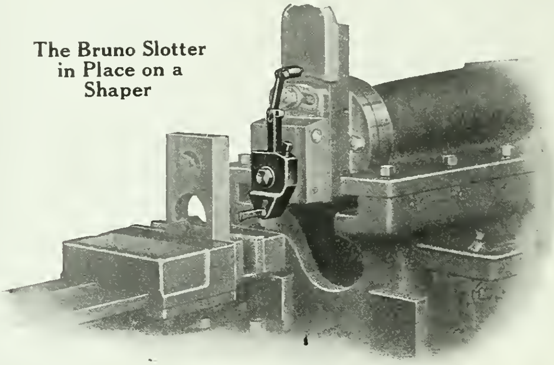
Write for the 1921 Catalog. Special Catalogs in French and Spanish.

FIVE MINUTES' USE

is enough to demonstrate that it's going to be well worth your while to adopt the Bruno Slotting Attachment as a permanent accessory for every shaper in your plant. We want you, however, to try it out in every possible way, and we're going to let you keep it ten days without charge or obligation.

The Bruno Slotter sells for $35.00, and it gives each shaper you attach it to the efficiency of a $1000.00 slotter. May we have your address?

The Bruno Slotter in Place on a Shaper



You have your choice of three sizes:
No. 0 takes ⅜" to ½" Round Shank,
No. 1 takes ½" to ⅝" Round Shank,
No. 2 takes ⅝" to ¾" Round Shank.
Each size is furnished with two cutting tools ready for use. State size when ordering.

H. A. Moore Co.
DEPT. M
Rochester N. Y., U. S. A.

They GLOBE Tumble Castings

For Gabriel Snubbers to get the Finish Wanted

If you're interested we'll be glad to tell you more about them.

Five GLOBE Tumbling Barrels in continuous operation tumbling five kinds of castings; two extra barrels in reserve for special work; a thoroughly satisfactory installation in a thoroughly modern plant.

The Gabriel Manufacturing Company, Cleveland, Ohio, finds this the most efficient and economical way to clean and polish small parts. The work is tumbled wet and the average charge is 60 to 70 pounds, the average run, 50 minutes per load.

The machines are simple and never out of order; easily operated, they do not require skilled labor to get the best results.

THE GLOBE MACHINE & STAMPING CO.
1250 West 76th Street CLEVELAND, OHIO

Also Manufacturers of Sheet Metal Stampings, Dies and Tools

FOREIGN REPRESENTATIVES: J. Horstmann, 81-83 Rue Saint Maur, Paris, France; 46 Rue Juliette-Recamier, Lyons, France.

SECOND HAND MACHINE TOOLS

BORING MACHINES

4" bar, Detrick & Harvey, floor type.
No. 2 Beaman & Smith, floor type 4" spindle, motor drive.
2½" bar, Bement Niles horizontal.
No. 1—3" Lucas horizontal.
34" Colburn vertical turret head.
38" Niles vertical, 2 heads.
60" Rogers & Hemphill, vert. 2 heads.
No. 1 Rockford horizontal.

DRILLS

No. 2—2 spindle Avey sensitive BB.
3 spindle Henry & Wright sens. BB.
No. 43—3 spindle Taylor & Fenn sens.
20" Style M Baker Bros., heavy duty.
20" Prentice Bros. sliding head, BG.
23" Rockford, slid. hd., tapping att.
24" Pratt & Whitney stat. head, BG and power feed.
28" Sibley sliding head, BG and power feed.
42' Cinn. Bick. sliding head, BG, PF, cone drive, tapping att.
No. 310 Baker Bros. heavy duty.
D2 Colburn heavy duty.
4½' Dreses plain radial, tapping attachment.
6 sp. Hendey, power feed to each spindle.
No. 30—12 spindle Bausch multiple.
No. 12—8 spindle Natco multiple, ¾" sp.
No. 22—16 spindle Natco multiple, 1" sp.

GRINDERS

3" x 18" Norton plain cylindrical.
5" x 18" Ott plain cylindrical.
6" x 32" Norton plain cylindrical.
10" x 48" B. & S. plain cylindrical.
10" x 30" Landis plain cylindrical.
12" x 36" Modern plain cylindrical.
No. 18—12" x 120" Landis plain.
14" x 40" Queen City, plain.
18" x 96" Norton plain, self-contained motor drive.
No. 3—12" x 40" Modern universal.
No. 1 Diamond autom. surface.
10" Garrigus rotary surface.
No. 1 Cinn. cutter and tool.
No. 1 Norton univ. cutter and tool.
No. 2 Norton univ. cutter and tool.
No. 11 Rivett oscillating.
B. & S. oscillating ball race.
No. 5 Rivett hand feed oscillating.
No. 6A Bryant internal.
No. 34 Van Norman internal, water aft.
No. 6 Rivett internal.
20" Besly disc, geared lever tables.

LATHES

No. 5 Rivett bench, slide rest.
14" x 6' Prentice Bros. CR, PCF.
14 x 6 Reed, CR, PCF.
16 x 6 Porter, CR, PCF.
16 x 8 Flather, QC, CR, PCF.
18 x 8 Prentice Bros. geared head chuck.
22 x 8 Schumacher-Boye, CR, PCF.
22-24 x 8 Lodge & Shipley selective head, manufacturing.
32" x 14' Hamilton, CR, PCF.
26" x 12' Putnam, CR, heavy duty.
38" x 20' New Haven, CR. PCF.
56" x 24' Wood & Light. CR, PCF.
3½" x 60" Fitchburg Lo-Swing.

MILLERS

No. 14 Garvin plain.
No. 2 Cincinnati plain, all feeds.
No. 2A Kempsmith plain, BG.
No. 3 Cincinnati plain, cone drive.
No. 4 Cincinnati plain, all feeds.
No. 1½ LeBlond univ., motor drive.
No. 2 Brown & Sharpe univ.
No. 3 Cincinnati high power vertical.
No. 4 Cincinnati high power vertical.
No. 4B Becker vertical cone drive.
No. 5 Hendey Lincoln type.
No. 12 B. & S. mfg.
Rivett bench, hand.
36" x 10' Newton side slab, motor drive.

TURRET MACHINES

16" x 5' American Fox, solid spindle.
16" Acme univ., friction BG.
24" Steinle heavy duty, geared head.
20 x 10 Fay & Scott univ. turret lathe.
24 x 10 Lodge & Davis turret.
24" Gisholt turret, 6" hollow spin.
2 x 24 J & L flat turret bar equipment.
3 x 36 J & L chuck or bar equipment.
¾" Bardons & Oliver turret, motor.
No. 1—7/16" capacity P & W, wire feed.
No. 2½ Garvin screw mach. air chuck.
No. 3 Windsor wire feed screw machine.

MISCELLANEOUS

Broaching Machine, No. 4. J. N. Lapointe
Centering Machine, 3", 2 spin., P. & W.
Compressor, 8 x 8 Clayton single air.
Gear Cutter, 34" x 10" B. & S. spur.
Keyseater, No. 2 Mitts & Merrill.
Motor, 2 HP., 115 V. D.C.—2 to 1 variable speed.
Motor, 3 H.P., 1200 R.P.M., 220 V., 60 Cy., 2 Ph.
Dynamometer, Sprague, 250 V., D.C., 775-1800 R.P.M.
Motor, 7½ H.P., 220 V., 60 Cy., 2 Ph., 1720 R.P.M.
Motor, 5 H.P., 110 V., D.C., 1300 R.P.M.
Planer, 24 x 24 x 6 Flather, 1 head.
Planer, 26 x 24 x 7 Gray, 1 head.
Planer, 30 x 30 x 8 Pond, 2 heads.
Planer, 36 x 30 x 14 Cincinnati, 3 heads.
Planer, 36 x 36 x 8 Pond, 2 heads.
Planer, 36 x 36 x 12 Cincinnati, heavy pattern, 4 heads, slightly used.
Planer, 36 x 36 x 12 Pond, 2 heads.
Planer, 48 x 48 x 15 Sellers, 3 heads.
Planer, 60 x 60 x 30 Bement, 3 heads.
Planer, 60 x 48 x 14 Gleason, 2 heads.
Press, No. 19 Bliss plain inclinable.
Press, No. 72 Ferracute, straight sided.
Press, No. 103 Ferracute, double action.
Profiler, No. 13, P. & W., 1 spindle.
Saw, 18" Newton circular.
Shaper, 14" P. & W. crank.
Shaper, 14" Springfield crank.
Shaper, 15" Potter & Johnston universal.
Shaper, 15" Hendey friction.
Shaper, 24" Hendey friction.
Surfacer, 26" x 3" Crescent wood.
Tapper, 6 spindle Acme ½" semi-autom. nut.
Welder, No. 6A National, Butt.

HENRY PRENTISS & COMPANY

Incorporated

New York, N. Y. **Warehouse, Jersey City**
BOSTON BUFFALO HARTFORD SYRACUSE ROCHESTER

Priced to Sell Under Present Conditions
Over 400 Machines in Stock at Our Warehouse

BORING MILLS

100" Betts, 3 heads, like new.
76" Betts, heavy, modern.
60" Niles-Bement-Pond, heavy, Single pulley drive.
60" Bickford standard, 2 heads low price.
36" Bullard, vertical turret.
3-24" Bullard, vertical turret.
3½" Horiz. Universal, belt driven.
4" Espen-Lucas Horiz. floor type.
3" Betts, horiz. knee type.

DRILLS

8' Niles Plain Radial.
6' Bausch Plain Radial, like new.
6' Bickford semi-univ. Radial.
5' Niles-Bement-Pond, motor driven.
4' Gang, gear-box drive.
2—28" Aurora Upright S.H. B.G. NEW.
6 Spindle Baush 1" capacity.
3 and 4 spindle Barnes 20" gang.
2 Spindle Foote-Burt heavy rail type.
6 spindle Rockford—automatic feed.
4 and 6 spindle Allen—sensitive.

LATHES

60" x 20' Fifield D.C. motor drive.
52" x 22' New Haven triple geared pulley drive.
60" x 17' New Haven Pulley.
36" x 14' Putnam triple geared.
36" x 12' Pond triple geared.
30" x 12' Johnson.
28" x 18' Johnson.
20" x 8' and 10' Americans.
20" x 8' Lodge & Shipleys.
14" x 6' Mulliner Tool-room.
14" x 6' Monarch.
12" x 5' P. & W.
10" x 4' Seneca Falls.

MILLING MACHINES

8 No. 5C Becker Verticals, new, price right.
No. 3 LeBlond, plain, high duty.
No. 5 Becker-Brainard Plain.
No. 2 Kempsmith Universal.
50" x 8' Ingersoll Slab.
No. 25 Becker Plain.
No. 2 Hendey Norton Plain.
No. 1½ Hendey Norton Universal.
No. 2 Van Norman Duplex.
31" x 5' Newton Vertical Slab.

PLANERS

84" x 84" x 13' Sellers, 3 heads, belt driven.
48" x 48" x 14' Powell, 4 heads, reversible motor drive, complete with electrical equipment.
48" x 48" x 16' Bement-Miles, 4 heads, belt driven.
42" x 42" x 12' Pond Machine Tool Co., 2 heads, belt driven.
36" x 36" x 12' Niles-Bement-Pond, 3 heads.
30" x 30" x 10' Flather, 2 heads, belt driven.
30" x 30" x 6' Gray, 3 heads, parallel drive.

PRESSES

No. 55 Adriance S. A.
No. 512 Bliss triple action.
No. 1 Farrel straight side 8" stroke.
D.D. 4 Ferracute D.A. roll feed.

SHAPERS

2—16" Newark box table and vise.
4—15" Hendey, box table and vise.
4—15" Smith & Mills, box table and vise.
3—48" Morton, extra heavy draw cut.
18" Fitchburg traveling head.

MISCELLANEOUS

10' Bement Boiler Plate Rolls.
18" Betts heavy type Slotter.
12" New Haven Slotter.
Sellers Heavy Punch 2" capacity.
No. 12 Buffalo Slitting Shear (new).
Newbold Rotary Shear ¾ capacity.
10" Newton Slotter (NEW).

GRAVES MACHINERY EXCHANGE

482 HUDSON TERMINAL NEW YORK CITY, N. Y.

Warehouse and Machine Shop, Johnson Ave. and Monitor St., Jersey City, N. J.

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Whatever You Want

So long as it's a

MACHINE TOOL

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HILL, CLARKE & CO., Inc.
The Machinery Merchants
156 Oliver Street Boston 9, Mass.

USED MACHINERY

FOR SALE BY

Vonnegut Machinery Company

INDIANAPOLIS, IND.

- 1—No. 55 Toledo Punch Press.
- 2—No. 74 Toledo Punch Presses.
- 1—12 x 42 Landis Grinder.
- 1—24" x 10' American Lathe.
- 1—36" Hoeffer, back geared, power feed, drill press.
- 3—28" Superior, back geared, power feed, drill presses.
- 1—4 spindle Moline Hole-Hog Drill Press, with 4 extra spindles.
- 2—4' Bickford Radial Drills.
- 1—Walker ring grinder, with magnetic chuck.

A FEW SELECT BARGAINS we are offering:

1—G. A. Gray 72 x 60 x 20' Planer, two heads on rail, two side heads, table widened to 62", equipped with G.E. 25 H.P. motor, variable speed, wall mounted reversing planer equipment, latest design, in excellent condition, having had practically no use.

1—36" x 22' Lodge & Shipley Engine Lathe, with geared head, quick change gear, compound rest, steady rest and standard equipment, excellent condition.

1 16 x 7 "Chard" Quick Change Engine Lathe, 3 step cone, double back gears, compound rest.

1—16 x 7 "Chard" Manufacturing Lathe, semi-quick change, 3 step cone, plain rest, pan bed.

1—Bridgeford 36" x 24' Bed Extra Heavy Geared Head Quick Change Engine Lathe, with compound rest, taper attachment, 14" steady rest, motor driven, including 25 H.P. "Westinghouse" variable speed motor, 220 volt D.C. reversing controller, apron control, automatic lead screw support, nearly new, machine in excellent condition.

1—Fosdick No. 2 Horizontal Boring, Milling and Drilling Machine, with special bar travel of 60", single pulley gear box drive, including two tables 42 x 22 x 15" high and a lot of special equipment, consisting of boring bars, angle plates and V-blocks, facing head, etc.

1—(Slightly used) 40" King Vertical Boring Mill, cone driven, 3 jaw universal chuck in table, right-hand turret head and left-hand swivel head, carrying four way tool block.

These machines are priced right. Write us for price and arrange for inspection

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WE WANT TO BUY FOR CASH

2000 Late Model Machines in good condition.

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1—60" x 60" x 20' Woodward & Powell, 4 heads, 35 H.P. motor rev.
1—48" Newton Rotary Planer, with 84" travel.
1—48" x 48" x 20' Ridgeway high duty four heads.
1—48" x 48" x 28' Cincinnati two heads. (NEW).
1—42" x 42" x 12' Openside Simmons Planer, two heads. (NEW).
1—36" x 36" x 20' Woodward & Powell. four heads.
1—30" x 30" x 18' Cincinnati, two heads.
1—24" x 24" x 8' Cincinnati, one head on rail.

BORING MILLS

1—10' Betts Vertical Mill, 15 H.P. Var. speed motor.
1—12' Bement Extra Heavy Boring-Turning Mill, two swivel heads.
1—34" Bertram Vertical Turret Head Boring Mill.
1—No. 31 Lucas Precision Horizontal Mill.
1—36" Bullard New Era Type Vertical Cutting Luc. system.
1—24" Bullard New Era Type Turret Lathe.

LATHES

4—60" x 29'—56' Niles-Bement-Pond Motor Drive. (NEW).
8—48" x 29'—56' Niles-Bement-Pond Motor Drive. (NEW).
1—42" x 20' Niles-Bement-Pond Heavy Duty Triple Geared.
6—36" x 34' Bridgeford Geared Head, QCG. (NEW).
1—36" x 18' Putnam Heavy Duty Triple Geared Lathe.
1—36" x 14' Putnam All Geared Head Lathe.
4—30" x 12' High Duty American Geared Head with motor.
8—27" x 24' LeBlond Heavy Duty, DBG, QCG (NEW).
8—27" x 18' LeBlond Heavy Duty, QCG, with motor.
1—24" x 18' LeBlond Heavy Duty Engine Lathe.
7—24" x 10' American High Duty Geared Head.
1—42" x 18' Bement Heavy Duty Lathe.
1—18" x 12' Prentice Engine Lathe.
2—No. 326 Toledo Spinning Lathes.

MILLERS

4—No. 2 Cincinnati Geared Head High Power Universal.
1—No. 3 Cincinnati High Power Plain.
8—No. 3-S Cincinnati Geared Head Universal.
5—No. 3 Cincinnati Heavy Duty Geared Head Vertical.
1—No. 4 Cincinnati High Duty Vertical.
1—Pratt & Whitney Heavy Duty Slab Miller.
1—Type B- Gooley & Edlund High Duty "Briggs" Miller.

RADIALS

4—20" Stationary Head Drills.
3—No. 310 Baker Heavy Duty Drills, 2½" cap in steel.
1—4' Bement-Miles Plain Radial.
1—4' Hammond High Speed Radial.
1—4' Dreses Plain, with tapping attachment.
1—5' Niles-Bement-Pond Semi-Universal.
1—5' Fosdick Full Universal Radial.
2—6' Reed-Prentice Radials, one with tapping attachment.
1—6' Pond Plain Radial.

MISCELLANEOUS

1—New 10-ton 48' span Niles Crane, 230 volt D.C. equipment.
2—New 5-ton Milwaukee Cranes, 38' span D.C. motor equipment.
1—Double End Punching and Shearing Machine, N-B-Pond 1½" cap.
1—14" x 96" Norton Plain Grinder. (NEW).
8—32" Cincinnati High Duty Shapers. (NEW).
2—No. 97 Bliss Straight Side Double Crank Geared Presses.
6—No. 20 Bliss Power Presses, complete.
1—No. 141 Bliss Press complete.

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Subject to Prior Sale

1—36″ Heavy T.B.G. Lathe with 26′ Bed.
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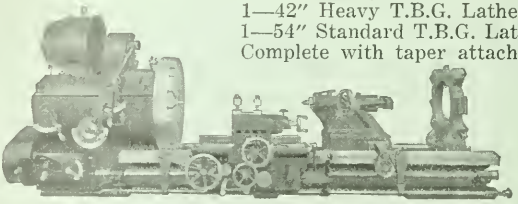
Complete with taper attachment, electrical equipment, etc.



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30″ Warner & Swasey Vertical
36″, 60″, 90″ Niles Vert., 2 hds.
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72″ Pond. Vert., 2 hds.
Garvin No. 12 Plain Miller
LeBlond No. 3 Plain Miller

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20″ Silver Drills, Plain and Bk. Gd.
20″ Champion, Plain and Bk. Gd.
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36″ Snyder B.G. Drill
40″ New Haven B.G.
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5′, 6′, 7′, 8′ Pond Radial
9′ Baush Radial

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Stiles Nos. 3 and 23 Inc. Power Presses
Garrison Dbl. Crank Sgl. Grd. 250-Ton
Niagara No. 116-A Power Press, M.D.
Bliss No. 75½ S.S. Geared, 6″ str.
Bliss No. 76½ Str. Slide, D.G., 8″ stroke
Corry Mch. Co., 12″ stroke
No. 56 Double Housing Power Press

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No. 45 Buffalo Punch ⅝″ x ½″
Reade 60″ Th. S.E. Punch and Shear
Carlin Alligator Shear cap. 2¼″ sq.
Garrison M.D. Alligator Shear 15″, knife, cap. 3″ sq., wt., 36,000 lbs.
Doelger & Kirkstein No. 4 High Knife Alligator Shear, cap. 4¾ round
Morgan Plate Shear, 96″ bet. housing, cap. 1″ thick
Mesta Plate Shear, cap. ¾″ x 156″
Garrison Plate Shear, cap. ⅞″ x 81″
Schatz Punch and Shear Hand Power, 7½″ thr.

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48″ x 32′ N.B.P. Triple Geared
48″ x 26′ Pond Triple Geared
48″ x 28′ Niles, C.R. Faceplate Drive
28″ x 12′ Boye-Emmes, q.c.g., d.b.g.
27″ x 12′ Pittsburgh, D.B.G.
36″ x 20′ x 6″ Putnam B.G. C.R.
24″ x 16′ 6″ Johnson, C.R.
26″ x 10′ x 6″ Walcott, q.c.g.
19″ x 10″ LeBlond M.D., 220 V., D.C.
18″ x 8′ Sidney, q.c.g.
18″ x 8′ Mueller, Q.C.G. (New)
16″ x 6′ Columbus, Q.C.G. (New)
14″ x 6′ Hendey, q.c.g.
24″ x 6′ Gisholt Turret, 6¼″, H.S.
22″ x 8½′ Bullard Turret

PLANERS AND SHAPERS

20″ x 20″ x 51″ Planer, 1 hd.
24″ x 24″ x 8′ Chandler 1 hd.
72″ x 56″ x 12′ Betts Planer, 2 hds.
48″ x 48″ x 12′ Sellers, M.D., 4 hds.
24″ Stockbridge Shaper
24″ Cincinnati B.G. Shaper, M.D.
24″ Walcott Geared Shaper

MISCELLANEOUS

100 and 200-lb. Power Hammers, Belted
2500 Bement-Mills Dbl. Leg. Steam Hammer
2500 Chambersburg D.L. Steam Hammer
3″ National Heading, Upsetting Machine
Contractors Steam Hoist with 8 H.P. Boiler and 5 H.P. Engine
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Greenfield Un. Cutter and Tool Grinder
Niles 15″ Slotter
Cleveland Straightening Rolls, 84″ x 10′
Landis 1¼″ Bolt Cutter
Buffalo Blowers, Vol. and Pressure
U. S. Buffer, spindle 63″ x 1″, m.d.
Greaves-Klusman 36″ Band Saw
Chicago Pneu. Air Comp., 8″ x 8″

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Immediate Delivery

34″ Colburn Vertical Boring Mill
38″ Bridgeport Vertical Boring Mill
60″ Bullard Vertical Boring Mill
60″ Betts Horiz. Boring Machine
22″ G. & E. Sliding Head Drill (2)
No. 25—24″ Foote-Burt Hvy. Duty Drill
2½″ Fosdick Plain Radial Drill
28″ Aurora Sliding Head Drill
32″ W. F. & John Barnes Sliding Head Drill
10″ x 26″ Ott Universal Grinder
No. 11 Landis 8″ x 32″ Plain Grinder
No. 1 Sellers Patent Tool Grinder
No 3 B. & S. Plain Grinder
No. 16, 10″ x 72″ B. & S. Plain Cylindrical Grinder
No. 3 26″ B. & S. Gear Cutter
800-lb. Massillon Steam Hammer
800-lb W. W. & Co. Board Drop Hammer
18″ x 8′ Whitcomb Blaisdell Lathe. Q.C.G.
18″ x 10′ Prentice Lathe. Q.C.G.
20″ x 14′ Putnam Lathe
33″ x 16′ Bridgeford Heavy Duty Lathe
No. 3 Burr Keyseat Miller, Routing Attachment
No. 33 Kempsmith Production Miller
24″ x 24″ x 8′ Ingersoll Slab Miller
No. 2 Milwaukee Universal Miller
No. 2 M. P. & J. Horiz. Auto. Miller
No. 2 M. P. & J. Vertical Auto Miller
62″ x 56″ x 26″ Gray Planer, 2 heads
36″ x 36″ x 8′ Betts Planer
36″ x 36″ x 12′ Woodward & Powell Planer
No. 73 ¾ Bliss Straight Sided Geared Press
No. ½ Toledo O. B. I. Punch Press
No. 57 Toledo Straight Sided Geared Press
No. 76 Toledo O. B. Press.
No. 38 Niagara Geared Punch Press
2″ x 2½″ Cleveland Auto Screw Machine
No. 252 Niagara Power Shear
72″ Loy & Nawrath ¼″ cap. Power Shear
2″ x 24″ Jones & Lamson Turret Lathe
No. 2 Pratt & Whitney Turret Lathe

The E. L. ESSLEY · MACHINERY · Co
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9—No. 60½ Bliss Reducing Presses, $500 ea.
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3—3x36 J. & L. Flat Turret 2 spindle machines, $500 each.
4—3x36 Stevens Flat Turret single spindle machines, $450 each.
1—Bridgeport 26x9″ Turret Lathe, $600.
1—American 22x8′ Turret Lathe, $500.
1—No. 2 Cincinnati Universal Miller, $750.
1—No. 1-B LeBlond Plain Miller, $800.
1—24x24x7½ Deitrich & Harvey Open Side Planer, $1250.
1—40″ Prentiss Radial Drill, $400.
2—24″ Baker Heavy Duty Drills, $400 ea.
5—14x8 Reed Plain Turning Lathes, $150 each.
1—Boilermakers roll, steam driven, 18′ 4″ between housings, top roll 20″, 2 bottom rolls 14″, capacity 1″ plate.

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One-Third Regular Price

H. S. MILLING CUTTERS.

EMERY WHEELS. For P. & W. 14″ Surface Grinder Elastic Wheels. 3/32 x 3″ to 12″ dia.

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TOTE BOXES. 24 x 10 x 5 – 16 Gauge.

ADJUSTABLE DRILL HEADS. 3/16″ capacity.

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Sell Your Discarded Machinery

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400 H.P. Steam Plant, Engine, Two Boilers, Oil Separator, Feed Water Heater, Pumps, Generator, Motors, Etc.

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3′ Late Type Cincinnati-Bickford Radial Drill Single Pulley, Tapping Att., $800.

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50″ Bickford Vertical Boring Mill, single head, excellent condition, $1,000.

All above with Full Equipment and Strictly Latest Type Tools.

Guaranteed A1 Working Condition

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1—No. 9 Stewart gas oven furnace.
1—14″ Lees-Bradner gear generator.
1—No. 15 Gardner plain bearing disc grinder.
1—No. 24 Gardner vert. spindle horiz. disc grinder.
1—5″ x 32″ Norton plain grinder.
1—17″ x 6′ Greaves-Klusman lathe with D-C. motor.
1—New No. 3 Van Norman double miller.
1—26″ x 26″ x 8′ Whitcomb-Blaisdell planer, two heads.
1—No. 1 Southworth ⅝″ screw machine.
1—New 1⅝″ x 10″ Millholland screw machine.

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2—Brown & Sharpe No. 3A Heavy Universal Millers, latest type, complete with Dividing Heads. (Like new).
2—24″ x 24″ x 6′ Gray Planers, 2 Heads on crossrail. (Like new).
1—Gang 2½′ Heavy Duty Radial Drill, B.G.P.F. with chuck. (Like new).
75—10″ Bench Drills with chucks. (New).
15—14″ Floor Drills. (New).
10—6″ Power Hack Saws. (New).
12—Manville No. 5G Power Presses. (Like new).
1—Snyder 24″ Drill Press, B.G.P.F. with chuck. (Like new).
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1 POWELL PLANER 36″ by 36″ by 12′ with or without motor. This planer is practically new, having been used very little. For further information apply to the

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COLUMBUS Dayton Office, 1118 Lindsey Bldg. OHIO

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84″ x 84″ x 32′ Putnam, 4 head.
66″ x 66″ x 20′ New Haven, 2 head.
54″ x 54″ x 16′ Sellers, 4 head.
48″ x 48″ x 16′ Bement-Miles, 2 head.
44″ x 44″ x 12′ Pond, 4 head.
36″ x 36″ x 12′ Niles, parallel drive.
24″ x 24″ x 6′ Pease.
16″ Rockford
14″ Niles traveling head.
14″ Smith & Mills Crank.

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1½″ Tilted Turret Friction Back Geared.
2″ x 24″ and 3″ x 36″ J. & L. Sing. Pul.
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Wells, Cutter & Tool, new (2).
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10″ x 30″ W. & P. Univ., new.
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28″ x 12′ Fay & Scott
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14″ x 6′ Hamilton
10″ x 5′ Summit (4).
8″ x 60″ Fitchburg Low Swing.

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Sensitive 1, 2, 3, 4, and 6 Spindle.
Sliding Head 24″, 26″, 28″ and 32″.
No. ½ Avey Bench High Speed (3).
3½′ Morris, plain gear box.
Canedy-Otto Plain new.

Presses

No. 6-A Willard 3400 lbs. inclinable.
No. 1½ Robinson 1500 lbs. inclinable (3).
Perkins Dbl. Crank. 16″ x 24″ Bolster.
No. 2 Loshbough-Jordon O.B.I.

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No. 32 Kempsmith Lincoln Type (3).
No. 1 Knight Milling & Drilling.
No. 2 Heavy B & S Plain
Gooley & Edlund Briggs Type (3).
No. 1½ B & S Plain.
No. 25 Becker Plain (2).

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Hammer, 40 lb. Bradley Cushioned Helve.
Hammer, Toledo 5000 lbs. Fric. Board.
Gear Cutter G & E 36″.
Oil Groover Garvin, nearly new.
Compressors, 8 x 8 and 12 x 10.
5′ and 8′ Robinson Squaring Shear.
Motors ½ to 50 H.P., 3 phase G.E.
Punch and Shear ½″ x ½″—12″ throat.

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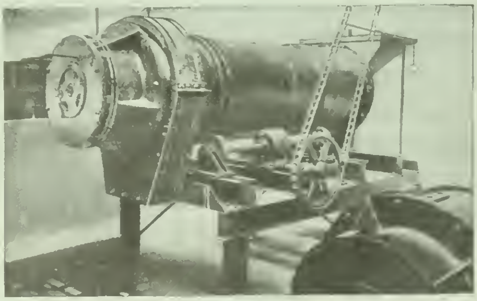
Absolutely New — Standard Makes in Original Factory Crates



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Length of furnace shell 8′
Dia. inside furnace shell 30″
Dia. inside lining 18″
Pitch of thread 8½″
Length over all 12′
Height to center of charging spout 4′ 10″
Height over all 6′ 6″
Width over all 5′ 10″
Weight complete 10,000 lbs.
Oil consumption per hour, U. S. Gals., 4
Work capacity per hour, 1000 lbs.
Horsepower required, 1

Price $600 each F. O. B. Bridgeport, Conn.

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LUCAS MACHINERY SERVICE
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54″ Bullard Vertical.
34″ King Vertical Turret Head Boring Mill.
34″ Colburn Vertical Turret Head Boring Mill.
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No. 612 Fellows Gear Shaper
No. 6 Bryant Chucking Grinder.
10 x 50 Norton Plain Grinder
20″ Taylor & Fenn Wet Tool Grinder.
Garvin Hand Feed Surface Grinder.

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Large size Thurston Die Miller.
No. ½ Van Norman Duplex.
No. 1 Garvin Universal.
No. 1B Milwaukee Universal.
No. 3 Becker Vertical.
No. 4 Hendey Lincoln type.
Gooley & Edlund type A Briggs.
3B Becker Plain Miller.

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17 x 17 x 4′ Whitcomb.
22 x 22 x 5′ Whitcomb.
24 x 24 x 6′ Whitcomb.
30 x 30 x 8′ Whitcomb.
30 x 30 x 10′ Powell.
42 x 42 x 18′ Woodward & Powell.
60 x 60 x 12′ Woodward & Powell.

DRILLS

1 spindle Allen b.b.
3 spindle Reed-Prentice b.b.
4 spindle Reed-Prentice b.b.
28″ Hoefer.
26″ H. & W. Sensitive Radial.
4′ Fosdick Radial SPD late type.
5′ Fosdick SPD speed box.
6′ American Radial SPD.

MISCELLANEOUS

2¼ x 24 J & L Flat Turret Lathe.
21″ x 10′ Roulsted Engine Lathe.
Rockford Shaft Straightener 10′.
20″ Burke Cold Saw.
No. 2B Cochrane & Bly Cold Saw.
50 lb. Standard Plain Drop.
200 lb. Automatic drop.
No. 9 Manville Embossing Press.
No. 1 Standard Broaching and Drawing Press.

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Gear Cutting Machinery, etc.

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8-21

MACHINERY'S Green Section, Date ....
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Name ....
Address ....

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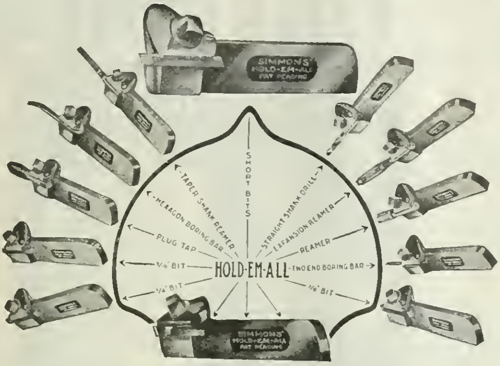

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Especially adapted for Stellite.
Combines many Holders in one.

Made right and left-hand off-set and straight shanks and conforms to all types of competitive makes.

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Power Hack Saws
Lathe Dogs
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Vises

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Taylor Cross Current Spot Welding
Cuts Production Costs 50 to 90 Per Cent.
Double electrode points increase output—reduce cost of labor, maintenance and power consumption; permit welding heavier material.

Try one for 30 days and see for yourself.
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"WILMINGTON FIBRE" SHEETS RODS TUBES WASHERS, &c SPECIALTIES
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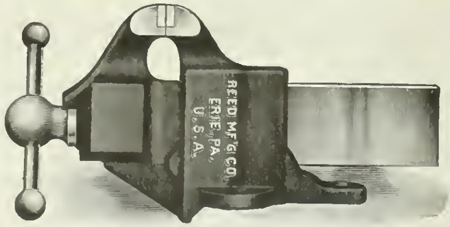

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ERIE, PA.

Out of the Pay—not your Pocket

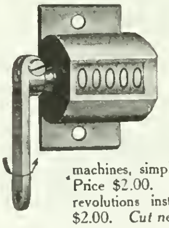
Now that you *must* get value for your money, should you pay for a workman's time or for his production?

Obviously you have got to make your profit on production, for your machines do not turn out *time*.

Measured production is the one thing you can afford to pay for; it's what

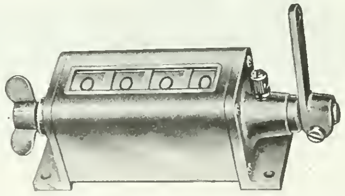
Veeder
COUNTERS

give you—along with what they save you by taking inefficiency out of the operative's pay, *not your pocket*.



This small **Rotary Ratchet Counter** (No. 6) counts reciprocating movements of the lever, as required in recording the product of the smaller punch presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of small machines, simply by regulating the throw of the lever. Price $2.00. Small *Revolution* Counter, to record revolutions instead of reciprocating movements, also $2.00. *Cut nearly full size.*

The **Revolution Set-Back Counter** below is designed for the larger machines where a shaft-revolution indicates an operation.



Registers one for each revolution of shaft, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $10.00—subject to discount. (*Cut ½ size*). Set Back Rotary Ratchet Counter, to record production of punch presses, etc., price $11.50 (list).

Write for booklet, "Checking up Production"—showing counters for every efficiency-promoting, wage-saving application.

The Veeder Mfg. Co.
39 Sargeant Street, Hartford, Conn.

Middle West Distributor:
F. A. Bringolf,
550 Washington Blvd.
Chicago, Ill.

Pacific Coast Distributor:
F. Somers Peterson Co.,
57 California St.
San Francisco, Cal.

Latrobe Drills are Highest Quality in material and workmanship—they are rugged drills—built for speed, accuracy, long life. **Latrobe** Drills are made from hot rolled special section high speed steel [as shown above] hot twisted and the grooves are milled—therefore **Latrobe** drills have all the strength of a forged drill plus the accuracy of a milled drill.

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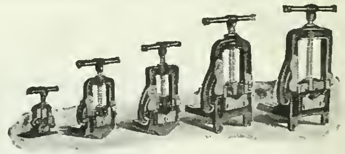
LATROBE TOOL CO.
MANUFACTURERS
LATROBE, PENNA.



Armstrong Hinge Pipe Vises

With Hardened Steel Jaws

MANUFACTURED BY

THE ARMSTRONG MFG. CO.
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SIMPLEX THE SELF READING MICROMETER

MANUFACTURED BY

CONSOLIDATED TOOL WORKS, Inc.
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QUALITY FIRST SERVICE ALWAYS

"FRASSTEELS"
A GOOD GRADE FOR EVERY PURPOSE

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Inspectors' Hammers

For stamping cold material. Machine turned from special bar steel. Engraved with private mark of inspector.

will help inspectors to perform their work efficiently and well by enabling them to make easily read, permanent markings.

In ordering, specify type of hammer and give lettering or mark desired.

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MARKERS

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STAMP COMPANY
PITTSBURGH PENNA., U. S. A.

For tie inspection. Forged from high grade steel. Letters deeply cut with broad face. Has scale on side for measuring tie

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Write today for this book.

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before you buy industrial diamonds. There are facts in it that you should know.

For years the Wheel Trueing Tool Company have studied diamonds and their mechanical uses, and this book sums up the result of those years of research.

It gives you valuable information on how to select the right diamond or diamond tool for a particular job and how to take care of it. It describes the unusual service given by the Wheel Trueing Tool Company. It tells how they protect you against diamond theft; about the cost system which the company installs for you and the continuous service which the company gives you—service which begins before your purchase and continues ever after.

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DIAMONDS
-CARBON-

WHEEL TRUEING TOOL CO.
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BORTZ & CARBON DIAMONDS
MANUFACTURERS OF
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CLEVELAND OFFICE
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CANADIAN BRANCHES
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Cable Address
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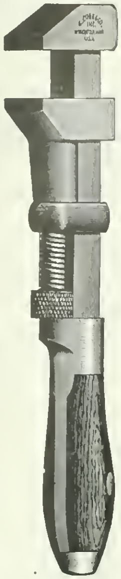

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Since 1841

Coes Wrenches have been part of the education of four generations of the world's best mechanics.

Every dealer who values the prestige of his place stocks Coes Wrenches.

In quality Coes Wrenches stand alone. In durability and strength they are unequalled.

"Coes" come in three models, and in sizes from 6 inches to 6 feet. Ask for Coes Wrenches —everywhere.

Coes Wrench Company

Worcester Mass., U. S. A.

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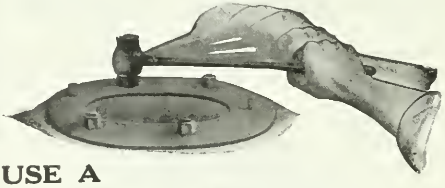
Don't Waste Time Turning Nuts With An Old-Fashioned Wrench



USE A

Favorite Reversible Ratchet Wrench

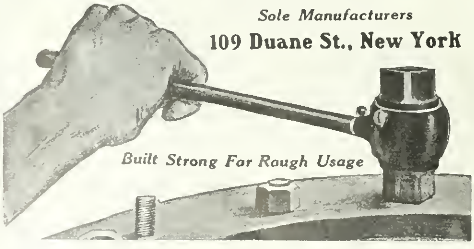
which is a time-saver because its movement is quick and positive, cutting out all the lost motion of the old-fashioned open end wrench.

Cannot slip off the nut and bark the knuckles.

GREENE, TWEED & CO.

Sole Manufacturers

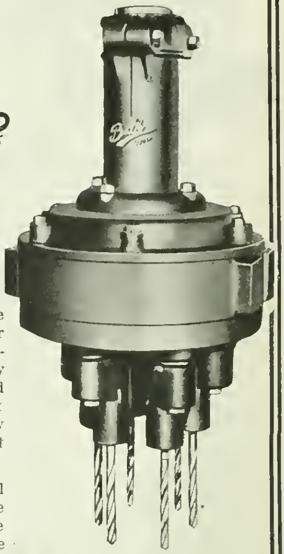
109 Duane St., New York


Built Strong For Rough Usage

Attach It in a Minute

The New Buhr Multiple Drill Head

PATENT



Convert your single spindle drill press for multiple drilling, quickly and easily. Fully adjustable, this head will perform at least 80% of the work now requiring specially set fixed drill heads.

Made in sizes to drill from 3 to 12 holes. The price is attractive—the results good. Get the Details.

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The Gammons Taper Pin Reamer

Saves 65% of Reaming Costs

It reams in any metal at least three times as fast as fluted reamers and the average breakage is one-tenth that of the best fluted reamers made

For use in a drill press, or electric or air drill. May be run at any reasonable feed or speed without fear of breakage

Why not save the two-thirds in costs? Only too glad to explain fully

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BROACHING MACHINES

The Fastest Producers

BROACHING TOOLS

of the best quality.

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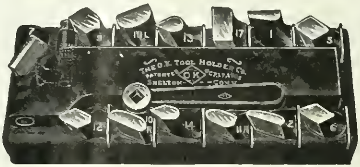

LATHE and PLANER TOOLS

THE O.K. TOOL HOLDER CO.

Shelton, Conn.

Trade H&G Mark

Simple As Can Be!

The H & G Self-Opening Die Head is
simple in design
simple in construction
simple in operation

Simplicity in **design** means perfect work.
Simplicity in **construction** means maximum strength.
Simplicity in **operation** means no worry, no trouble.
Made in three styles, adaptable to all machines.

Prove it in Your Own Shop

Try H & G Die Heads in your own shop. Prove to your own satisfaction that they will improve and increase the quality and the production of your threading. We will gladly send one to any responsible concern for 30 days' use without obligation.

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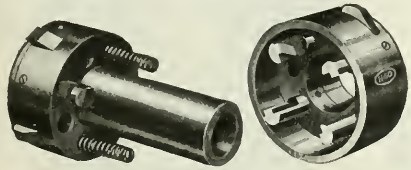
Single and Double Spindle Threading Machines, Chaser Grinders, Screw Machine Products

Foreign Representatives: Goodchild & Partners, Ltd., London, England. Societe Des Usines Curial, Paris, France.



Style A, taken apart, showing the simple construction

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Carbon and High Speed Steel
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WHAT do you get when you purchase ***twist drills, reamers, or milling cutters?***

If the ***National Twist Drill & Tool Co.'s Tools*** have been used on the job, you will find more work being produced and less tools being sharpened in your factory than ever before.

They are conscientiously built to withstand the hardest service ever encountered in production work and to maintain accuracy during their entire life—which is much longer than the average cutting tools.

They demand your utmost confidence in every day service.

Try them on your next job.

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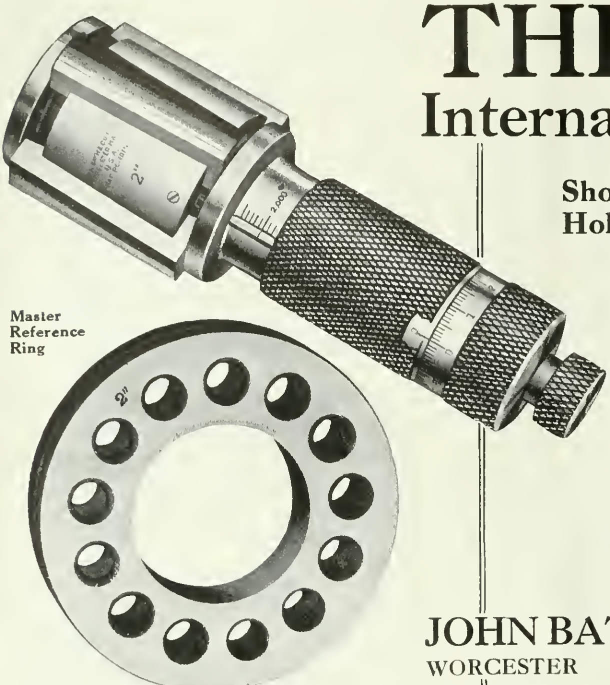
NATIONAL TWIST DRILL & TOOL CO



THE BATH
Internal Micrometer

Shows Instantly the Size of a Hole and Degree of Accuracy

Measures holes the same as you are now measuring shafts. You would not be without the outside micrometers—you should not be without the Bath Internal Micrometers.

All sizes in stock from ¾ to 3". Our Bulletin No. 10 gives a complete description.

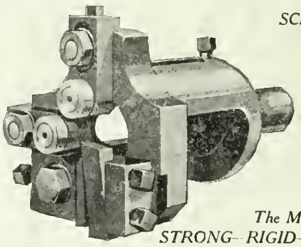
JOHN BATH & COMPANY, Inc.
WORCESTER MASS., U. S. A.

Of What Does This Remind You?

SUPPOSE that you had on hand when your first tap was broken a commercial device built especially to remove the broken pieces of tap, a commercial device not a home-made article, would you not have saved a great deal of time?

Write Us for Information

The Walton Company
310 PEARL STREET HARTFORD, CONN.



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Quality
with
Watson
Tangent Cut
Box Tools

The Model "D"—Look it Over
STRONG—RIGID—SIMPLE—COMPACT

All movable parts mounted on one-piece steel body giving strength and rigidity. Former travel in straight lines, are easily set, and give correct bit clearance and work support for all diameters. Four sizes accommodate diameters from ⅛" to 2$\frac{1}{16}$". Write for particulars and prices.

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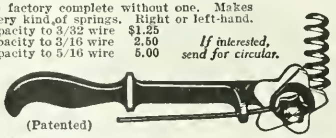
Hjorth Perfection Spring Winder

No factory complete without one. Makes every kind of springs. Right or left-hand.

Capacity to 3/32 wire	$1.25
Capacity to 3/16 wire	2.50
Capacity to 5/16 wire	5.00

If interested, send for circular.



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Lathe & Tool
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STEEL STAMPS

HAND CUT STEEL LETTERS and FIGURES
STENCILS-BURNING BRANDS,-SEALS,
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SEND FOR CATALOG
THE SCHWERDTLE STAMP CO.
ESTABLISHED 1879
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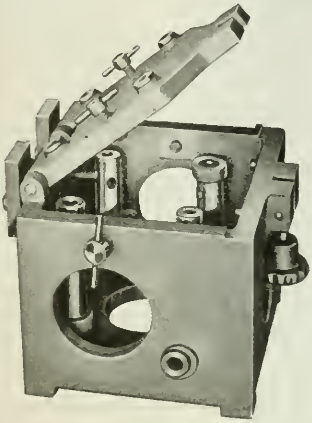
Bilton Reputation and Experience are Back of Bilton Contract Work



You can't judge the quality of special tools, dies, jigs, machines, etc., until you use them—the best you can do is to gauge them by previous results; therefore, the reputation and experience of the manufacturer is more important in contract work than in any other phase of the machine tool business. Here's where the Bilton reputation for results obtained and service given points the way to future satisfaction. The Bilton Contract Shop, working to the same high standards as the rest of this big plant, can be depended on to "deliver the goods" as wanted, when wanted and at a fair price. As for capacity—our foundry is equipped to furnish gray iron and semi-steel castings up to 20,000 pounds. Try us.

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Tool Engineers and Builders

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Special and Standard High Grade Machinery

Jigs, Tools, Fixtures, Punches and Dies

Send blue prints for estimates

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Designers and Builders of Tool Equipment and Special Machines.

Send us your blue prints for estimate and time study.

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Dies, Tools, Jigs, Gages, Fixtures, Etc.

We have the reputation for producing tools that are fool-proof, easy to manipulate and give the largest possible production.

Quality Prompt Delivery Fair Price

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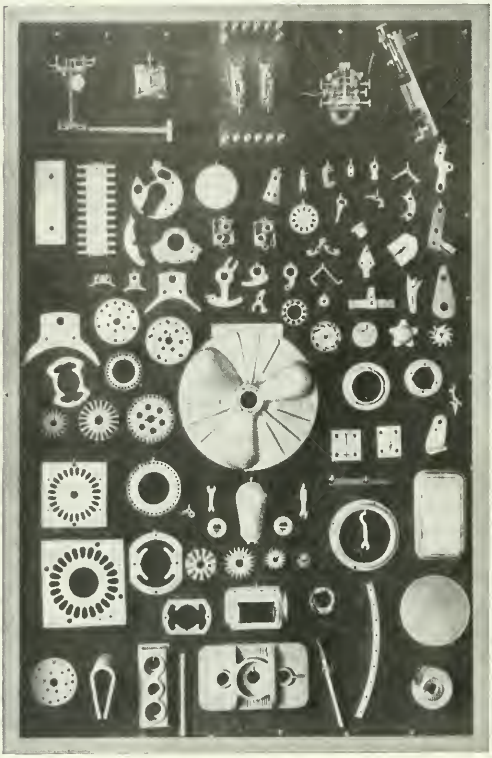


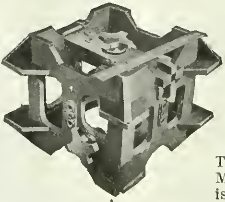
A Few of the Things We are Proud to have Produced

American Tool, Die, Jig and Fixture Service *satisfies*. That's why we hold our customers. If you'll try us once you'll be satisfied too.

The accompanying picture represents stampings, bakelite and rubber molds and electrical instruments. The dies and tools for making these parts and the complete relays were produced in our thoroughly equipped plant. Our extensive facilities and service enable us to do satisfactory work for clients in New Orleans, Duluth, New York or Denver as well as right here in our own neighborhood. Drop us a line today for particulars.

American Tool & Mfg. Co.
"Quality Rather than Quantity"
URBANA OHIO

TRADE **MEHL MADE** MARK



Know Mehl Tool Service

The difference between Mehl-Made tools and other makes is the difference between tools that are carefully designed to fit particular problems and tools built to simply turn out the work.

Mehl Tool Service is complete, as both the designing and building of all our tools are done under one roof.

Even though you may not now be in the market for tool service, you should have the Mehl prospectus for future needs. Write for your copy today.

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CONRADSON MACHINE TOOL CO.
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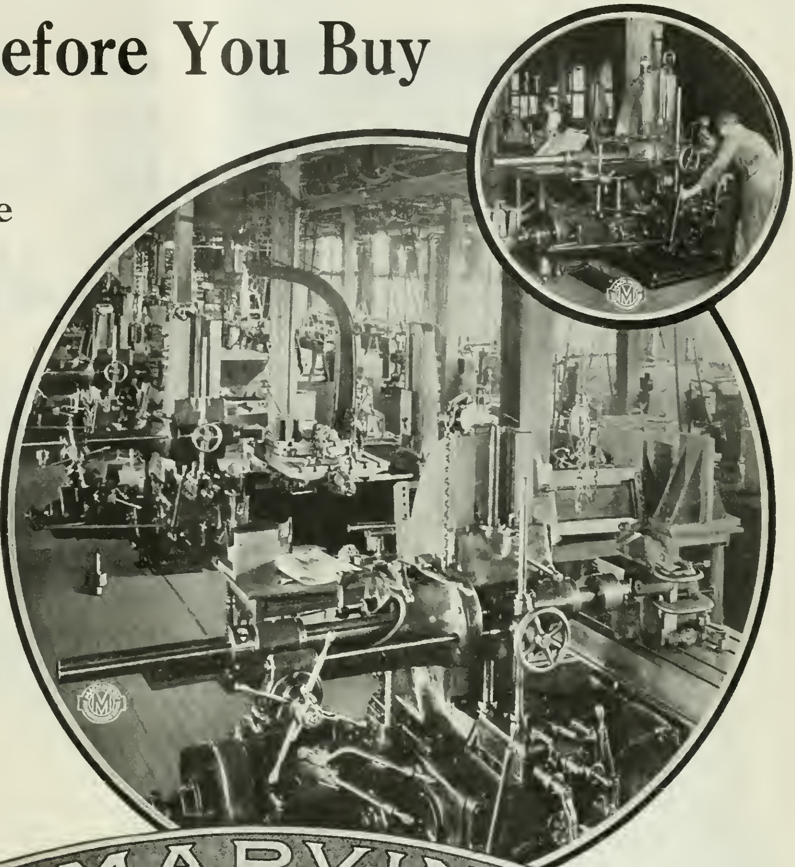
Send us Your Blue Prints or Models

Look Before You Buy

A Glimpse of the Marvin Shops



MARVIN

URBANA, O.

Placing contracts for special machines, tools, jigs, dies, etc., blindly is much like buying watermelons—you can't tell what you've got until the deed is done.

Reputation for past performance—of no use in the case of melons—is the one infallible sign that points the way for the man placing contract orders for new work.

The Marvin reputation for efficient service guarantees satisfaction to the manufacturer—you buy with your eyes wide open.

Old customers say—Marvin prices and results are right.

W. B. Marvin Manufacturing Co.
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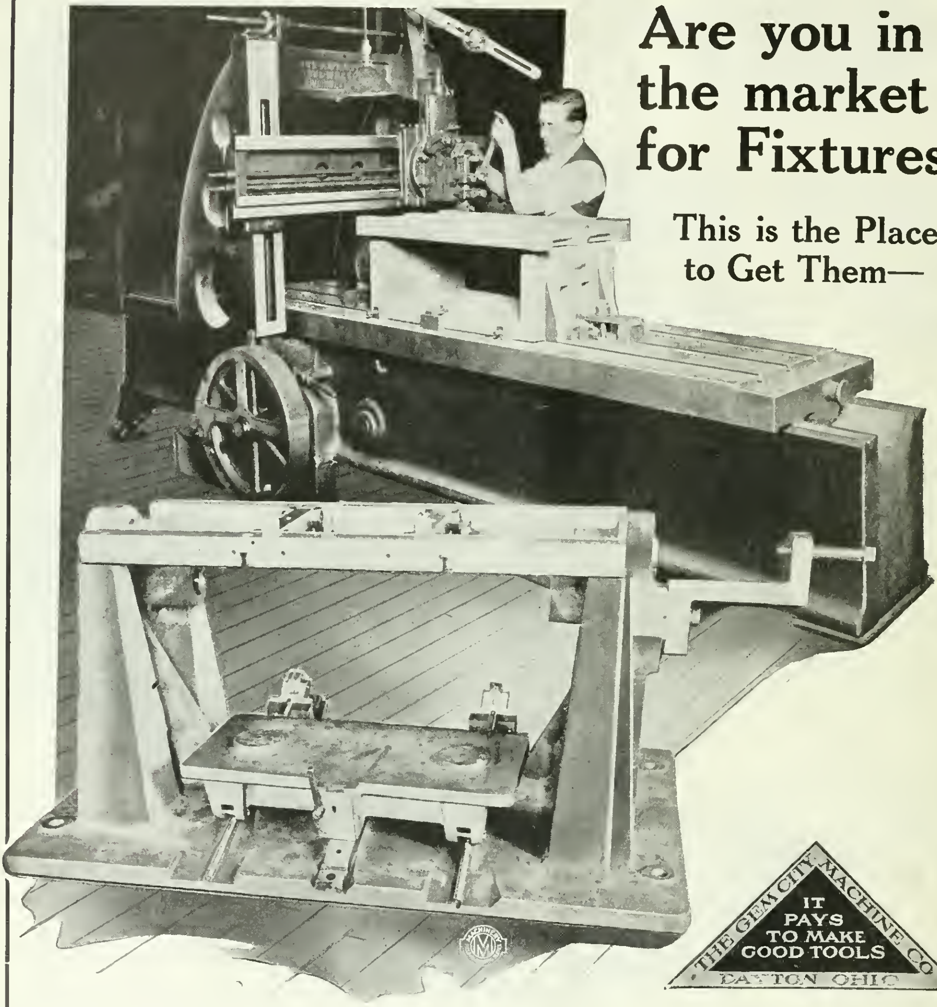

Are you in the market for Fixtures?

This is the Place to Get Them—

THE GEM CITY MACHINE CO.
IT PAYS TO MAKE GOOD TOOLS
DAYTON OHIO

How about your fixtures? Are you buying them right?—are they accurate, correctly designed, delivered on time? Try us! We make a specialty of fixtures. No matter how large or how intricate they must be we're equipped to make them.

If you're on the market for Fixtures, Jigs, Dies, Gages, Special Machines and Machinery you'll find it of advantage to communicate with us.

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Bliss Offers Special Machinery Facilities on a Large Scale

For many years we have been developing, designing and building special machinery of various kinds, machine parts and tools, not only for our own use, but for a big list of customers who early discovered the fact that we could do these things better than themselves.

We have five big, completely equipped plants with much capacity open to this class of work. We offer you every manufacturing facility, an engineering staff we consider second to no other in the country and what is equally important, BLISS knowledge, experience and reputation behind every contract we take.

If we can be of assistance at this time we will be glad to go into the matter with you.

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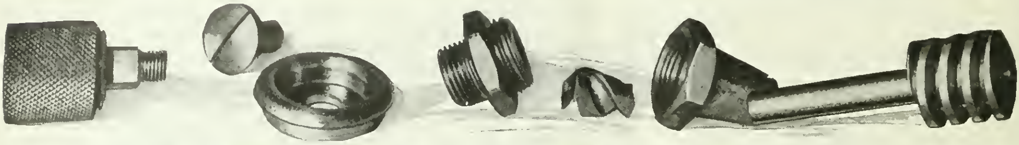
LONDON, ENGLAND PARIS, FRANCE

No. 167

BLISS

Wicaco Screw & Machine Works, Inc.



Let Contract Specialists Handle Your Contract Work

Let men who "know how" see that you get what you want at the proper price.

Wicaco Service is ready to supply you with anything you need in the way of contract metal work; complete and efficient, it insures economical production and satisfactory results.

We specialize on screw machine products, external and internal grinding, thread milling and the manufacture of machines, tools, cutters, jigs, fixtures, etc., in brass, bronze, monel, steel and iron.

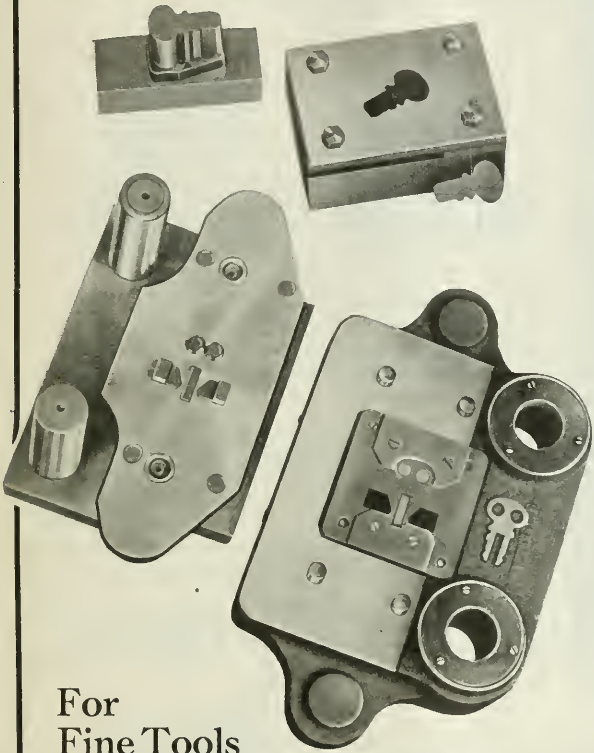
Get a Wicaco estimate on your next contract job.

Established 1868

Wicaco Screw & Machine Works, Inc.

PHILADELPHIA Stenton Avenue and Louden Street PA., U. S. A.

URBANA



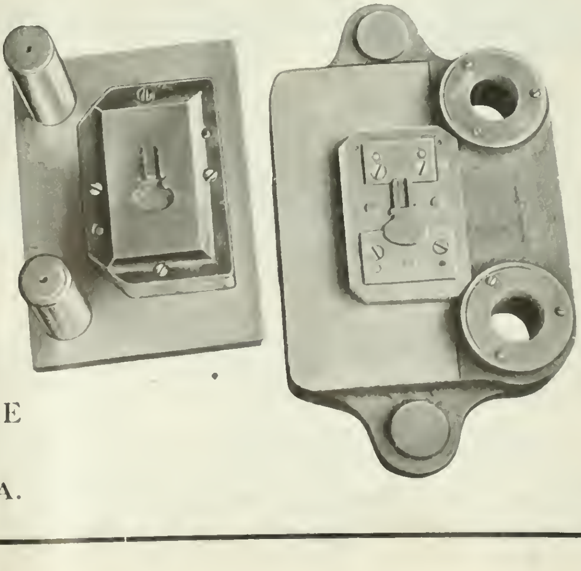
Here's What the Right Kind of Shaving Die Will Do

Study these photographs and you will appreciate that the exacting requirements the buyer dictated *were met*—100% right. The pictures represent a set of three dies for a cash register key: blanking die; notch and pierce; shaving die.

To secure the satisfactory shave, the fit between the punch and die *must be perfect*, neither tight nor loose. *The walls of the die must be straight to insure long life.* This Urbana product is all of these things. We build a great many shaving dies, and the service they are rendering speaks volumes for the quality of Urbana workmanship.

Shaving dies are used to secure smooth, square edges on stampings and to maintain extreme accuracy of outline. In these key dies, the edges of the key (throughout its working outline) are square, smooth and accurate to within one-half thousandth for some of the dimensions and one thousandth on others.

For Fine Tools Come to Urbana



Write us for particulars. We are specialists in jigs, fixtures and dies for a wide variety of effort including rifle, watch, adding machine, automobile and electrical work.

URBANA TOOL & DIE
COMPANY

URBANA, OHIO, U. S. A.

RELIANCE SERVICE

Complicated Contours Present No Difficulties to Our Well Equipped Die Department.

In the field of die making we are second to none. We make first-class dies because we produce first-class stampings—the latter depends on the former.

We make your dies with the same conscientious care we give to our own; we try them out in our stampings department before shipment. Men and machines are both chosen with a view to their special suitability for this work. We can handle the most complicated contours.

Metals are selected with care, machining, heat-treatment and grinding are done with scientific accuracy, the result of many years experience in striving for perfection.

Our prices are unusually reasonable; try us for Special Tools, Dies, Gages, Jigs, and Fixtures; satisfaction is guaranteed. Write for estimate.

Reliance Die & Stamping Company
515 North LaSalle St. Chicago Ill., U. S. A.

W.F.M. Co.

Meyers Stampings

Anything That's Made on a Punch Press is "Meyers" Work

We have the men, materials, the machines to assure the utmost in Meyers Stampings. It took many men many years to attain the knowledge and experience demanded in Meyers Stampings Department. It took a machine equipment without superior, selected materials, careful management and conscientious work, before we could say, as we say now, that we're equipped to produce *"anything that's made on a punch press."*

Send samples or prints; mention quantity required, and we will quote you our price

W. F. Meyers Gage Company
BEDFORD INDIANA

TAPCO

Trade Mark Registered

Economical Tools For Efficient Service

This multiple spindle drill head was designed and made in the Tapco Plant and is a sample of Tapco work.

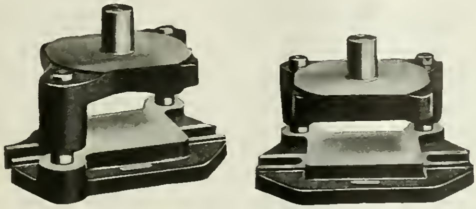
We have the experience, equipment and working force to handle special work efficiently at moderate cost.

The Tool & Auto Products Co.
Cleveland Ohio, U. S. A.

Precision Products—Built on a Production Basis

U. S. SUB PRESSES

You'll Be Astonished at Our Low Prices



U. S. Sub Presses are made in large quantities; they are inexpensive because produced on a production basis. Though they cost much less than the average toolmaker could build them for, they lose nothing in quality on this account.

Send for circular and price list.

Carried in Stock—Parcel Post Delivery

Let us quote you on your Stampings, Dies, Jigs, Gages, Fixtures and Experimental Work.

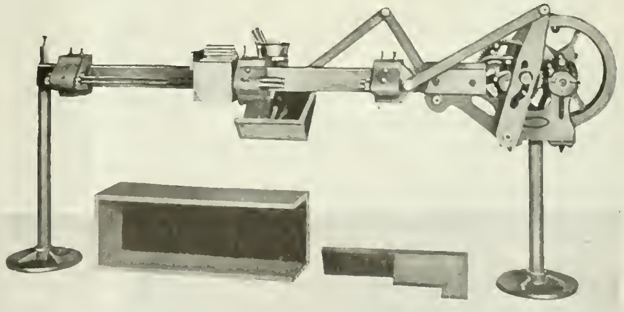
U. S. TOOL COMPANY, Incorporated
117 Mechanic Street NEWARK, N. J., U. S. A.

BUILT BY BUDD-RANNEY

WHAT IS IT?

Are you getting utmost production? — is the quality of your product what it should be?— does its factory cost make it readily marketable? If you're in doubt on any of these questions write us. We've been sixteen years in the business of building Special Machinery, Dies and Tools and our customers say we've been unusually successful.

We'll consider all correspondence confidential —may we hear from you?



This is a porcelain tube machine built by us which made the work absolutely safe, and speeded production up to 22,500 tubes per 8 hour day.

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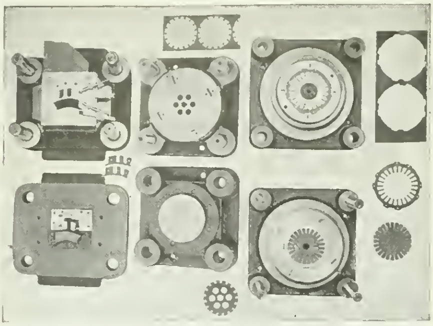

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MACHINERY'S PRODUCT INDEX

FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX PAGES 319-320

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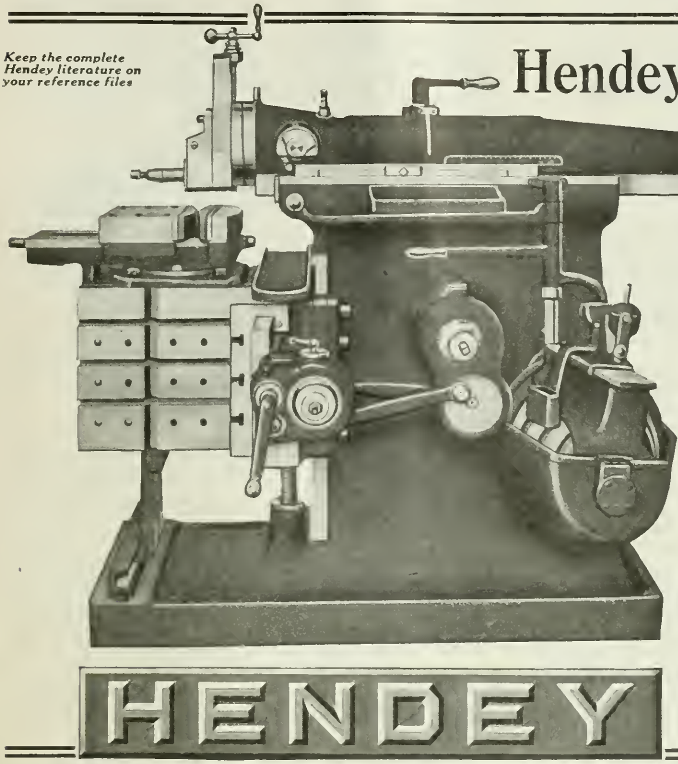

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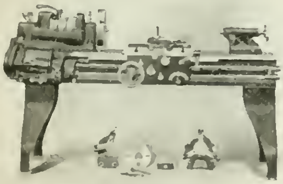

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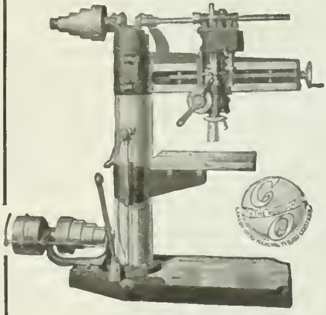

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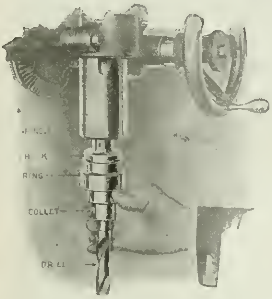
MODERN "Magic" Chucks



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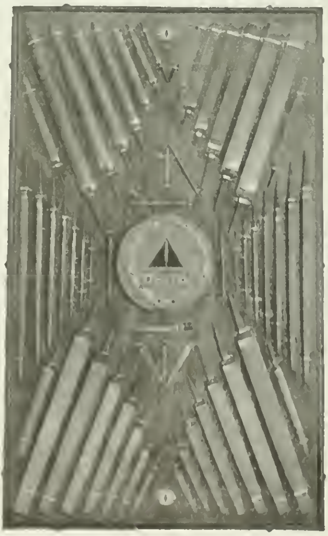

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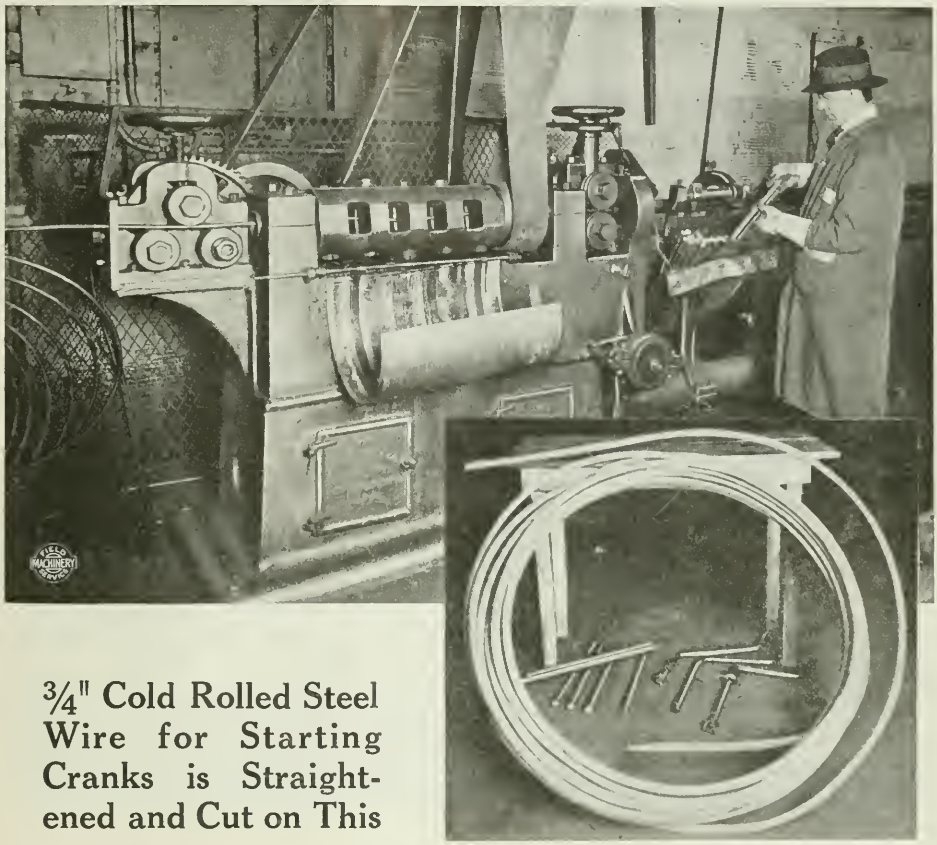

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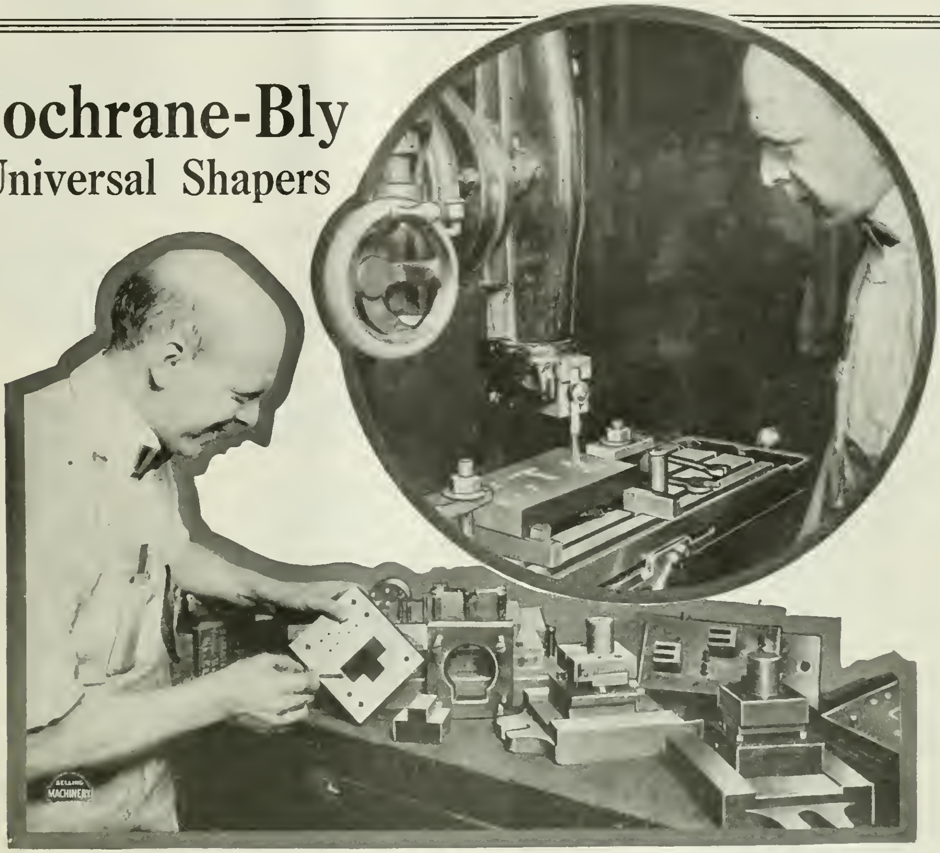

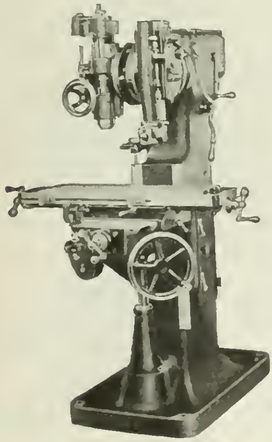

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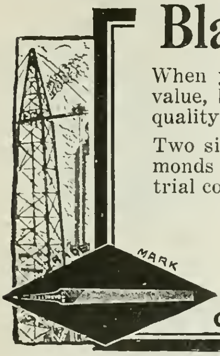

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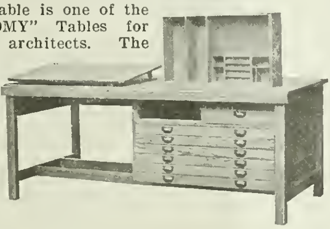

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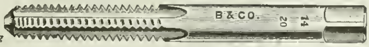

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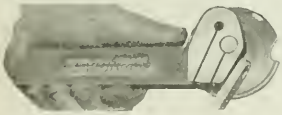

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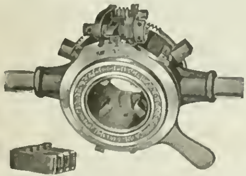

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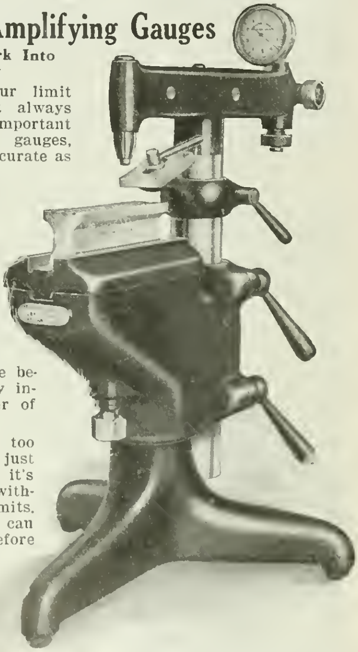

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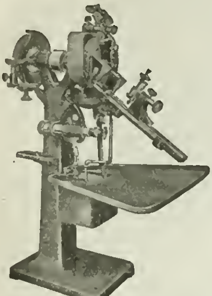

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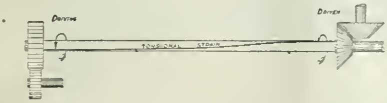
ALPHABETICAL INDEX TO ADVERTISERS, PAGES 319-320

What torsion means to you in gear Hobbing—



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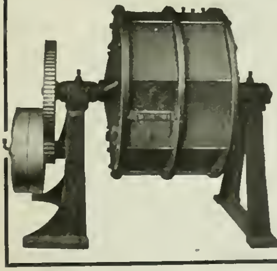

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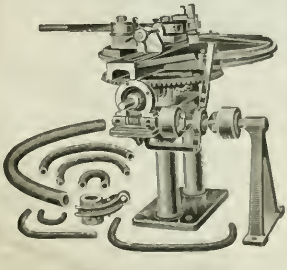

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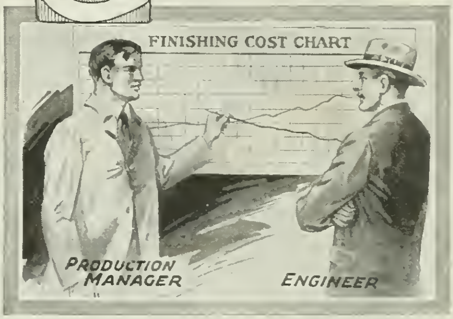

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Flather & Co., Inc., Nashua, N. H.
Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gisholt Mch. Co., 9 South Baldwin St., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati.
Greaves Mch. Tool Co., Cincinnati.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hamilton Mch. Tool Co., Hamilton, O.
Hendey Mch. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Johnston Mfg. Co., Arlington, N. J.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Lehmann Machine Co., St. Louis, Mo.
Lodge & Shipley Machine Tool Co., Cincinnati.
Monarch Mch. Tool Co., 109 Oak St., Sidney, O.
Morris Machine Tool Co., Cincinnati.
Mueller Machine Tool Co., Cincinnati.
Myers Machine Tool Corp., Columbia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Porter-Cable Machine Co., Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Rockford Lathe & Drill Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
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Sidney Machine Tool Co., Sidney, O.
South Bend Lathe Works, South Bend, Ind.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Standard Lathe Works, Cincinnati.
Whitcomb-Blaisdell Mch. Tool Co., Worcester, Mass.

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Harrington, Son & Co., Inc., Edwin, Philadelphia.
Myers Machine Tool Corp., Columbia, Pa.
South Bend Lathe Works, South Bend, Ind.

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Reed-Prentice Co., Worcester, Mass.
Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.

LATHES, GUN BORING

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LeBlond Mch. Tool Co., R. K., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.

LATHES, PATTERNMAKERS'

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Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.

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Avey Drilling Mch. Co., Cincinnati.

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Fitchburg Machine Works, Fitchburg, Mass.
Greaves Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, SPEED

Blount Co., J. G., Everett, Mass.
Diamond Mch. Co., Providence, R. I.
Potter Tool & Mch. Works, S. A., 77 E. 130th St., New York.

LATHES, SPINNING

Bliss Co., E. W., Brooklyn, N. Y.
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Betts Machine Co., Rochester, N. Y.
Bullard Mch. Tool Co., Bridgeport, Conn.
Dreses Machine Tool Co., Cincinnati.
Foster Mch. Tool Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Machine Co., 9 So. Baldwin St., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati.
Greaves Mch. Tool Co., Cincinnati, O.
International Mch. Tool Co., Indianapolis, Ind.
Jones & Lamson Machine Co., Springfield, Vt.
Lodge & Shipley Machine Tool Co., Cincinnati.
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Starrett Co., L. S., Athol, Mass.

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Cooper-Hewitt Electric Co., Hoboken, N. J.

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Texas Co. 17 Battery Pl., New York.

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Clark-Mesker Co., Cleveland.
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Ingersoll Milling Mch. Co., Rockford, Ill.
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Kempsmith Mfg. Co., Milwaukee, Wis.
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Oesterlein Machine Co., Cincinnati.
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Pratt & Whitney Co., Hartford, Conn.
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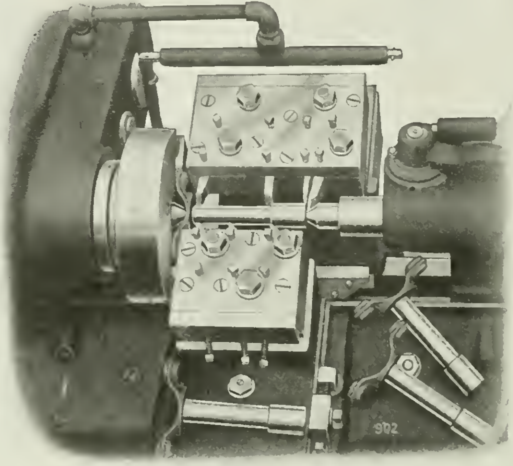

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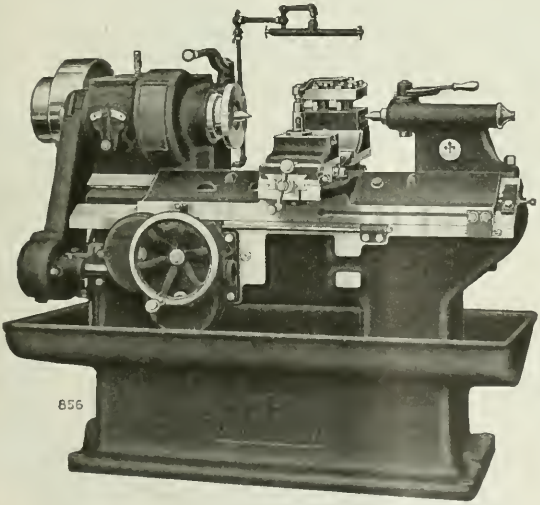

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NUT TAPPERS
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Gits Gros. Mfg. Co., 1901 South Kilbourne Ave., Chicago.
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OILERS
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PRESSES, DROP
See Hammers, Drop.

ALPHABETICAL INDEX TO ADVERTISERS, PAGES 319-320

KNIGHT

Milling and Drilling Machines

They're Appreciated Here

This No. 1½ Knight is finishing 3/16" wide slots in a cast-iron gear guard. Slots are made by sinking milling cutter vertically into the pieces, after which the Knight also finishes their ends. The micrometer indices on slide and table rapidly locate cutter and determine length of slot.

The large amount of experimental work handled in the Jersey City plant of the Davis-Bournonville Co. is largely taken care of by four Knight Milling and Drilling Machines.

Four sizes—all with tilting table. Send for catalog.

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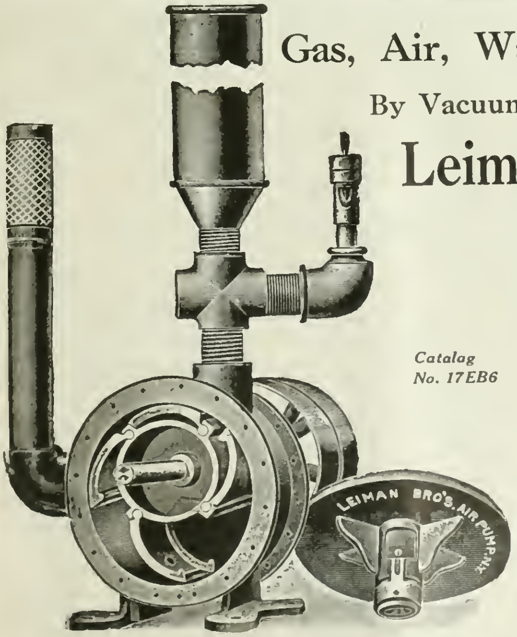
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Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

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Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Lucas Machine Tool Co., Cleveland.

PRESSES, ROLL AND DIAL FEED FOR

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PRESSES, SCREW

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Bliss Co., E. W., Brooklyn, N. Y.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Ferracute Mch. Co., Bridgeton, N. J.
Globe Mch. & Stamping Co. Cleveland.
Shuster Co., F. B., New Haven, Conn.
Swaine Mfg. Co., F. J., St. Louis, Mo.
Toledo Mch. & Tool Co., Toledo, O.

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Baird Mch. Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgeton, N. J.
Kane & Roach, Syracuse, N. Y.
Loy & Nawrath, Newark, N. J.
Massillon Fdry. & Mch. Co., Massillon, Ohio.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Stoll Co., Inc., D. H., Buffalo, N. Y.
Swaine Mfg. Co., F. J., St. Louis, Mo.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Glendale, Long Island, N. Y.

PRESSES, SHELL BENDING

Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
West Tire Setter Co., Rochester, N. Y.

PRESSES, STRAIGHTENING

Canedy-Otto Mfg. Co., Chicago Heights, Illinois.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Watson-Stillman Co., 192 Fulton St., New York.

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Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Bliss Co., E. W., Brooklyn, N. Y.
Erie Foundry Co., Erie, Pa.
Ferracute Fdry. & Mch. Co., Massillon, O.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Glendale, Long Island, N. Y.
Williams, White & Co., Moline, Ill.

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Leland-Gifford Co., Worcester, Mass.
Newton Mch. Tool Works, Inc., Philadelphia.
Pratt & Whitney Co., Hartford, Conn.

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Cresson-Morris Co., Philadelphia.
Johnson Machine Co., Carlyle, Manchester, Conn.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Medart Patent Pulley Co., St. Louis, Mo.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Link-Belt Company, Chicago.
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Watson-Stillman Co., 192 Fulton St., New York.

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Leader-Trahern Products Co., Rockford, Ill.

PUMPS, ROTARY

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Niles-Bement-Pond Co., 111 Broadway, New York.
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Williams, White & Co., Moline, Ill.

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Gould & Eberhardt, Newark, N. J.
LeBlond Mch. Tool Co., R. K., Cincinnati.

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RACKS, TOOL

See Racks, Stocks, Tool and Pattern.

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RADIUS TOOLS

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Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
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Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Kelly Reamer Co., Cleveland.
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Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
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Whitman & Barnes Mfg. Co., Akron, Ohio.

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Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Gisholt Machine Co., 9 So. Baldwin St., Madison, Wis.
Kelly Reamer Co., Cleveland.
McCrosky Tool Co., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Inc., J. M., Gloucester City, N. J.
Schellenbach-Hunt Tool Co., Cincinnati.
Taft-Peirce Mfg. Co., Woonsocket, R I.

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Taft-Peirce Mfg. Co., Woonsocket, R. I.

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RIVETERS, STEAM

Hanna Engineering Works, 1763 Elston Ave., Chicago.

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Hanna Engineering Works, 1763 Elston Ave., Chicago.
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ALPHABETICAL INDEX TO ADVERTISERS, PAGES 319-320

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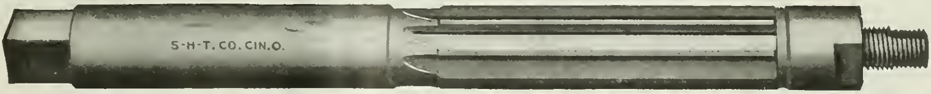

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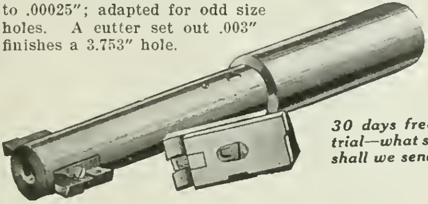

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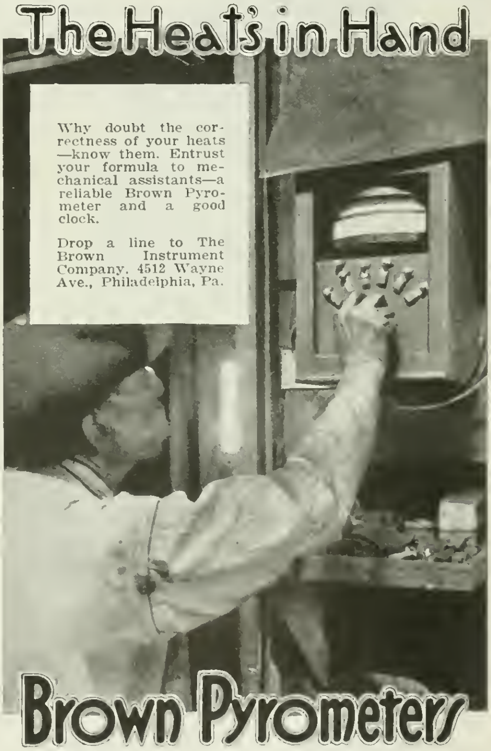

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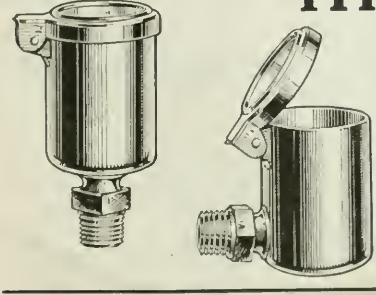

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Newton Machine Tool Works, Inc., Philadelphia.
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SCREW CUTTING TOOLS

See Taps and Dies.

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Pratt & Whitney Co., Hartford, Conn.

SCREW MACHINES, HAND

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Brown & Sharpe Mfg. Co., Providence, R. I.
Dreses Machine Tool Co., Cincinnati.
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Foster Machine Co., Elkhart, Ind.
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Wicaco Screw & Machine Works, Philadelphia.

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See Tubing, Seamless Steel.

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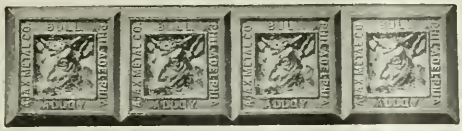

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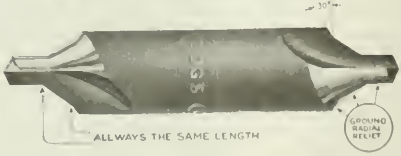

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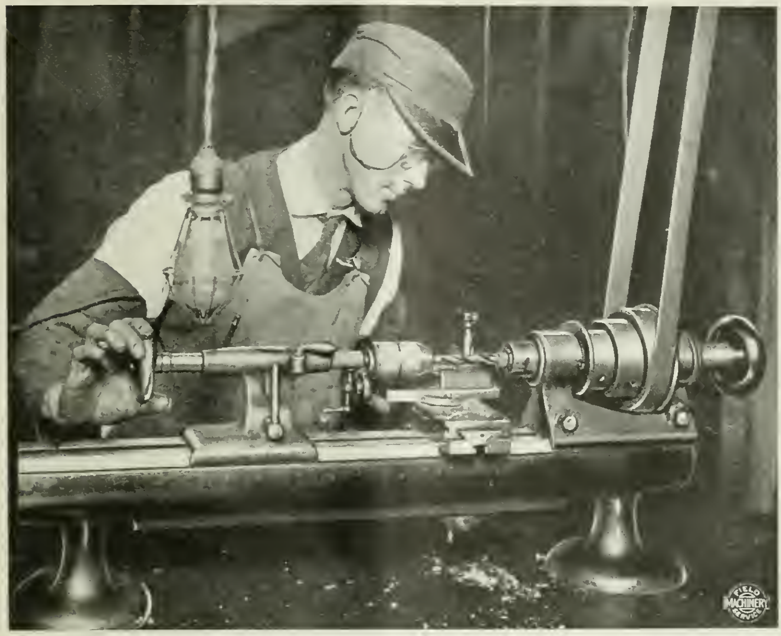

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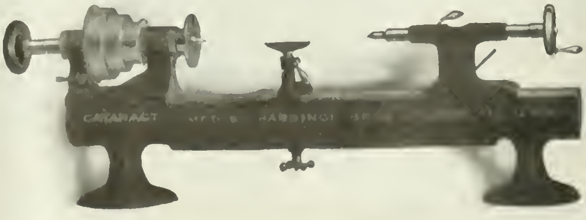

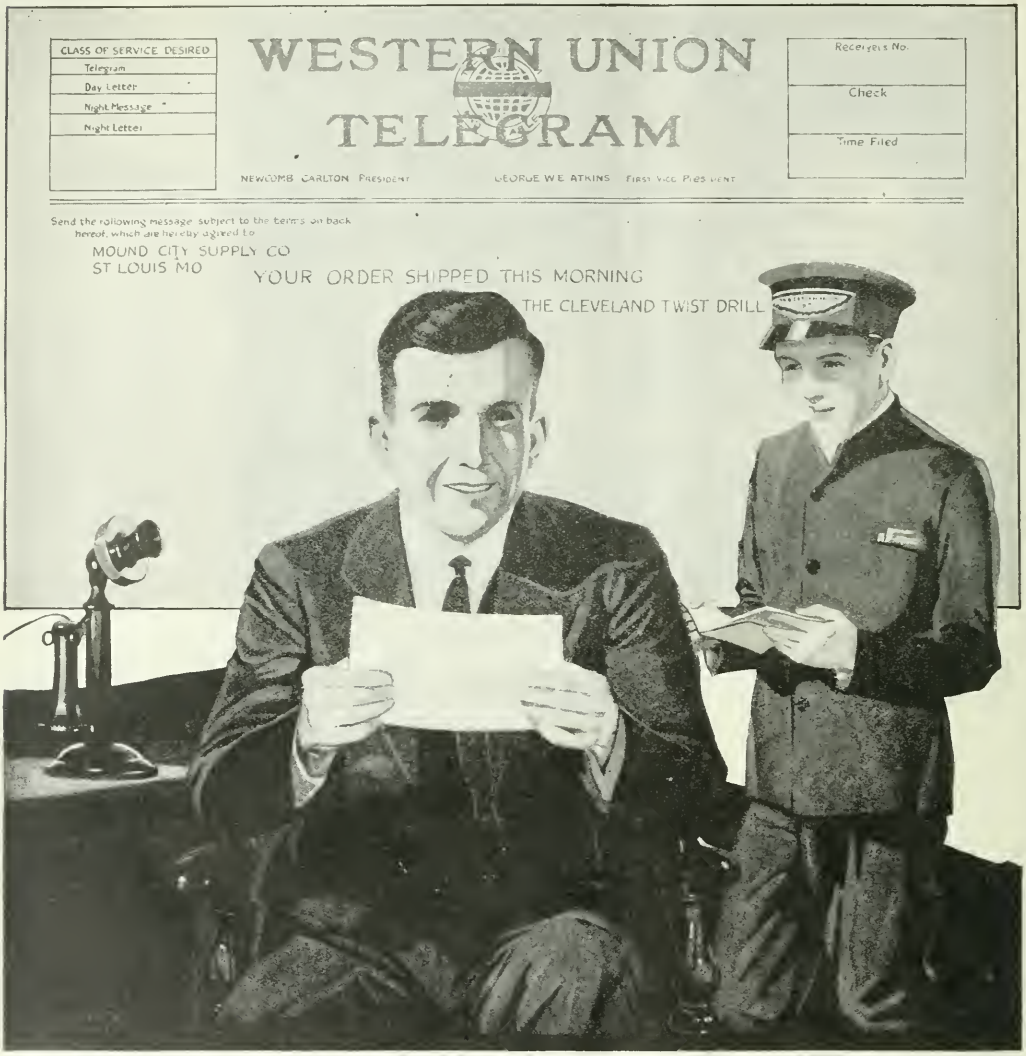

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